**信道预测**

# 信道预测目标

随着无线通信技术的不断进步，尤其是第五代（5G）移动通信系统的广泛应用，精确预测信道状态信息（CSI）已成为提升网络性能的关键。信道预测技术在无线资源管理、链路自适应调整以及干扰协调中发挥了重要作用，有助于保证服务质量并提高频谱利用率。

在深度学习中，时间序列预测方法通常分为单步预测和多步预测两种。在信道预测任务中，虽然单步预测利用历史数据计算简单，但存在一定局限性。它需要系统频繁进行预测，这可能导致在动态变化的通信环境中出现延迟和资源浪费。此外，单步预测难以捕捉信道状态的长期依赖关系，从而可能降低预测准确性。相比之下，多步预测通过一次性预测未来多个时间点的信道状态，提供了对信道未来行为的更全面视角。这种方法能够减少预测次数，降低计算负担和响应时间。同时，它使通信系统能够更有效地规划资源分配，如功率控制和频谱使用，因为它提供了未来一段时间内的信道条件信息

信道预测的目标是根据历史的信道状态信息来预测未来一段时间内的信道状态信息。若以Xt表示t时刻的信道状态信息，k表示多步预测的预测长度（即预测窗口），L表示历史信道状态信息的输入长度（即观察窗口），则可将任务表示为：

…

...

历史信道状态信息

预测信道状态信息

图1 信道预测任务

因此，信道预测的核心问题就是建模出预测函数G(·)。

近年来，AI技术的兴起使得基于AI的时间序列处理方法在发挥历史数据的作用和提供可靠预测结果方面表现优于传统方法。因此，本研究选择了基于AI的方法来建模预测函数G(·)。结果表明，与目前常用的直接利用当前信道状态来预测未来信道状态的方法相比，基于AI的预测方式能够更准确地预测未来一段时间内的信道状态。

# 模型结构

本研究选用了多种模型结构，包括CNN、LSTM、RNN、MLP、Transformer以及Informer。

**多层感知器（MLP）**具有简单的前馈结构，容易实现和调试，非常适合快速的模型开发和实验。MLP在处理多步时间序列预测任务时，因其简单的结构和通过激活函数（如ReLU、Sigmoid）能够捕捉时间序列中的复杂非线性关系，而具有强大的非线性建模能力。MLP可以根据需要调整网络结构（如隐藏层数、每层的神经元数）和超参数（如学习率、批量大小）以适应不同的时间序列任务。因此，其能够有效地处理信道的多步预测问题。但是，因其简单的网络构造，使得其在处理复杂度较高的预测任务时，其预测的精度会较低。

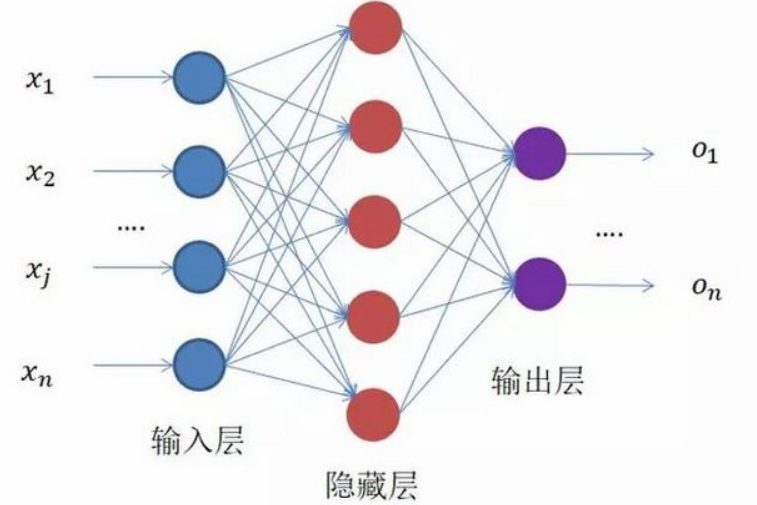


图2 MLP模型结构

**卷积神经网络（CNN）**在处理多步时间序列预测方面有其独特的优点，CNN局部特征提取能力强，能够自动从时间序列数据中提取局部特征，这对于捕捉时间序列中的短期模式非常有效。CNN模型中包含多层卷积和池化操作。其中，卷积层通过使用共享的卷积核，显著减少了模型的参数数量，池化层通过最大池化或平均池化，能够减少时间序列数据的维度，同时保留重要的特征信息。这有助于降低计算复杂度，并减少过拟合的风险。这对于多步预测中的复杂模式识别非常重要。但是，卷积核大小通常较小受限，因此在处理较长的上下文信道状态信息时，存在性能瓶颈。

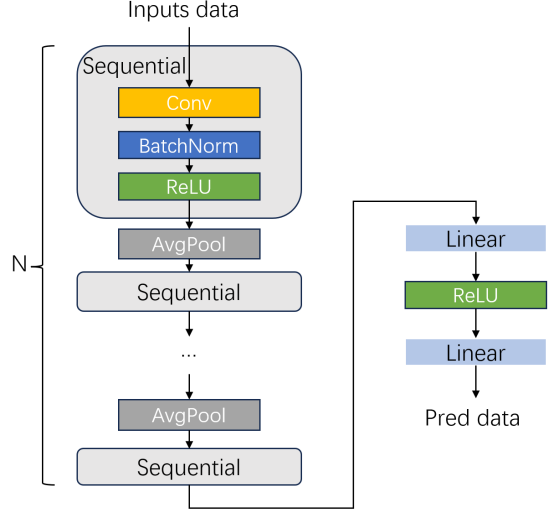


图3 CNN模型结构

**递归神经网络（RNN）**在处理多元时序预测任务时，因其独特的循环结构，能够有效捕捉序列中的时间依赖关系和动态变化，具有很高的灵活性和通用性。但是，RNN在长时间序列预测任务中存在一些挑战，如梯度消失和计算复杂度问题。

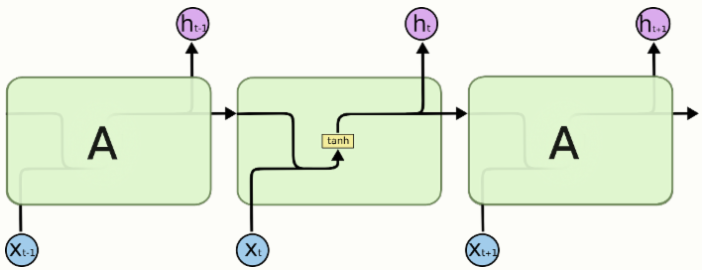


图4 RNN模型结构

**长短期记忆网络（LSTM）**通过其记忆单元和门控机制，能够处理长时间跨度的数据，有效捕捉和利用时间序列中的长期依赖关系。同时，LSTM通过输入门、遗忘门和输出门选择性地更新和保留信息，因此，通过门控机制，其能够选择性地更新和遗忘信息，从而保留对多步预测重要的历史数据，这使得重要的历史数据能够被有效利用，而不重要的信息则被忽略。并且，LSTM解决了传统RNN在处理长时间序列时面临的梯度消失等问题。这使得它更适合用于通信中对信道状态进行长期预测的应用需求。

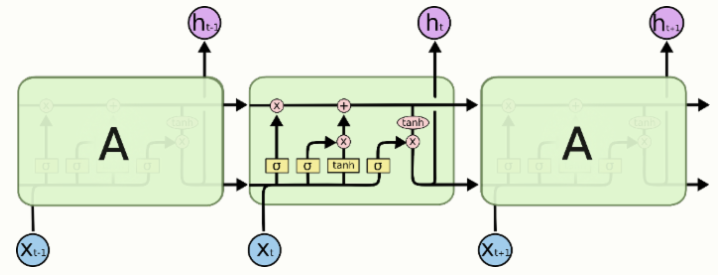


图5 LSTM模型结构

自Transformer模型被提出以来，在自然语言处理（NLP）领域取得了巨大的成功，特别是在长距离依赖和序列建模方面表现出色。这些特性使得Transformer成为处理信道预测这一时序问题的理想选择。其中自注意力（Self-Attention）能够有效捕捉序列内的长期依赖关系。与传统的循环神经网络（RNN）或长短期记忆网络（LSTM）相比，Transformer不受限于序列的顺序处理，它能够并行处理整个序列并直接学习任意两个时间点之间的关系，从而提高了预测的准确性和效率。并且Transformer模型具备执行多步预测的能力，这使其更为契合通信中对信道状态进行长期预测的应用场景需求。但是，因transformer独特的网络架构，其网络模型参数量庞大，且需要的计算资源较多，在模型的实际部署过程中，会面临很大的挑战。

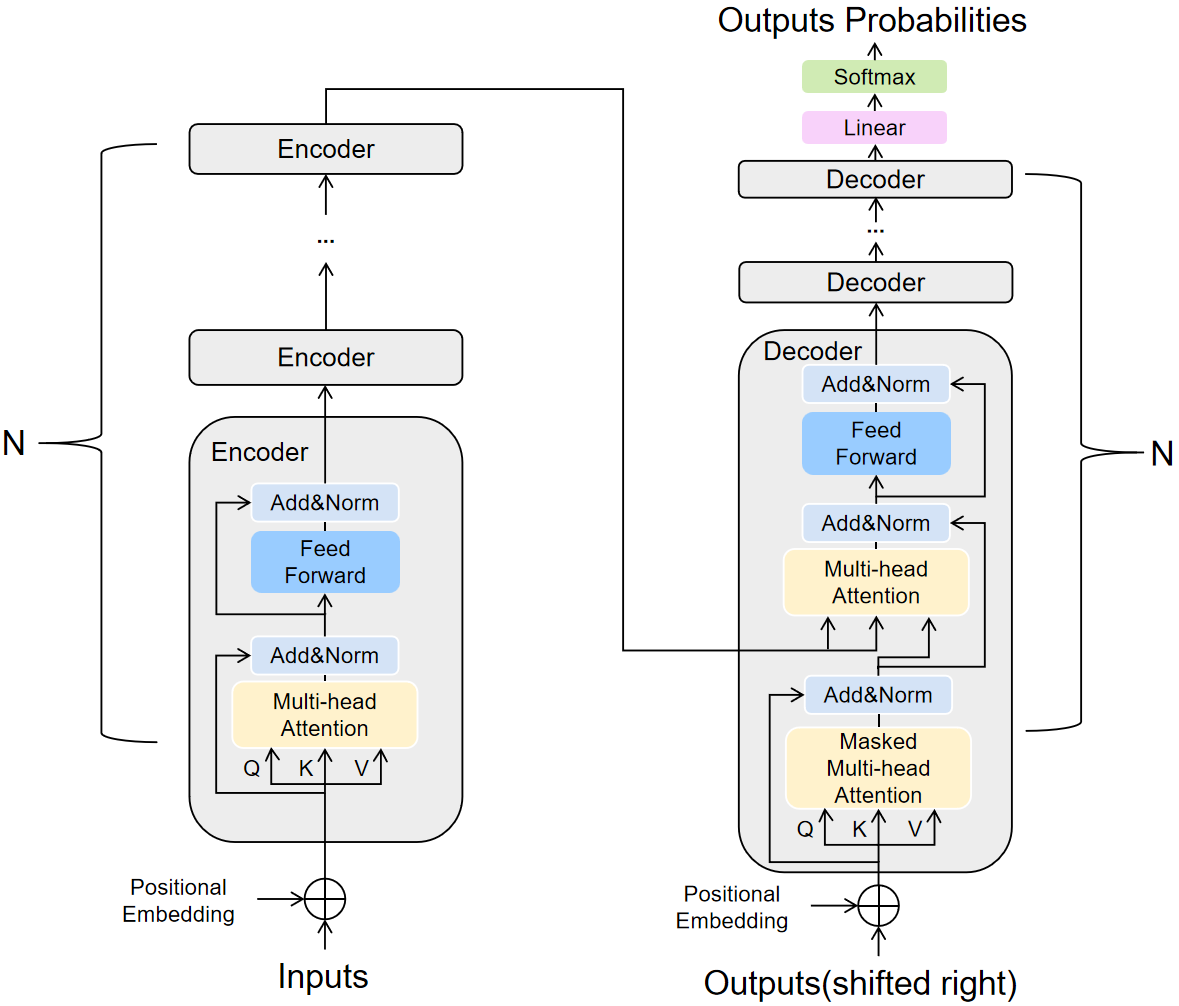


图6 Transformer模型结构

选用Informer模型则是因为Transformer中的全注意力机制带来了较高的复杂度。全注意力机制中大量的低注意力权重消耗了过多的运算资源，这导致模型在进行预测时需要花费更长时间。Informer模型中对注意力机制进行了优化，实际上全注意力机制中大部分注意力权重都为一个很小的值，于是引入了概率稀疏自注意力机制（ProbSparse Self-attention），只计算较高注意力权重的值，大大减少了无关注意力消耗的运算资源，提高了模型预测的速度，使其更加适合于处理通信中的大规模时序数据。同时，Informer模型还引入了一种创新的时间编码技术，能够更好地捕捉时间序列中的长距离依赖关系。这对于信道预测来说至关重要，因为它需要模型能够理解和预测在不同时间尺度上信道状态的动态变化，因此在预测信道性能时，能够更加准确地识别未来可能出现的信号衰减或干扰，从而为调整传输策略提供了可靠的依据。

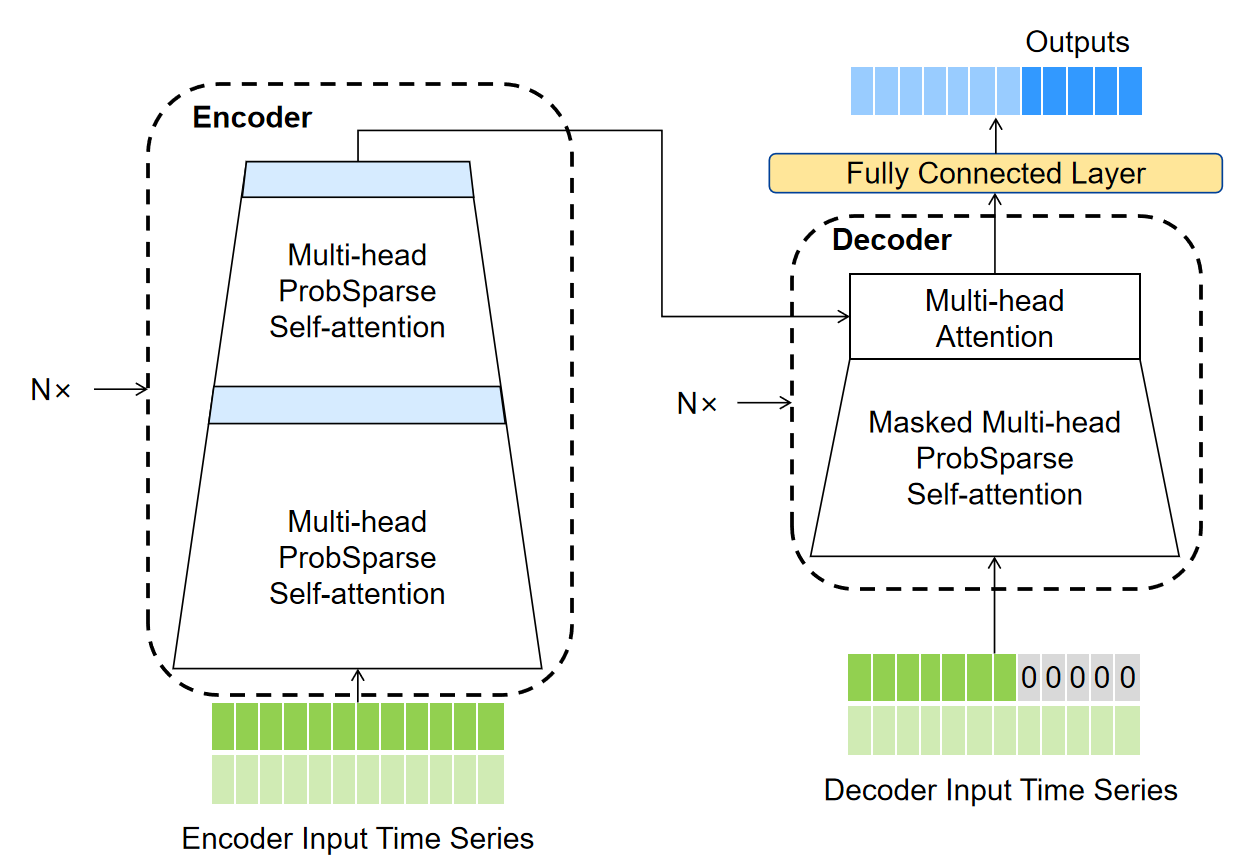


图7 Informer模型结构

复值神经网络（Complex-Valued Neural Networks，CVNNs）是一种特殊的神经网络，它能够直接处理复数输入、权重和输出。在无线通信系统中，特别是在信道预测任务中，复值神经网络的应用具有显著的优势，因为无线信道通常可以表示为复数，以同时表示信号的幅度和相位信息。本实验中，我们把复值神经网络的概念引入到卷积神经网络(Complex CNN)中，其主要的结构是复值卷积层和复值全连接层。

复值卷积计算公式如下：

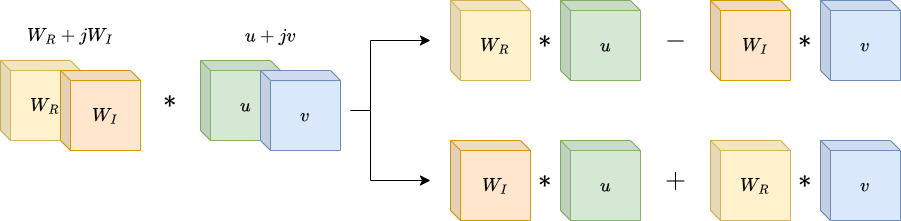
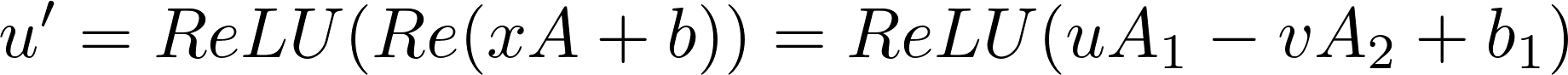
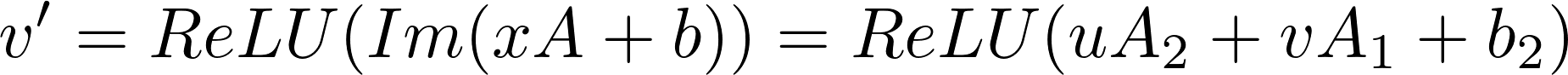


图8 复值卷积操作结构

复数全连接的公式如下：





对于输入，权重矩阵，偏置，激活函数为ReLu，最终的输出为。

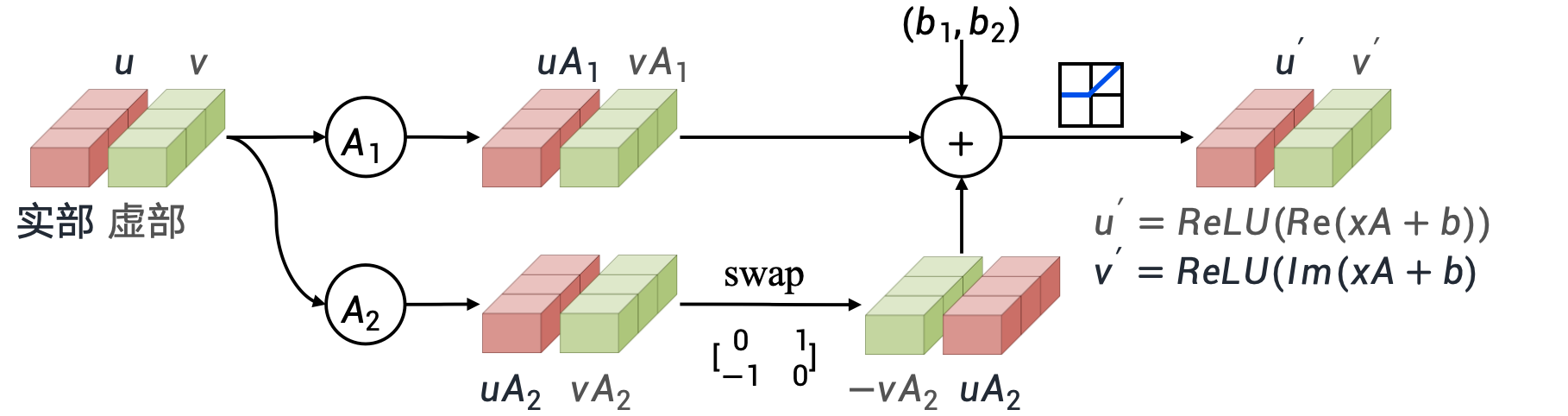


图9 复值全连接操作结构

本次实验中，我们提出了**相干信息嵌入编码（Cherence Embedding）**，其中相干信息包括空间相干性和时间相干性，并将其作为额外的信息加入到预测模型中。它能够提供当前信道状态下，有效的时间或空间稳定性信息，来应对深度学习模型本质上是一个高度非线性的黑盒系统且其内部机制难以直观解释的局限性。

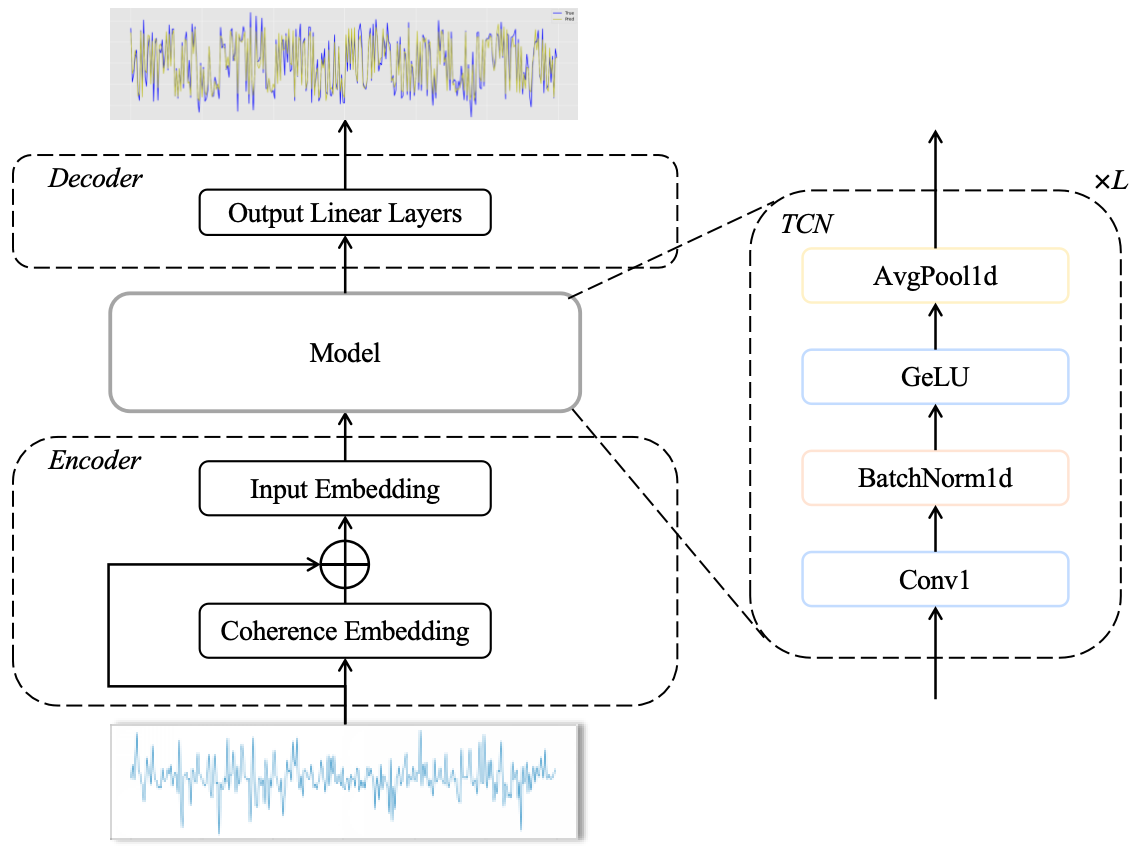
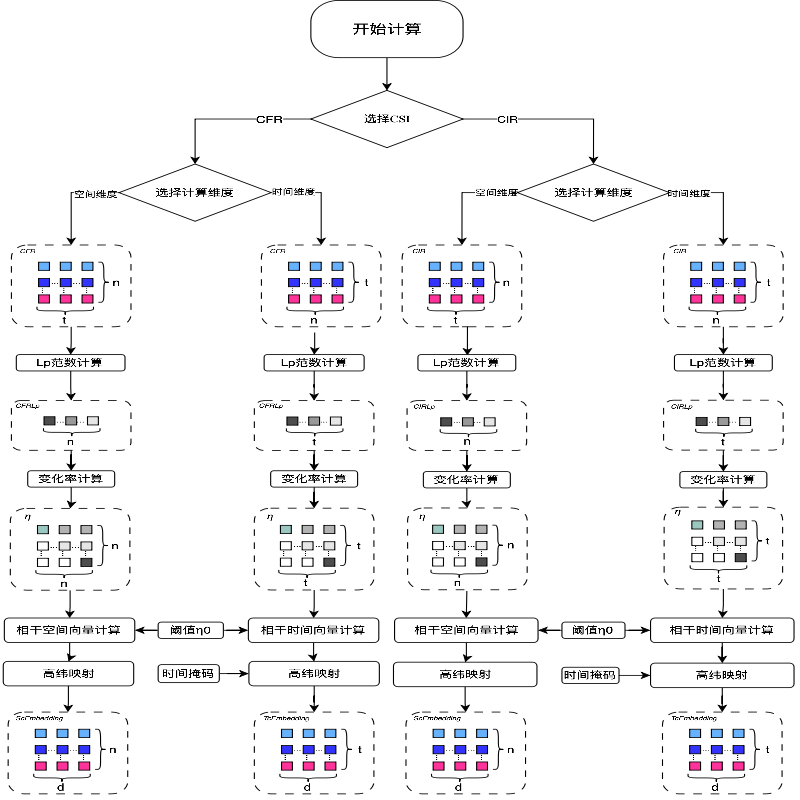
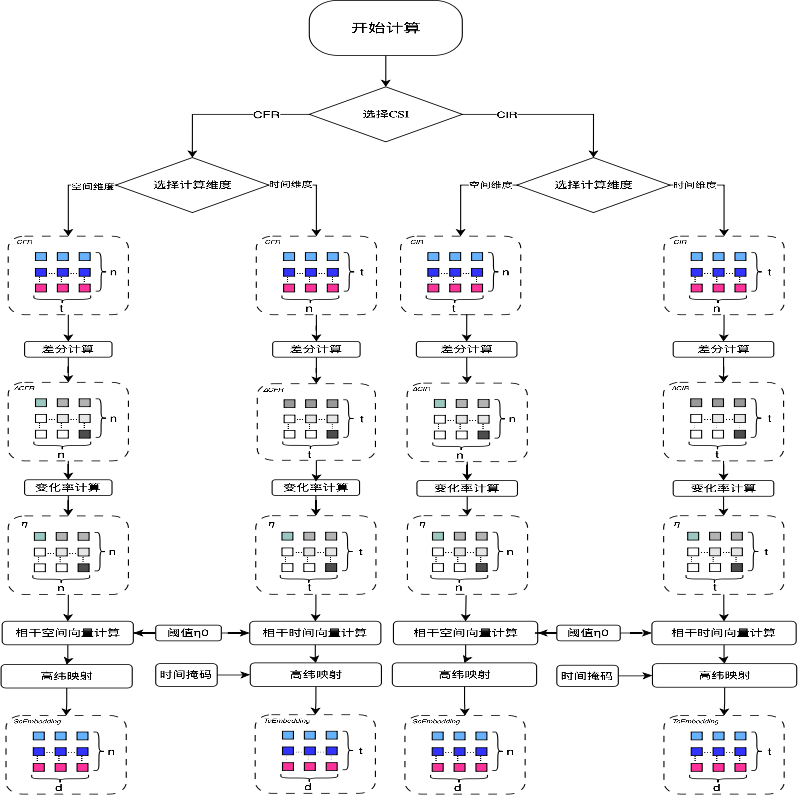


图10 Coherence Embedding模型结构（以TCN为例）



(a)方法一



(b)方法二

图11 Coherence Embedding计算流程图

# 数据集

## 数据集介绍

本实验选用开源的移动通信开放数据平台（**[https://www.mobileai-dataset.com](https://www.mobileai-dataset.com/)/**）上的数据集。该数据的采集场景为密集城区（仅宏站），频率范围为2GHz仅FR1。

数据集的配置为：频域信道，每个样本包括时域的20个TTl和频域的8个RB，TTl的间隔为5ms。数据维度尺寸大小为(21000, 20, 2, 32, 4, 8)，其意义是：(UE number, Time, Real&Imaginary parts, Tx, Rx, RB number)。其中，因User Equipment移动速率的不同将数据集划分为以下case：

Case1:UMA4Rx32Tx5Ms8RB30km,对应于用户的移动速率为30km/h；

Case2:UMA4Rx32Tx5Ms8RB60km,对应于用户的移动速率为60km/h；

Case3:UMA4Rx32Tx5Ms8RB120km,对应于用户的移动速率为120km/h；

Case4:UMA4Rx32Tx5Ms8RBxkm,对应于用户的移动速率为混合30km/h、60kn/h、120km/h。

**同时，本实验也选用校内实测数据集：**



Case5：室外环境下，接收端与发射端间距20米测得的信道数据。

Case6：室内环境下，接收端与发射端间距20米测得的信道数据。

Case7：室内环境下，接收端与发射端间距30米测得的信道数据。

## 数据集划分

在单轮实验过程中，训练集、验证集和测试集的划分比例为[0.8, 0.1, 0.1]，即训练集占80%，验证集占10%，测试集占10%。其中，训练集用于模型的学习，验证集用于模型的选择和模型超参数的调整，测试集则用于评估模型的泛化能力。

# 实验结果

## 实验设置

根据通信标准，在实际训练过程中，我们将采用可变的观察窗口大小和预测窗口大小来对模型进行训练。将观窗口大小设置为5，预测窗口大小分别设置为1、3、5。

MLP的网络参数设置如下：批次大小设置为256，隐藏层大小设置为512，学习率大小设置为1e-4；

CNN类的网络参数设置如下：批次大小设置为256，隐藏层大小设置为512，学习率大小设置为1e-4，，卷积核大小设置为3，卷积核的通道数设置为256；

RNN、LSTM的网络参数设置如下：批次大小设置为256，隐藏层大小设置为512，学习率大小设置为1e-4，网络层数设置为4；

Transformer、Informer的网络参数设置如下：批次大小设置为256，模型深度设置为2048，学习率大小设置为1e-5，编码器层数设置为2，解码器层数设置为1;

## 评价指标

本实验使用NMSE(db)（Normalized Mean Square Error，归一化均方误差）、SGCS（ Cosine Similarity，余弦相似度）、FLOPs（Number of Floating Point Operations，浮点操作数）、Params（parameters，参数量）、TOPS（Tera Operations Per Second，每秒万亿次操作）作为评价指标量化预测的效果。

## 模型命名

各模型及其名称如下：

* MLP:使用MLP预测模型进行预测的结果；
* CNN:使用CNN预测模型进行预测的结果；
* CVCNN：使用ComplexCNN预测模型进行预测的结果；
* RNN:使用RNN预测模型进行预测的结果；
* LSTM:使用LSTM预测模型进行预测的结果；
* Transformer:使用Transformer预测模型进行预测的结果；
* Informer:使用Informer预测模型进行预测的结果；

## **结果展示**

### Case1

#### >1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -15.823 | | 0.961 | | 0.049 | | 0.05 | |
| CNN | unuse | | - | | | - | | - | | - | | -14.946 | | 0.946 | | 0.602 | | 0.35 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -10.142 | | 0.86 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -10.147 | | 0.861 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -10.147 | | 0.861 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -9.896 | | 0.858 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -9.895 | | 0.859 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -9.895 | | 0.859 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -9.991 | | 0.856 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -10.001 | | 0.856 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -10.01 | | 0.856 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -9.939 | | 0.858 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -9.94 | | 0.858 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -9.95 | | 0.858 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -9.162 | | 0.802 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -9.163 | | 0.801 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -9.163 | | 0.801 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -9.164 | | 0.8 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -9.163 | | 0.801 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -9.163 | | 0.801 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -9.161 | | 0.807 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -9.168 | | 0.805 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -9.178 | | 0.805 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -9.158 | | 0.806 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -9.179 | | 0.805 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -9.177 | | 0.805 | | 0.607 | | 0.351 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -16.342 | | 0.96 | | 1.968 | | 0.546 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -9.737 | | 0.859 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -9.746 | | 0.859 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -9.746 | | 0.859 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -9.656 | | 0.858 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -9.647 | | 0.858 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -9.647 | | 0.858 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -9.595 | | 0.854 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -9.606 | | 0.854 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -9.606 | | 0.854 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -9.577 | | 0.851 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -9.568 | | 0.851 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -9.566 | | 0.852 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -8.887 | | 0.802 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -8.886 | | 0.802 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -8.886 | | 0.802 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -8.874 | | 0.8 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -8.886 | | 0.802 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -8.886 | | 0.802 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -8.923 | | 0.807 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -8.918 | | 0.804 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -8.928 | | 0.805 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -8.909 | | 0.807 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -8.901 | | 0.805 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -8.906 | | 0.806 | | 1.973 | | 0.547 | |
| LSTM | unuse | | - | | | - | | - | | - | | -16.989 | | 0.961 | | 37.298 | | 7.66 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -10.547 | | 0.873 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -10.551 | | 0.873 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -10.551 | | 0.873 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -10.437 | | 0.86 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -10.435 | | 0.861 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -10.435 | | 0.861 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -10.387 | | 0.856 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -10.398 | | 0.856 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -10.387 | | 0.856 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -10.396 | | 0.855 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -10.376 | | 0.855 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -10.372 | | 0.854 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -9.95 | | 0.817 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -9.947 | | 0.817 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -9.947 | | 0.817 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -9.939 | | 0.815 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -9.947 | | 0.817 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -9.947 | | 0.817 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -9.929 | | 0.819 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -9.968 | | 0.818 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -9.971 | | 0.818 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -9.925 | | 0.82 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -9.97 | | 0.819 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -9.963 | | 0.82 | | 37.303 | | 7.661 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -16.561 | | 0.956 | | 496.607 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -15.821 | | 0.952 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -16.241 | | 0.956 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -15.949 | | 0.955 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -14.77 | | 0.936 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -15.262 | | 0.949 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -15.333 | | 0.947 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -15.049 | | 0.944 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -15.147 | | 0.942 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -15.167 | | 0.95 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -15.452 | | 0.948 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -15.76 | | 0.952 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -15.436 | | 0.95 | | 497.099 | | 92.586 | | 0.099 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -15.747 | | 0.949 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -15.748 | | 0.944 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -15.614 | | 0.945 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -15.731 | | 0.946 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -15.737 | | 0.946 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -15.911 | | 0.946 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -15.411 | | 0.941 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -15.398 | | 0.942 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -15.701 | | 0.944 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -15.618 | | 0.942 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -15.66 | | 0.944 | | 517.579 | | 96.782 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -15.479 | | 0.943 | | 517.579 | | 96.782 | | 0.104 | |
| Informer | | unuse | | - | - | | - | | - | | -17.213 | | 0.956 | | 551.166 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -16.572 | | 0.95 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -16.386 | | 0.939 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -15.98 | | 0.942 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -15.627 | | 0.946 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -15.53 | | 0.944 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -16.395 | | 0.952 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -15.989 | | 0.949 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -14.904 | | 0.936 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -16.066 | | 0.94 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -16.309 | | 0.952 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -15.429 | | 0.944 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -16.203 | | 0.945 | | 551.658 | | 105.175 | | 0.11 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -16.339 | | 0.946 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -15.922 | | 0.941 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -16.19 | | 0.948 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -16.54 | | 0.95 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -16.214 | | 0.948 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -16.48 | | 0.949 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -16.295 | | 0.947 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -15.915 | | 0.944 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -15.932 | | 0.945 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -16.263 | | 0.948 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -15.913 | | 0.943 | | 572.138 | | 109.371 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -16.237 | | 0.945 | | 572.138 | | 109.371 | | 0.114 | |

#### 5->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -8.738 | 0.817 | 0.066 | 0.066 |
| CNN | unuse | - | - | - | - | -9.882 | 0.844 | 0.618 | 0.367 |
| CNN | use | spatial | first | CFR | L1 | -8.228 | 0.772 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L2 | -8.232 | 0.772 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L3 | -8.232 | 0.772 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L1 | -8.106 | 0.765 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L2 | -8.109 | 0.765 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L3 | -8.109 | 0.765 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L1 | -8.096 | 0.766 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L2 | -8.096 | 0.766 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L3 | -8.095 | 0.766 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L1 | -8.139 | 0.763 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L2 | -8.142 | 0.763 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L3 | -8.132 | 0.763 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L1 | -7.764 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L2 | -7.763 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L3 | -7.763 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L1 | -7.758 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L2 | -7.763 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L3 | -7.763 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L1 | -7.755 | 0.74 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L2 | -7.769 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L3 | -7.77 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L1 | -7.768 | 0.742 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L2 | -7.762 | 0.741 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L3 | -7.768 | 0.741 | 0.623 | 0.368 |
| CVCNN | unuse | - | - | - | - | -10.276 | 0.852 | 1.984 | 0.563 |
| CVCNN | use | spatial | first | CFR | L1 | -8.076 | 0.778 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L2 | -8.08 | 0.779 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L3 | -8.08 | 0.779 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L1 | -7.993 | 0.773 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L2 | -7.992 | 0.773 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L3 | -7.992 | 0.773 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L1 | -7.949 | 0.765 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L2 | -7.952 | 0.765 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L3 | -7.954 | 0.765 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L1 | -8.001 | 0.768 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L2 | -8.005 | 0.769 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L3 | -8.008 | 0.769 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L1 | -7.623 | 0.737 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L2 | -7.622 | 0.737 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L3 | -7.622 | 0.737 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L1 | -7.603 | 0.736 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L2 | -7.622 | 0.737 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L3 | -7.622 | 0.737 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L1 | -7.597 | 0.737 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L2 | -7.612 | 0.736 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L3 | -7.605 | 0.736 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L1 | -7.596 | 0.738 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L2 | -7.595 | 0.737 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L3 | -7.592 | 0.738 | 1.989 | 0.564 |
| LSTM | unuse | - | - | - | - | -10.334 | 0.862 | 37.315 | 7.676 |
| LSTM | use | spatial | first | CFR | L1 | -8.18 | 0.786 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L2 | -8.189 | 0.787 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L3 | -8.189 | 0.787 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L1 | -7.988 | 0.769 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L2 | -7.984 | 0.769 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L3 | -7.984 | 0.769 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L1 | -8.076 | 0.776 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L2 | -8.068 | 0.774 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L3 | -8.058 | 0.774 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L1 | -7.965 | 0.771 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L2 | -7.971 | 0.771 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L3 | -7.995 | 0.772 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L1 | -7.965 | 0.752 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L2 | -7.967 | 0.752 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L3 | -7.967 | 0.752 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L1 | -7.958 | 0.753 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L2 | -7.967 | 0.752 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L3 | -7.967 | 0.752 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L1 | -7.934 | 0.752 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L2 | -7.944 | 0.751 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L3 | -7.952 | 0.751 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L1 | -7.945 | 0.753 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L2 | -7.935 | 0.752 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L3 | -7.901 | 0.748 | 37.32 | 7.678 |

#### 5->5

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -6.714 | 0.738 | 0.082 | 0.083 |
| CNN | unuse | - | - | - | - | -8.609 | 0.795 | 0.635 | 0.383 |
| CNN | use | spatial | first | CFR | L1 | -7.452 | 0.733 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L2 | -7.455 | 0.733 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L3 | -7.455 | 0.733 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L1 | -7.361 | 0.731 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L2 | -7.357 | 0.731 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L3 | -7.357 | 0.731 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L1 | -7.392 | 0.727 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L2 | -7.39 | 0.727 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L3 | -7.392 | 0.727 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L1 | -7.378 | 0.727 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L2 | -7.381 | 0.728 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L3 | -7.385 | 0.728 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L1 | -6.95 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L2 | -6.951 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L3 | -6.951 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L1 | -6.946 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L2 | -6.951 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L3 | -6.951 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L1 | -6.914 | 0.706 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L2 | -6.924 | 0.706 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L3 | -6.926 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L1 | -6.92 | 0.707 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L2 | -6.911 | 0.706 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L3 | -6.919 | 0.708 | 0.64 | 0.384 |
| CVCNN | unuse | - | - | - | - | -8.634 | 0.792 | 2.0 | 0.579 |
| CVCNN | use | spatial | first | CFR | L1 | -7.283 | 0.744 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L2 | -7.287 | 0.744 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L3 | -7.287 | 0.744 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L1 | -7.2 | 0.74 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L2 | -7.199 | 0.74 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L3 | -7.199 | 0.74 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L1 | -7.217 | 0.734 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L2 | -7.222 | 0.734 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L3 | -7.223 | 0.734 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L1 | -7.211 | 0.736 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L2 | -7.206 | 0.736 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L3 | -7.195 | 0.736 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L1 | -6.909 | 0.707 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L2 | -6.911 | 0.707 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L3 | -6.911 | 0.707 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L1 | -6.905 | 0.708 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L2 | -6.911 | 0.707 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L3 | -6.911 | 0.707 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L1 | -6.864 | 0.705 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L2 | -6.878 | 0.706 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L3 | -6.89 | 0.706 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L1 | -6.86 | 0.706 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L2 | -6.867 | 0.706 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L3 | -6.88 | 0.707 | 2.006 | 0.58 |
| LSTM | unuse | - | - | - | - | -8.628 | 0.798 | 37.331 | 7.693 |
| LSTM | use | spatial | first | CFR | L1 | -7.304 | 0.75 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L2 | -7.297 | 0.75 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L3 | -7.297 | 0.75 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L1 | -7.321 | 0.748 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L2 | -7.318 | 0.748 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L3 | -7.318 | 0.748 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L1 | -7.231 | 0.745 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L2 | -7.234 | 0.745 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L3 | -7.229 | 0.744 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L1 | -7.22 | 0.744 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L2 | -7.2 | 0.745 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L3 | -7.198 | 0.744 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L1 | -6.995 | 0.716 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L2 | -6.993 | 0.716 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L3 | -6.993 | 0.716 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L1 | -6.984 | 0.715 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L2 | -6.993 | 0.716 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L3 | -6.993 | 0.716 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L1 | -6.988 | 0.712 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L2 | -6.988 | 0.714 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L3 | -7.002 | 0.715 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L1 | -6.98 | 0.712 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L2 | -6.974 | 0.715 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L3 | -7.0 | 0.716 | 37.336 | 7.694 |

#### 10->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | |
| MLP | unuse | | - | | | - | | - | | - | | -21.693 | | 0.985 | | 0.36 | | 0.362 | |
| CNN | unuse | | - | | | - | | - | | - | | -15.3 | | 0.948 | | 2.204 | | 1.294 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -10.448 | | 0.881 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -10.448 | | 0.881 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -10.448 | | 0.881 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -10.241 | | 0.867 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -10.238 | | 0.867 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -10.238 | | 0.867 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -10.36 | | 0.877 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -10.359 | | 0.878 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -10.356 | | 0.877 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -10.366 | | 0.882 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -10.401 | | 0.883 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -10.386 | | 0.882 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -9.476 | | 0.809 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -9.479 | | 0.809 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -9.479 | | 0.809 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -9.462 | | 0.807 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -9.479 | | 0.809 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -9.479 | | 0.809 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -9.483 | | 0.813 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -9.514 | | 0.813 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -9.502 | | 0.813 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -9.479 | | 0.811 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -9.498 | | 0.811 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -9.487 | | 0.812 | | 2.215 | | 1.295 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -17.318 | | 0.971 | | 6.311 | | 1.49 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -10.104 | | 0.869 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -10.105 | | 0.869 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -10.105 | | 0.869 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -10.109 | | 0.862 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -10.11 | | 0.862 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -10.11 | | 0.862 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -10.086 | | 0.863 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -10.091 | | 0.862 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -10.09 | | 0.862 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -10.118 | | 0.859 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -10.1 | | 0.856 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -10.117 | | 0.857 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -9.402 | | 0.813 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -9.401 | | 0.812 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -9.401 | | 0.812 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -9.411 | | 0.809 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -9.401 | | 0.812 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -9.401 | | 0.812 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -9.433 | | 0.818 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -9.425 | | 0.816 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -9.406 | | 0.816 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -9.447 | | 0.816 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -9.432 | | 0.815 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -9.441 | | 0.817 | | 6.322 | | 1.491 | |
| LSTM | unuse | | - | | | - | | - | | - | | -22.229 | | 0.988 | | 1181.254 | | 121.866 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -10.811 | | 0.869 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -10.8 | | 0.867 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -10.8 | | 0.867 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -10.846 | | 0.863 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -10.848 | | 0.861 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -10.848 | | 0.861 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -10.673 | | 0.866 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -10.715 | | 0.862 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -10.735 | | 0.862 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -10.811 | | 0.863 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -10.788 | | 0.863 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -10.75 | | 0.861 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -10.424 | | 0.822 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -10.425 | | 0.821 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -10.425 | | 0.821 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -10.377 | | 0.829 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -10.425 | | 0.821 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -10.425 | | 0.821 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -10.38 | | 0.834 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -10.395 | | 0.834 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -10.432 | | 0.835 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -10.41 | | 0.835 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -10.415 | | 0.833 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -10.436 | | 0.834 | | 1181.264 | | 121.867 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -16.131 | | 0.956 | | 959.496 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -16.54 | | 0.958 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -16.072 | | 0.954 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -16.072 | | 0.954 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -15.38 | | 0.951 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -16.152 | | 0.956 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -16.152 | | 0.956 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -15.567 | | 0.952 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -14.78 | | 0.946 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -15.05 | | 0.948 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -15.573 | | 0.949 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -15.694 | | 0.946 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -15.463 | | 0.949 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -14.188 | | 0.924 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -15.032 | | 0.939 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -15.032 | | 0.939 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -14.699 | | 0.934 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -15.032 | | 0.939 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -15.032 | | 0.939 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -14.521 | | 0.93 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -14.486 | | 0.93 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -14.464 | | 0.928 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -14.449 | | 0.929 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -14.642 | | 0.931 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -14.7 | | 0.931 | | 1001.439 | | 92.299 | | 0.2 | |
| Informer | | unuse | | - | - | | - | | - | | -16.049 | | 0.956 | | 976.273 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -15.399 | | 0.944 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -15.473 | | 0.946 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -15.473 | | 0.946 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -16.132 | | 0.945 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -16.254 | | 0.952 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -16.254 | | 0.952 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -15.873 | | 0.947 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -15.488 | | 0.943 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -15.868 | | 0.949 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -15.418 | | 0.946 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -15.926 | | 0.938 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -16.143 | | 0.949 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -15.975 | | 0.944 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -15.608 | | 0.942 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -15.608 | | 0.942 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -15.957 | | 0.947 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -15.608 | | 0.942 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -15.608 | | 0.942 | | 1018.216 | | 104.305 | | 0.204 | |

#### 10->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -11.192 | 0.879 | 0.426 | 0.428 |
| CNN | unuse | - | - | - | - | -10.319 | 0.855 | 2.27 | 1.359 |
| CNN | use | spatial | first | CFR | L1 | -8.608 | 0.801 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L2 | -8.608 | 0.801 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L3 | -8.608 | 0.801 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L1 | -8.605 | 0.798 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L2 | -8.605 | 0.798 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L3 | -8.605 | 0.798 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L1 | -8.572 | 0.797 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L2 | -8.571 | 0.797 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L3 | -8.575 | 0.797 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L1 | -8.617 | 0.795 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L2 | -8.597 | 0.795 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L3 | -8.594 | 0.795 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L1 | -8.424 | 0.761 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L2 | -8.428 | 0.76 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L3 | -8.428 | 0.76 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L1 | -8.418 | 0.76 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L2 | -8.428 | 0.76 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L3 | -8.428 | 0.76 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L1 | -8.44 | 0.762 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L2 | -8.443 | 0.763 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L3 | -8.437 | 0.763 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L1 | -8.431 | 0.763 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L2 | -8.423 | 0.762 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L3 | -8.426 | 0.763 | 2.28 | 1.36 |
| CVCNN | unuse | - | - | - | - | -10.626 | 0.867 | 6.377 | 1.556 |
| CVCNN | use | spatial | first | CFR | L1 | -8.552 | 0.8 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L2 | -8.554 | 0.801 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L3 | -8.554 | 0.801 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L1 | -8.548 | 0.796 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L2 | -8.549 | 0.796 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L3 | -8.549 | 0.796 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L1 | -8.5 | 0.796 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L2 | -8.5 | 0.796 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L3 | -8.5 | 0.795 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L1 | -8.536 | 0.793 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L2 | -8.539 | 0.792 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L3 | -8.54 | 0.792 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L1 | -8.375 | 0.762 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L2 | -8.38 | 0.761 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L3 | -8.38 | 0.761 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L1 | -8.388 | 0.762 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L2 | -8.38 | 0.761 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L3 | -8.38 | 0.761 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L1 | -8.353 | 0.762 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L2 | -8.362 | 0.763 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L3 | -8.368 | 0.764 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L1 | -8.341 | 0.763 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L2 | -8.325 | 0.762 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L3 | -8.329 | 0.763 | 6.387 | 1.556 |
| LSTM | unuse | - | - | - | - | -12.33 | 0.91 | 1181.319 | 121.932 |
| LSTM | use | spatial | first | CFR | L1 | -8.818 | 0.799 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L2 | -8.816 | 0.798 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L3 | -8.816 | 0.798 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L1 | -8.942 | 0.799 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L2 | -8.934 | 0.8 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L3 | -8.934 | 0.8 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L1 | -8.762 | 0.793 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L2 | -8.747 | 0.792 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L3 | -8.757 | 0.793 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L1 | -8.859 | 0.796 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L2 | -8.808 | 0.791 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L3 | -8.878 | 0.797 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L1 | -8.693 | 0.772 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L2 | -8.676 | 0.772 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L3 | -8.676 | 0.772 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L1 | -8.722 | 0.774 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L2 | -8.676 | 0.772 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L3 | -8.676 | 0.772 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L1 | -8.646 | 0.775 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L2 | -8.625 | 0.775 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L3 | -8.686 | 0.77 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L1 | -8.69 | 0.772 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L2 | -8.721 | 0.772 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L3 | -8.708 | 0.771 | 1181.329 | 121.933 |

#### 10->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -8.866 | 0.813 | 0.491 | 0.494 |
| CNN | unuse | - | - | - | - | -8.797 | 0.796 | 2.336 | 1.425 |
| CNN | use | spatial | first | CFR | L1 | -7.903 | 0.76 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L2 | -7.904 | 0.76 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L3 | -7.904 | 0.76 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L1 | -7.891 | 0.755 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L2 | -7.887 | 0.755 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L3 | -7.887 | 0.755 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L1 | -7.878 | 0.761 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L2 | -7.881 | 0.761 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L3 | -7.881 | 0.76 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L1 | -7.863 | 0.751 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L2 | -7.865 | 0.751 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L3 | -7.871 | 0.751 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L1 | -7.76 | 0.733 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L2 | -7.764 | 0.733 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L3 | -7.764 | 0.733 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L1 | -7.771 | 0.733 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L2 | -7.764 | 0.733 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L3 | -7.764 | 0.733 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L1 | -7.748 | 0.733 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L2 | -7.761 | 0.734 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L3 | -7.756 | 0.734 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L1 | -7.741 | 0.732 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L2 | -7.739 | 0.731 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L3 | -7.738 | 0.732 | 2.346 | 1.426 |
| CVCNN | unuse | - | - | - | - | -9.001 | 0.8 | 6.442 | 1.621 |
| CVCNN | use | spatial | first | CFR | L1 | -8.011 | 0.766 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L2 | -8.009 | 0.766 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L3 | -8.009 | 0.766 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L1 | -7.99 | 0.763 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L2 | -7.992 | 0.763 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L3 | -7.992 | 0.763 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L1 | -7.997 | 0.762 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L2 | -7.995 | 0.762 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L3 | -7.995 | 0.762 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L1 | -7.991 | 0.76 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L2 | -7.998 | 0.76 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L3 | -7.998 | 0.76 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L1 | -7.747 | 0.735 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L2 | -7.752 | 0.734 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L3 | -7.752 | 0.734 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L1 | -7.755 | 0.736 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L2 | -7.752 | 0.734 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L3 | -7.752 | 0.734 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L1 | -7.734 | 0.735 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L2 | -7.744 | 0.736 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L3 | -7.758 | 0.736 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L1 | -7.726 | 0.735 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L2 | -7.72 | 0.734 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L3 | -7.741 | 0.735 | 6.453 | 1.622 |
| LSTM | unuse | - | - | - | - | -9.646 | 0.833 | 1181.385 | 121.997 |
| LSTM | use | spatial | first | CFR | L1 | -8.055 | 0.768 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L2 | -8.054 | 0.768 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L3 | -8.054 | 0.768 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L1 | -7.953 | 0.751 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L2 | -7.959 | 0.751 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L3 | -7.959 | 0.751 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L1 | -8.028 | 0.765 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L2 | -8.011 | 0.765 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L3 | -8.017 | 0.765 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L1 | -7.948 | 0.752 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L2 | -7.943 | 0.751 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L3 | -7.959 | 0.752 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L1 | -7.812 | 0.737 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L2 | -7.814 | 0.737 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L3 | -7.814 | 0.737 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L1 | -7.825 | 0.739 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L2 | -7.814 | 0.737 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L3 | -7.814 | 0.737 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L1 | -7.835 | 0.738 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L2 | -7.848 | 0.739 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L3 | -7.856 | 0.739 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L1 | -7.846 | 0.739 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L2 | -7.824 | 0.739 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L3 | -7.833 | 0.739 | 1181.395 | 121.998 |

### Case2

#### 5->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -7.587 | | 0.693 | | 0.049 | | 0.05 | |
| CNN | unuse | | - | | | - | | - | | - | | -8.847 | | 0.759 | | 0.602 | | 0.35 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -7.74 | | 0.708 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -7.743 | | 0.708 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -7.743 | | 0.708 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -7.668 | | 0.704 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -7.665 | | 0.703 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -7.665 | | 0.703 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -7.599 | | 0.699 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -7.593 | | 0.699 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -7.589 | | 0.699 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -7.606 | | 0.703 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -7.657 | | 0.703 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -7.656 | | 0.703 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -7.667 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -7.664 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -7.664 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -7.658 | | 0.695 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -7.664 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -7.664 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -7.652 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -7.654 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -7.649 | | 0.696 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -7.651 | | 0.695 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -7.638 | | 0.695 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -7.645 | | 0.696 | | 0.607 | | 0.351 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -8.709 | | 0.766 | | 1.968 | | 0.546 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -7.762 | | 0.728 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -7.762 | | 0.727 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -7.762 | | 0.727 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -7.706 | | 0.724 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -7.709 | | 0.724 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -7.709 | | 0.724 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -7.675 | | 0.721 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -7.669 | | 0.721 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -7.667 | | 0.721 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -7.699 | | 0.724 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -7.7 | | 0.723 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -7.698 | | 0.723 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -7.663 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -7.665 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -7.665 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -7.652 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -7.665 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -7.665 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -7.669 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -7.675 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -7.674 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -7.67 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -7.66 | | 0.711 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -7.663 | | 0.712 | | 1.973 | | 0.547 | |
| LSTM | unuse | | - | | | - | | - | | - | | -8.657 | | 0.766 | | 37.298 | | 7.66 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -7.575 | | 0.729 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -7.574 | | 0.729 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -7.574 | | 0.729 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -7.512 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -7.51 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -7.51 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -7.513 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -7.519 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -7.515 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -7.496 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -7.487 | | 0.724 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -7.497 | | 0.723 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -7.787 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -7.784 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -7.784 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -7.787 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -7.784 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -7.784 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -7.786 | | 0.727 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -7.795 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -7.792 | | 0.727 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -7.79 | | 0.727 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -7.789 | | 0.728 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -7.79 | | 0.727 | | 37.303 | | 7.661 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -8.373 | | 0.76 | | 496.607 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -8.213 | | 0.75 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -8.392 | | 0.76 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -8.392 | | 0.76 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -8.236 | | 0.752 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -8.15 | | 0.744 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -8.15 | | 0.744 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -8.08 | | 0.74 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -8.266 | | 0.752 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -8.09 | | 0.743 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -8.285 | | 0.754 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -8.165 | | 0.746 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -8.162 | | 0.744 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -8.089 | | 0.735 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -8.134 | | 0.734 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -8.134 | | 0.734 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -8.094 | | 0.733 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -8.134 | | 0.734 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -8.134 | | 0.734 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -8.122 | | 0.731 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -8.128 | | 0.735 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -8.143 | | 0.735 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -8.12 | | 0.731 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -8.11 | | 0.734 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -8.131 | | 0.734 | | 517.579 | | 92.299 | | 0.104 | |
| Informer | | unuse | | - | - | | - | | - | | -8.501 | | 0.754 | | 551.166 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -8.318 | | 0.748 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -8.399 | | 0.753 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -8.399 | | 0.753 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -8.399 | | 0.747 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -8.364 | | 0.746 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -8.364 | | 0.746 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -8.347 | | 0.752 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -8.136 | | 0.733 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -8.198 | | 0.745 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -8.405 | | 0.75 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -8.255 | | 0.745 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -8.362 | | 0.747 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -8.198 | | 0.735 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -8.198 | | 0.737 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -8.198 | | 0.737 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -8.195 | | 0.733 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -8.198 | | 0.737 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -8.198 | | 0.737 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -8.164 | | 0.73 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -8.161 | | 0.73 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -8.223 | | 0.732 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -8.15 | | 0.73 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -8.176 | | 0.733 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -8.165 | | 0.733 | | 572.138 | | 104.305 | | 0.114 | |

#### 5->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -6.022 | 0.636 | 0.066 | 0.066 |
| CNN | unuse | - | - | - | - | -7.416 | 0.704 | 0.618 | 0.367 |
| CNN | use | spatial | first | CFR | L1 | -6.905 | 0.684 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L2 | -6.908 | 0.684 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L3 | -6.908 | 0.684 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L1 | -6.842 | 0.681 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L2 | -6.843 | 0.681 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L3 | -6.843 | 0.681 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L1 | -6.86 | 0.674 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L2 | -6.859 | 0.675 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L3 | -6.852 | 0.674 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L1 | -6.86 | 0.677 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L2 | -6.872 | 0.677 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L3 | -6.871 | 0.677 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L1 | -6.778 | 0.671 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L2 | -6.778 | 0.671 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L3 | -6.778 | 0.671 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L1 | -6.78 | 0.67 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L2 | -6.778 | 0.671 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L3 | -6.778 | 0.671 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L1 | -6.776 | 0.67 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L2 | -6.779 | 0.67 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L3 | -6.781 | 0.671 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L1 | -6.781 | 0.67 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L2 | -6.772 | 0.669 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L3 | -6.776 | 0.67 | 0.623 | 0.368 |
| CVCNN | unuse | - | - | - | - | -7.453 | 0.717 | 1.984 | 0.563 |
| CVCNN | use | spatial | first | CFR | L1 | -6.891 | 0.696 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L2 | -6.892 | 0.696 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L3 | -6.892 | 0.696 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L1 | -6.86 | 0.693 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L2 | -6.862 | 0.693 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L3 | -6.862 | 0.693 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L1 | -6.837 | 0.69 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L2 | -6.834 | 0.69 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L3 | -6.829 | 0.69 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L1 | -6.843 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L2 | -6.844 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L3 | -6.843 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L1 | -6.657 | 0.669 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L2 | -6.658 | 0.669 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L3 | -6.658 | 0.669 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L1 | -6.658 | 0.668 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L2 | -6.658 | 0.669 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L3 | -6.658 | 0.669 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L1 | -6.649 | 0.668 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L2 | -6.651 | 0.668 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L3 | -6.655 | 0.668 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L1 | -6.655 | 0.667 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L2 | -6.649 | 0.668 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L3 | -6.652 | 0.668 | 1.989 | 0.564 |
| LSTM | unuse | - | - | - | - | -7.485 | 0.721 | 37.315 | 7.676 |
| LSTM | use | spatial | first | CFR | L1 | -6.645 | 0.689 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L2 | -6.641 | 0.689 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L3 | -6.641 | 0.689 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L1 | -6.542 | 0.675 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L2 | -6.547 | 0.675 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L3 | -6.547 | 0.675 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L1 | -6.55 | 0.686 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L2 | -6.549 | 0.687 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L3 | -6.555 | 0.687 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L1 | -6.498 | 0.685 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L2 | -6.518 | 0.684 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L3 | -6.488 | 0.685 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L1 | -6.77 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L2 | -6.769 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L3 | -6.769 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L1 | -6.774 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L2 | -6.769 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L3 | -6.769 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L1 | -6.779 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L2 | -6.779 | 0.686 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L3 | -6.776 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L1 | -6.783 | 0.687 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L2 | -6.777 | 0.686 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L3 | -6.773 | 0.686 | 37.32 | 7.678 |

#### 5->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -4.72 | 0.574 | 0.082 | 0.083 |
| CNN | unuse | - | - | - | - | -6.635 | 0.666 | 0.635 | 0.383 |
| CNN | use | spatial | first | CFR | L1 | -6.338 | 0.653 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L2 | -6.338 | 0.653 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L3 | -6.338 | 0.653 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L1 | -6.281 | 0.65 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L2 | -6.284 | 0.65 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L3 | -6.284 | 0.65 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L1 | -6.295 | 0.65 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L2 | -6.292 | 0.65 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L3 | -6.289 | 0.65 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L1 | -6.279 | 0.651 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L2 | -6.285 | 0.651 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L3 | -6.283 | 0.652 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L1 | -6.032 | 0.64 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L2 | -6.032 | 0.64 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L3 | -6.032 | 0.64 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L1 | -6.027 | 0.64 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L2 | -6.032 | 0.64 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L3 | -6.032 | 0.64 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L1 | -6.043 | 0.64 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L2 | -6.043 | 0.639 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L3 | -6.047 | 0.639 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L1 | -6.045 | 0.639 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L2 | -6.043 | 0.639 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L3 | -6.044 | 0.639 | 0.64 | 0.384 |
| CVCNN | unuse | - | - | - | - | -6.688 | 0.684 | 2.0 | 0.579 |
| CVCNN | use | spatial | first | CFR | L1 | -6.168 | 0.667 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L2 | -6.169 | 0.667 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L3 | -6.169 | 0.667 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L1 | -6.14 | 0.672 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L2 | -6.14 | 0.672 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L3 | -6.14 | 0.672 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L1 | -6.122 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L2 | -6.126 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L3 | -6.123 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L1 | -6.113 | 0.663 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L2 | -6.123 | 0.663 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L3 | -6.141 | 0.671 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L1 | -5.93 | 0.646 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L2 | -5.928 | 0.646 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L3 | -5.928 | 0.646 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L1 | -5.925 | 0.646 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L2 | -5.928 | 0.646 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L3 | -5.928 | 0.646 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L1 | -5.926 | 0.646 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L2 | -5.931 | 0.645 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L3 | -5.959 | 0.651 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L1 | -5.948 | 0.65 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L2 | -5.928 | 0.645 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L3 | -5.936 | 0.645 | 2.006 | 0.58 |
| LSTM | unuse | - | - | - | - | -6.607 | 0.691 | 37.331 | 7.693 |
| LSTM | use | spatial | first | CFR | L1 | -5.953 | 0.655 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L2 | -5.953 | 0.655 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L3 | -5.953 | 0.655 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L1 | -5.885 | 0.651 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L2 | -5.888 | 0.652 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L3 | -5.888 | 0.652 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L1 | -5.921 | 0.65 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L2 | -5.92 | 0.65 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L3 | -5.918 | 0.65 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L1 | -5.874 | 0.653 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L2 | -5.883 | 0.653 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L3 | -5.882 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L1 | -5.905 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L2 | -5.902 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L3 | -5.902 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L1 | -5.919 | 0.655 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L2 | -5.902 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L3 | -5.902 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L1 | -5.923 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L2 | -5.923 | 0.653 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L3 | -5.935 | 0.653 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L1 | -5.929 | 0.654 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L2 | -5.927 | 0.653 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L3 | -5.928 | 0.653 | 37.336 | 7.694 |

#### 10->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | |
| MLP | unuse | | - | | | - | | - | | - | | -7.947 | | 0.707 | | 0.36 | | 0.362 | |
| CNN | unuse | | - | | | - | | - | | - | | -8.668 | | 0.76 | | 2.204 | | 1.294 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -8.122 | | 0.724 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -8.124 | | 0.724 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -8.124 | | 0.724 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -8.118 | | 0.725 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -8.118 | | 0.725 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -8.118 | | 0.725 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -8.105 | | 0.724 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -8.107 | | 0.724 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -8.108 | | 0.724 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -8.094 | | 0.726 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -8.099 | | 0.727 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -8.097 | | 0.727 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -8.111 | | 0.731 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -8.133 | | 0.731 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -8.133 | | 0.731 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -8.105 | | 0.73 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -8.133 | | 0.731 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -8.133 | | 0.731 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -8.113 | | 0.727 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -8.115 | | 0.728 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -8.125 | | 0.729 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -8.119 | | 0.728 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -8.126 | | 0.728 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -8.128 | | 0.728 | | 2.215 | | 1.295 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -8.749 | | 0.772 | | 6.311 | | 1.49 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -8.069 | | 0.744 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -8.068 | | 0.744 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -8.068 | | 0.744 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -8.021 | | 0.745 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -8.019 | | 0.745 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -8.019 | | 0.745 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -8.043 | | 0.743 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -8.052 | | 0.743 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -8.051 | | 0.742 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -7.997 | | 0.746 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -7.996 | | 0.746 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -8.004 | | 0.745 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -8.007 | | 0.732 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -8.008 | | 0.732 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -8.008 | | 0.732 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -8.001 | | 0.731 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -8.008 | | 0.732 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -8.008 | | 0.732 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -7.983 | | 0.729 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -7.995 | | 0.729 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -7.997 | | 0.729 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -7.998 | | 0.729 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -7.995 | | 0.729 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -7.994 | | 0.727 | | 6.322 | | 1.491 | |
| LSTM | unuse | | - | | | - | | - | | - | | -9.144 | | 0.775 | | 1181.254 | | 121.866 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -8.165 | | 0.749 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -8.181 | | 0.749 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -8.181 | | 0.749 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -8.093 | | 0.742 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -8.09 | | 0.743 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -8.09 | | 0.743 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -8.09 | | 0.728 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -8.153 | | 0.748 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -8.155 | | 0.747 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -8.185 | | 0.743 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -8.16 | | 0.742 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -8.145 | | 0.743 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -8.344 | | 0.749 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -8.352 | | 0.75 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -8.352 | | 0.75 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -8.376 | | 0.748 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -8.352 | | 0.75 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -8.352 | | 0.75 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -8.347 | | 0.743 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -8.379 | | 0.743 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -8.37 | | 0.747 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -8.331 | | 0.747 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -8.341 | | 0.743 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -8.383 | | 0.745 | | 1181.264 | | 121.867 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -8.417 | | 0.75 | | 959.496 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -8.555 | | 0.763 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -8.535 | | 0.762 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -8.535 | | 0.762 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -8.312 | | 0.743 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -8.369 | | 0.749 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -8.369 | | 0.749 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -8.203 | | 0.736 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -8.304 | | 0.745 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -8.194 | | 0.737 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -8.497 | | 0.763 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -8.316 | | 0.75 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -8.338 | | 0.75 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -8.198 | | 0.735 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -8.163 | | 0.734 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -8.163 | | 0.734 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -8.197 | | 0.735 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -8.163 | | 0.734 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -8.163 | | 0.734 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -8.205 | | 0.736 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -8.209 | | 0.738 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -8.189 | | 0.73 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -8.247 | | 0.738 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -8.232 | | 0.734 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -8.201 | | 0.737 | | 1001.439 | | 92.299 | | 0.2 | |
| Informer | | unuse | | - | - | | - | | - | | -8.404 | | 0.763 | | 976.273 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -8.298 | | 0.748 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -8.329 | | 0.753 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -8.329 | | 0.753 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -8.259 | | 0.749 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -8.256 | | 0.747 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -8.256 | | 0.747 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -8.193 | | 0.733 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -8.15 | | 0.74 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -8.153 | | 0.739 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -8.331 | | 0.746 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -8.231 | | 0.749 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -8.318 | | 0.748 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -8.157 | | 0.734 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -8.172 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -8.172 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -8.164 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -8.172 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -8.172 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -8.199 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -8.199 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -8.209 | | 0.734 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -8.19 | | 0.732 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -8.19 | | 0.731 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -8.209 | | 0.735 | | 1018.216 | | 104.305 | | 0.204 | |

#### 10->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -7.151 | 0.685 | 0.426 | 0.428 |
| CNN | unuse | - | - | - | - | -7.682 | 0.714 | 2.27 | 1.359 |
| CNN | use | spatial | first | CFR | L1 | -7.535 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L2 | -7.535 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L3 | -7.535 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L1 | -7.479 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L2 | -7.479 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L3 | -7.479 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L1 | -7.523 | 0.706 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L2 | -7.527 | 0.706 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L3 | -7.524 | 0.706 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L1 | -7.506 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L2 | -7.507 | 0.707 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L3 | -7.505 | 0.707 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L1 | -7.455 | 0.701 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L2 | -7.456 | 0.702 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L3 | -7.456 | 0.702 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L1 | -7.455 | 0.7 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L2 | -7.456 | 0.702 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L3 | -7.456 | 0.702 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L1 | -7.459 | 0.697 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L2 | -7.449 | 0.699 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L3 | -7.46 | 0.7 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L1 | -7.456 | 0.697 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L2 | -7.438 | 0.699 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L3 | -7.445 | 0.7 | 2.28 | 1.36 |
| CVCNN | unuse | - | - | - | - | -7.806 | 0.724 | 6.377 | 1.556 |
| CVCNN | use | spatial | first | CFR | L1 | -7.399 | 0.719 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L2 | -7.397 | 0.719 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L3 | -7.397 | 0.719 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L1 | -7.441 | 0.721 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L2 | -7.439 | 0.721 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L3 | -7.439 | 0.721 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L1 | -7.393 | 0.716 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L2 | -7.392 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L3 | -7.394 | 0.716 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L1 | -7.427 | 0.719 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L2 | -7.442 | 0.72 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L3 | -7.436 | 0.719 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L1 | -7.432 | 0.71 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L2 | -7.434 | 0.711 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L3 | -7.434 | 0.711 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L1 | -7.431 | 0.709 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L2 | -7.434 | 0.711 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L3 | -7.434 | 0.711 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L1 | -7.426 | 0.71 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L2 | -7.437 | 0.708 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L3 | -7.43 | 0.709 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L1 | -7.428 | 0.709 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L2 | -7.434 | 0.709 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L3 | -7.435 | 0.708 | 6.387 | 1.556 |
| LSTM | unuse | - | - | - | - | -7.757 | 0.737 | 1181.319 | 121.932 |
| LSTM | use | spatial | first | CFR | L1 | -7.482 | 0.712 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L2 | -7.481 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L3 | -7.481 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L1 | -7.537 | 0.714 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L2 | -7.546 | 0.714 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L3 | -7.546 | 0.714 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L1 | -7.463 | 0.712 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L2 | -7.489 | 0.711 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L3 | -7.488 | 0.712 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L1 | -7.511 | 0.714 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L2 | -7.505 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L3 | -7.488 | 0.714 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L1 | -7.315 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L2 | -7.413 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L3 | -7.413 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L1 | -7.392 | 0.712 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L2 | -7.413 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L3 | -7.413 | 0.713 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L1 | -7.378 | 0.709 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L2 | -7.373 | 0.707 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L3 | -7.383 | 0.711 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L1 | -7.368 | 0.707 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L2 | -7.375 | 0.708 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L3 | -7.354 | 0.708 | 1181.329 | 121.933 |

#### 10->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -6.474 | 0.658 | 0.491 | 0.494 |
| CNN | unuse | - | - | - | - | -7.06 | 0.677 | 2.336 | 1.425 |
| CNN | use | spatial | first | CFR | L1 | -7.153 | 0.683 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L2 | -7.153 | 0.683 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L3 | -7.153 | 0.683 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L1 | -7.15 | 0.683 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L2 | -7.151 | 0.683 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L3 | -7.151 | 0.683 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L1 | -7.147 | 0.682 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L2 | -7.148 | 0.682 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L3 | -7.148 | 0.682 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L1 | -7.14 | 0.682 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L2 | -7.145 | 0.682 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L3 | -7.136 | 0.682 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L1 | -7.035 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L2 | -7.041 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L3 | -7.041 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L1 | -7.03 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L2 | -7.041 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L3 | -7.041 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L1 | -7.035 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L2 | -7.031 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L3 | -7.03 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L1 | -7.026 | 0.678 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L2 | -7.026 | 0.677 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L3 | -7.026 | 0.677 | 2.346 | 1.426 |
| CVCNN | unuse | - | - | - | - | -7.255 | 0.701 | 6.442 | 1.621 |
| CVCNN | use | spatial | first | CFR | L1 | -7.112 | 0.699 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L2 | -7.112 | 0.699 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L3 | -7.112 | 0.699 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L1 | -7.17 | 0.702 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L2 | -7.169 | 0.702 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L3 | -7.169 | 0.702 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L1 | -7.11 | 0.698 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L2 | -7.121 | 0.698 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L3 | -7.12 | 0.698 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L1 | -7.139 | 0.702 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L2 | -7.086 | 0.703 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L3 | -7.14 | 0.702 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L1 | -6.914 | 0.688 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L2 | -6.922 | 0.689 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L3 | -6.922 | 0.689 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L1 | -6.933 | 0.684 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L2 | -6.922 | 0.689 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L3 | -6.922 | 0.689 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L1 | -6.922 | 0.687 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L2 | -6.928 | 0.686 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L3 | -6.928 | 0.687 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L1 | -6.92 | 0.687 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L2 | -6.927 | 0.686 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L3 | -6.918 | 0.685 | 6.453 | 1.622 |
| LSTM | unuse | - | - | - | - | -7.243 | 0.698 | 1181.385 | 121.997 |
| LSTM | use | spatial | first | CFR | L1 | -6.973 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L2 | -6.96 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L3 | -6.96 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L1 | -6.984 | 0.692 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L2 | -6.97 | 0.692 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L3 | -6.97 | 0.692 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L1 | -6.93 | 0.692 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L2 | -6.951 | 0.693 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L3 | -6.958 | 0.693 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L1 | -6.951 | 0.693 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L2 | -6.954 | 0.693 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L3 | -6.969 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L1 | -6.813 | 0.675 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L2 | -6.886 | 0.686 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L3 | -6.886 | 0.686 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L1 | -6.867 | 0.684 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L2 | -6.886 | 0.686 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L3 | -6.886 | 0.686 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L1 | -6.809 | 0.677 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L2 | -6.889 | 0.684 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L3 | -6.837 | 0.677 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L1 | -6.83 | 0.675 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L2 | -6.871 | 0.687 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L3 | -6.823 | 0.675 | 1181.395 | 121.998 |

### Case3

#### 5->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -6.746 | | 0.658 | | 0.049 | | 0.05 | |
| CNN | unuse | | - | | | - | | - | | - | | -7.48 | | 0.708 | | 0.602 | | 0.35 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -6.992 | | 0.673 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -6.994 | | 0.673 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -6.994 | | 0.673 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -6.974 | | 0.667 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -6.974 | | 0.667 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -6.974 | | 0.667 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -6.873 | | 0.671 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -6.87 | | 0.671 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -6.871 | | 0.67 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -6.956 | | 0.668 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -6.957 | | 0.67 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -6.949 | | 0.669 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -6.923 | | 0.68 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -6.906 | | 0.669 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -6.906 | | 0.669 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -6.924 | | 0.679 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -6.906 | | 0.669 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -6.906 | | 0.669 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -6.889 | | 0.67 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -6.894 | | 0.671 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -6.907 | | 0.678 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -6.898 | | 0.671 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -6.895 | | 0.671 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -6.907 | | 0.677 | | 0.607 | | 0.351 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -7.509 | | 0.717 | | 1.968 | | 0.546 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -7.153 | | 0.697 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -7.154 | | 0.697 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -7.154 | | 0.697 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -7.117 | | 0.692 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -7.115 | | 0.693 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -7.115 | | 0.693 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -7.097 | | 0.691 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -7.096 | | 0.691 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -7.094 | | 0.691 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -7.112 | | 0.691 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -7.106 | | 0.692 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -7.104 | | 0.692 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -6.916 | | 0.677 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -6.917 | | 0.676 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -6.917 | | 0.676 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -6.91 | | 0.676 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -6.917 | | 0.676 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -6.917 | | 0.676 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -6.905 | | 0.676 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -6.911 | | 0.678 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -6.911 | | 0.677 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -6.915 | | 0.678 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -6.919 | | 0.679 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -6.915 | | 0.678 | | 1.973 | | 0.547 | |
| LSTM | unuse | | - | | | - | | - | | - | | -7.495 | | 0.711 | | 37.298 | | 7.66 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -7.154 | | 0.691 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -7.154 | | 0.691 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -7.154 | | 0.691 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -7.101 | | 0.697 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -7.099 | | 0.697 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -7.099 | | 0.697 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -7.085 | | 0.687 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -7.084 | | 0.687 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -7.104 | | 0.694 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -7.082 | | 0.696 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -7.076 | | 0.696 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -7.083 | | 0.691 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -6.956 | | 0.685 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -6.955 | | 0.685 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -6.955 | | 0.685 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -6.928 | | 0.683 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -6.955 | | 0.685 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -6.955 | | 0.685 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -6.957 | | 0.684 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -6.951 | | 0.685 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -6.942 | | 0.685 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -6.967 | | 0.687 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -6.966 | | 0.687 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -6.947 | | 0.684 | | 37.303 | | 7.661 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -7.498 | | 0.71 | | 496.607 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -7.468 | | 0.699 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -7.365 | | 0.695 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -7.365 | | 0.695 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -7.442 | | 0.703 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -7.433 | | 0.704 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -7.433 | | 0.704 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -7.415 | | 0.701 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -7.343 | | 0.691 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -7.383 | | 0.697 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -7.439 | | 0.697 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -7.474 | | 0.705 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -7.43 | | 0.696 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -7.406 | | 0.694 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -7.425 | | 0.692 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -7.425 | | 0.692 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -7.422 | | 0.689 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -7.425 | | 0.692 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -7.425 | | 0.692 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -7.444 | | 0.696 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -7.427 | | 0.695 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -7.414 | | 0.696 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -7.416 | | 0.695 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -7.424 | | 0.696 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -7.406 | | 0.695 | | 517.579 | | 92.299 | | 0.104 | |
| Informer | | unuse | | - | - | | - | | - | | -7.59 | | 0.716 | | 551.166 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -7.503 | | 0.707 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -7.493 | | 0.707 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -7.493 | | 0.707 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -7.494 | | 0.697 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -7.497 | | 0.689 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -7.497 | | 0.689 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -7.477 | | 0.7 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -7.461 | | 0.701 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -7.474 | | 0.69 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -7.466 | | 0.697 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -7.517 | | 0.692 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -7.486 | | 0.703 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -7.442 | | 0.689 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -7.418 | | 0.683 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -7.418 | | 0.683 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -7.452 | | 0.693 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -7.418 | | 0.683 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -7.418 | | 0.683 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -7.437 | | 0.688 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -7.436 | | 0.688 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -7.44 | | 0.692 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -7.458 | | 0.69 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -7.439 | | 0.691 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -7.458 | | 0.689 | | 572.138 | | 104.305 | | 0.114 | |

#### 5->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -5.373 | 0.602 | 0.066 | 0.066 |
| CNN | unuse | - | - | - | - | -6.523 | 0.652 | 0.618 | 0.367 |
| CNN | use | spatial | first | CFR | L1 | -6.316 | 0.643 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L2 | -6.317 | 0.643 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L3 | -6.317 | 0.643 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L1 | -6.273 | 0.641 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L2 | -6.271 | 0.641 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L3 | -6.271 | 0.641 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L1 | -6.256 | 0.639 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L2 | -6.256 | 0.639 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L3 | -6.254 | 0.639 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L1 | -6.274 | 0.64 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L2 | -6.271 | 0.641 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L3 | -6.27 | 0.64 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L1 | -6.044 | 0.631 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L2 | -6.043 | 0.631 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L3 | -6.043 | 0.631 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L1 | -6.045 | 0.632 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L2 | -6.043 | 0.631 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L3 | -6.043 | 0.631 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L1 | -6.048 | 0.632 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L2 | -6.044 | 0.632 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L3 | -6.043 | 0.632 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L1 | -6.05 | 0.632 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L2 | -6.05 | 0.633 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L3 | -6.048 | 0.633 | 0.623 | 0.368 |
| CVCNN | unuse | - | - | - | - | -6.556 | 0.672 | 1.984 | 0.563 |
| CVCNN | use | spatial | first | CFR | L1 | -6.262 | 0.663 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L2 | -6.264 | 0.663 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L3 | -6.264 | 0.663 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L1 | -6.195 | 0.661 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L2 | -6.198 | 0.658 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L3 | -6.198 | 0.658 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L1 | -6.209 | 0.657 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L2 | -6.21 | 0.658 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L3 | -6.21 | 0.658 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L1 | -6.208 | 0.66 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L2 | -6.208 | 0.66 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L3 | -6.204 | 0.66 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L1 | -6.083 | 0.639 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L2 | -6.083 | 0.639 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L3 | -6.083 | 0.639 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L1 | -6.081 | 0.638 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L2 | -6.083 | 0.639 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L3 | -6.083 | 0.639 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L1 | -6.072 | 0.64 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L2 | -6.07 | 0.64 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L3 | -6.065 | 0.64 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L1 | -6.074 | 0.64 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L2 | -6.073 | 0.64 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L3 | -6.07 | 0.64 | 1.989 | 0.564 |
| LSTM | unuse | - | - | - | - | -6.507 | 0.674 | 37.315 | 7.676 |
| LSTM | use | spatial | first | CFR | L1 | -6.319 | 0.66 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L2 | -6.321 | 0.66 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L3 | -6.321 | 0.66 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L1 | -6.252 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L2 | -6.251 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L3 | -6.251 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L1 | -6.284 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L2 | -6.287 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L3 | -6.289 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L1 | -6.232 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L2 | -6.221 | 0.658 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L3 | -6.226 | 0.658 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L1 | -5.962 | 0.645 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L2 | -5.959 | 0.645 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L3 | -5.959 | 0.645 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L1 | -5.964 | 0.645 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L2 | -5.959 | 0.645 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L3 | -5.959 | 0.645 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L1 | -5.96 | 0.646 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L2 | -5.962 | 0.646 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L3 | -5.968 | 0.646 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L1 | -5.965 | 0.647 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L2 | -5.975 | 0.646 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L3 | -5.969 | 0.645 | 37.32 | 7.678 |

#### 5->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -4.109 | 0.544 | 0.082 | 0.083 |
| CNN | unuse | - | - | - | - | -5.858 | 0.623 | 0.635 | 0.383 |
| CNN | use | spatial | first | CFR | L1 | -5.658 | 0.614 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L2 | -5.659 | 0.613 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L3 | -5.659 | 0.613 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L1 | -5.618 | 0.612 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L2 | -5.618 | 0.612 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L3 | -5.618 | 0.612 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L1 | -5.605 | 0.608 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L2 | -5.605 | 0.608 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L3 | -5.602 | 0.609 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L1 | -5.587 | 0.61 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L2 | -5.61 | 0.611 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L3 | -5.611 | 0.611 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L1 | -5.348 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L2 | -5.347 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L3 | -5.347 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L1 | -5.341 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L2 | -5.347 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L3 | -5.347 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L1 | -5.333 | 0.595 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L2 | -5.339 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L3 | -5.339 | 0.596 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L1 | -5.341 | 0.597 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L2 | -5.343 | 0.597 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L3 | -5.342 | 0.597 | 0.64 | 0.384 |
| CVCNN | unuse | - | - | - | - | -5.876 | 0.644 | 2.0 | 0.579 |
| CVCNN | use | spatial | first | CFR | L1 | -5.647 | 0.635 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L2 | -5.649 | 0.635 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L3 | -5.649 | 0.635 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L1 | -5.6 | 0.633 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L2 | -5.6 | 0.633 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L3 | -5.6 | 0.633 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L1 | -5.599 | 0.629 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L2 | -5.602 | 0.63 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L3 | -5.601 | 0.63 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L1 | -5.602 | 0.631 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L2 | -5.606 | 0.631 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L3 | -5.602 | 0.631 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L1 | -5.39 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L2 | -5.392 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L3 | -5.392 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L1 | -5.381 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L2 | -5.392 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L3 | -5.392 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L1 | -5.375 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L2 | -5.386 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L3 | -5.382 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L1 | -5.379 | 0.607 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L2 | -5.384 | 0.608 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L3 | -5.385 | 0.608 | 2.006 | 0.58 |
| LSTM | unuse | - | - | - | - | -5.784 | 0.644 | 37.331 | 7.693 |
| LSTM | use | spatial | first | CFR | L1 | -5.647 | 0.635 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L2 | -5.646 | 0.635 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L3 | -5.646 | 0.635 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L1 | -5.511 | 0.627 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L2 | -5.51 | 0.627 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L3 | -5.51 | 0.627 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L1 | -5.612 | 0.632 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L2 | -5.612 | 0.632 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L3 | -5.614 | 0.632 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L1 | -5.511 | 0.63 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L2 | -5.513 | 0.63 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L3 | -5.51 | 0.63 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L1 | -5.267 | 0.612 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L2 | -5.264 | 0.613 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L3 | -5.264 | 0.613 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L1 | -5.259 | 0.612 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L2 | -5.264 | 0.613 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L3 | -5.264 | 0.613 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L1 | -5.25 | 0.612 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L2 | -5.259 | 0.612 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L3 | -5.259 | 0.613 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L1 | -5.269 | 0.613 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L2 | -5.267 | 0.612 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L3 | -5.269 | 0.613 | 37.336 | 7.694 |

#### 10->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | | domain | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | |
| MLP | unuse | | | - | | - | | - | | - | | -7.301 | | 0.68 | | 0.36 | | 0.362 | |
| CNN | unuse | | | - | | - | | - | | - | | -7.642 | | 0.702 | | 2.204 | | 1.294 | |
| CNN | use | | | spatial | | first | | CFR | | L1 | | -7.518 | | 0.693 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | first | | CFR | | L2 | | -7.518 | | 0.693 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | first | | CFR | | L3 | | -7.518 | | 0.693 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | first | | CIR | | L1 | | -7.532 | | 0.691 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | first | | CIR | | L2 | | -7.536 | | 0.691 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | first | | CIR | | L3 | | -7.536 | | 0.691 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | second | | CFR | | L1 | | -7.509 | | 0.69 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | second | | CFR | | L2 | | -7.508 | | 0.69 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | second | | CFR | | L3 | | -7.506 | | 0.69 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | second | | CIR | | L1 | | -7.528 | | 0.692 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | second | | CIR | | L2 | | -7.524 | | 0.692 | | 2.215 | | 1.295 | |
| CNN | use | | | spatial | | second | | CIR | | L3 | | -7.526 | | 0.691 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | first | | CFR | | L1 | | -7.426 | | 0.693 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | first | | CFR | | L2 | | -7.433 | | 0.694 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | first | | CFR | | L3 | | -7.433 | | 0.694 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | first | | CIR | | L1 | | -7.428 | | 0.695 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | first | | CIR | | L2 | | -7.433 | | 0.694 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | first | | CIR | | L3 | | -7.433 | | 0.694 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | second | | CFR | | L1 | | -7.42 | | 0.693 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | second | | CFR | | L2 | | -7.436 | | 0.695 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | second | | CFR | | L3 | | -7.429 | | 0.695 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | second | | CIR | | L1 | | -7.419 | | 0.695 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | second | | CIR | | L2 | | -7.444 | | 0.697 | | 2.215 | | 1.295 | |
| CNN | use | | | temporal | | second | | CIR | | L3 | | -7.424 | | 0.695 | | 2.215 | | 1.295 | |
| CVCNN | unuse | | | - | | - | | - | | - | | -7.683 | | 0.72 | | 6.311 | | 1.49 | |
| CVCNN | use | | | spatial | | first | | CFR | | L1 | | -7.54 | | 0.71 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | first | | CFR | | L2 | | -7.54 | | 0.71 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | first | | CFR | | L3 | | -7.54 | | 0.71 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | first | | CIR | | L1 | | -7.554 | | 0.711 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | first | | CIR | | L2 | | -7.554 | | 0.71 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | first | | CIR | | L3 | | -7.554 | | 0.71 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | second | | CFR | | L1 | | -7.546 | | 0.708 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | second | | CFR | | L2 | | -7.543 | | 0.708 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | second | | CFR | | L3 | | -7.541 | | 0.707 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | second | | CIR | | L1 | | -7.543 | | 0.709 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | second | | CIR | | L2 | | -7.547 | | 0.708 | | 6.322 | | 1.491 | |
| CVCNN | use | | | spatial | | second | | CIR | | L3 | | -7.539 | | 0.707 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | first | | CFR | | L1 | | -7.399 | | 0.693 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | first | | CFR | | L2 | | -7.404 | | 0.694 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | first | | CFR | | L3 | | -7.404 | | 0.694 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | first | | CIR | | L1 | | -7.4 | | 0.694 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | first | | CIR | | L2 | | -7.404 | | 0.694 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | first | | CIR | | L3 | | -7.404 | | 0.694 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | second | | CFR | | L1 | | -7.352 | | 0.694 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | second | | CFR | | L2 | | -7.371 | | 0.696 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | second | | CFR | | L3 | | -7.352 | | 0.697 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | second | | CIR | | L1 | | -7.361 | | 0.695 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | second | | CIR | | L2 | | -7.388 | | 0.697 | | 6.322 | | 1.491 | |
| CVCNN | use | | | temporal | | second | | CIR | | L3 | | -7.361 | | 0.696 | | 6.322 | | 1.491 | |
| LSTM | unuse | | | - | | - | | - | | - | | -7.753 | | 0.721 | | 1181.254 | | 121.866 | |
| LSTM | use | | | spatial | | first | | CFR | | L1 | | -7.417 | | 0.703 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | first | | CFR | | L2 | | -7.42 | | 0.703 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | first | | CFR | | L3 | | -7.42 | | 0.703 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | first | | CIR | | L1 | | -7.408 | | 0.707 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | first | | CIR | | L2 | | -7.405 | | 0.706 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | first | | CIR | | L3 | | -7.405 | | 0.706 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | second | | CFR | | L1 | | -7.42 | | 0.706 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | second | | CFR | | L2 | | -7.416 | | 0.705 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | second | | CFR | | L3 | | -7.413 | | 0.705 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | second | | CIR | | L1 | | -7.431 | | 0.697 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | second | | CIR | | L2 | | -7.465 | | 0.704 | | 1181.264 | | 121.867 | |
| LSTM | use | | | spatial | | second | | CIR | | L3 | | -7.464 | | 0.705 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | first | | CFR | | L1 | | -7.45 | | 0.702 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | first | | CFR | | L2 | | -7.45 | | 0.702 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | first | | CFR | | L3 | | -7.45 | | 0.702 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | first | | CIR | | L1 | | -7.432 | | 0.702 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | first | | CIR | | L2 | | -7.45 | | 0.702 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | first | | CIR | | L3 | | -7.45 | | 0.702 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | second | | CFR | | L1 | | -7.453 | | 0.703 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | second | | CFR | | L2 | | -7.386 | | 0.699 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | second | | CFR | | L3 | | -7.396 | | 0.701 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | second | | CIR | | L1 | | -7.453 | | 0.704 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | second | | CIR | | L2 | | -7.467 | | 0.705 | | 1181.264 | | 121.867 | |
| LSTM | use | | | temporal | | second | | CIR | | L3 | | -7.444 | | 0.705 | | 1181.264 | | 121.867 | |
| Model | | Embed | domain | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | - | | - | | - | | - | | -7.718 | | 0.716 | | 959.496 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | first | | CFR | | L1 | | -7.714 | | 0.716 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | first | | CFR | | L2 | | -7.713 | | 0.715 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | first | | CFR | | L3 | | -7.713 | | 0.715 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | first | | CIR | | L1 | | -7.687 | | 0.706 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | first | | CIR | | L2 | | -7.673 | | 0.706 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | first | | CIR | | L3 | | -7.673 | | 0.706 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | second | | CFR | | L1 | | -7.541 | | 0.7 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | second | | CFR | | L2 | | -7.556 | | 0.699 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | second | | CFR | | L3 | | -7.539 | | 0.698 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | second | | CIR | | L1 | | -7.602 | | 0.702 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | second | | CIR | | L2 | | -7.639 | | 0.707 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | spatial | | second | | CIR | | L3 | | -7.695 | | 0.71 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | temporal | | first | | CFR | | L1 | | -7.614 | | 0.695 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | first | | CFR | | L2 | | -7.651 | | 0.697 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | first | | CFR | | L3 | | -7.651 | | 0.697 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | first | | CIR | | L1 | | -7.631 | | 0.696 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | first | | CIR | | L2 | | -7.651 | | 0.697 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | first | | CIR | | L3 | | -7.651 | | 0.697 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | second | | CFR | | L1 | | -7.638 | | 0.702 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | second | | CFR | | L2 | | -7.621 | | 0.696 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | second | | CFR | | L3 | | -7.651 | | 0.7 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | second | | CIR | | L1 | | -7.59 | | 0.698 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | second | | CIR | | L2 | | -7.633 | | 0.703 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | temporal | | second | | CIR | | L3 | | -7.65 | | 0.701 | | 1001.439 | | 92.299 | | 0.2 | |
| Informer | | unuse | - | | - | | - | | - | | -7.748 | | 0.718 | | 976.273 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | first | | CFR | | L1 | | -7.666 | | 0.714 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | first | | CFR | | L2 | | -7.673 | | 0.715 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | first | | CFR | | L3 | | -7.673 | | 0.715 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | first | | CIR | | L1 | | -7.661 | | 0.702 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | first | | CIR | | L2 | | -7.654 | | 0.698 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | first | | CIR | | L3 | | -7.654 | | 0.698 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | second | | CFR | | L1 | | -7.573 | | 0.702 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | second | | CFR | | L2 | | -7.463 | | 0.691 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | second | | CFR | | L3 | | -7.471 | | 0.691 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | second | | CIR | | L1 | | -7.629 | | 0.707 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | second | | CIR | | L2 | | -7.598 | | 0.704 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | spatial | | second | | CIR | | L3 | | -7.58 | | 0.699 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | temporal | | first | | CFR | | L1 | | -7.567 | | 0.691 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | first | | CFR | | L2 | | -7.57 | | 0.691 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | first | | CFR | | L3 | | -7.57 | | 0.691 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | first | | CIR | | L1 | | -7.57 | | 0.691 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | first | | CIR | | L2 | | -7.57 | | 0.691 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | first | | CIR | | L3 | | -7.57 | | 0.691 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | second | | CFR | | L1 | | -7.541 | | 0.689 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | second | | CFR | | L2 | | -7.568 | | 0.69 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | second | | CFR | | L3 | | -7.544 | | 0.692 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | second | | CIR | | L1 | | -7.566 | | 0.694 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | second | | CIR | | L2 | | -7.572 | | 0.69 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | temporal | | second | | CIR | | L3 | | -7.561 | | 0.693 | | 1018.216 | | 104.305 | | 0.204 | |

#### 10->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -6.56 | 0.656 | 0.426 | 0.428 |
| CNN | unuse | - | - | - | - | -7.023 | 0.671 | 2.27 | 1.359 |
| CNN | use | spatial | first | CFR | L1 | -6.981 | 0.673 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L2 | -6.982 | 0.673 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L3 | -6.982 | 0.673 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L1 | -6.983 | 0.666 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L2 | -6.985 | 0.666 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L3 | -6.985 | 0.666 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L1 | -6.962 | 0.673 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L2 | -6.965 | 0.673 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L3 | -6.964 | 0.672 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L1 | -6.976 | 0.662 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L2 | -6.974 | 0.662 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L3 | -6.973 | 0.661 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L1 | -6.943 | 0.661 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L2 | -6.943 | 0.661 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L3 | -6.943 | 0.661 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L1 | -6.9 | 0.657 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L2 | -6.943 | 0.661 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L3 | -6.943 | 0.661 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L1 | -6.906 | 0.658 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L2 | -6.899 | 0.658 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L3 | -6.902 | 0.658 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L1 | -6.935 | 0.661 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L2 | -6.904 | 0.659 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L3 | -6.902 | 0.659 | 2.28 | 1.36 |
| CVCNN | unuse | - | - | - | - | -7.159 | 0.686 | 6.377 | 1.556 |
| CVCNN | use | spatial | first | CFR | L1 | -7.118 | 0.682 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L2 | -7.118 | 0.683 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L3 | -7.118 | 0.683 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L1 | -7.136 | 0.686 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L2 | -7.138 | 0.687 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L3 | -7.138 | 0.687 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L1 | -7.11 | 0.681 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L2 | -7.113 | 0.681 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L3 | -7.111 | 0.681 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L1 | -7.113 | 0.682 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L2 | -7.111 | 0.682 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L3 | -7.112 | 0.682 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L1 | -6.895 | 0.665 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L2 | -6.895 | 0.666 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L3 | -6.895 | 0.666 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L1 | -6.89 | 0.666 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L2 | -6.895 | 0.666 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L3 | -6.895 | 0.666 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L1 | -6.888 | 0.665 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L2 | -6.89 | 0.666 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L3 | -6.893 | 0.667 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L1 | -6.885 | 0.666 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L2 | -6.891 | 0.667 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L3 | -6.889 | 0.668 | 6.387 | 1.556 |
| LSTM | unuse | - | - | - | - | -7.072 | 0.685 | 1181.319 | 121.932 |
| LSTM | use | spatial | first | CFR | L1 | -6.905 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L2 | -6.889 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L3 | -6.889 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L1 | -6.882 | 0.674 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L2 | -6.889 | 0.675 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L3 | -6.889 | 0.675 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L1 | -6.892 | 0.671 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L2 | -6.889 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L3 | -6.888 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L1 | -6.87 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L2 | -6.871 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L3 | -6.857 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L1 | -6.865 | 0.671 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L2 | -6.81 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L3 | -6.81 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L1 | -6.824 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L2 | -6.81 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L3 | -6.81 | 0.672 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L1 | -6.83 | 0.673 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L2 | -6.822 | 0.673 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L3 | -6.814 | 0.674 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L1 | -6.862 | 0.673 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L2 | -6.856 | 0.673 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L3 | -6.792 | 0.675 | 1181.329 | 121.933 |

#### 10->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -6.014 | 0.641 | 0.491 | 0.494 |
| CNN | unuse | - | - | - | - | -6.474 | 0.645 | 2.336 | 1.425 |
| CNN | use | spatial | first | CFR | L1 | -6.707 | 0.651 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L2 | -6.707 | 0.651 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L3 | -6.707 | 0.651 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L1 | -6.673 | 0.654 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L2 | -6.677 | 0.654 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L3 | -6.677 | 0.654 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L1 | -6.659 | 0.649 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L2 | -6.66 | 0.649 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L3 | -6.662 | 0.649 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L1 | -6.643 | 0.648 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L2 | -6.632 | 0.648 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L3 | -6.642 | 0.648 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L1 | -6.56 | 0.643 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L2 | -6.565 | 0.644 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L3 | -6.565 | 0.644 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L1 | -6.551 | 0.643 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L2 | -6.565 | 0.644 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L3 | -6.565 | 0.644 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L1 | -6.527 | 0.641 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L2 | -6.463 | 0.638 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L3 | -6.481 | 0.639 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L1 | -6.546 | 0.643 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L2 | -6.47 | 0.64 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L3 | -6.476 | 0.64 | 2.346 | 1.426 |
| CVCNN | unuse | - | - | - | - | -6.713 | 0.669 | 6.442 | 1.621 |
| CVCNN | use | spatial | first | CFR | L1 | -6.766 | 0.668 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L2 | -6.767 | 0.668 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L3 | -6.767 | 0.668 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L1 | -6.735 | 0.672 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L2 | -6.743 | 0.669 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L3 | -6.743 | 0.669 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L1 | -6.751 | 0.667 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L2 | -6.749 | 0.667 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L3 | -6.748 | 0.667 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L1 | -6.746 | 0.669 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L2 | -6.747 | 0.669 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L3 | -6.743 | 0.669 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L1 | -6.528 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L2 | -6.528 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L3 | -6.528 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L1 | -6.518 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L2 | -6.528 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L3 | -6.528 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L1 | -6.498 | 0.652 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L2 | -6.499 | 0.652 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L3 | -6.504 | 0.653 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L1 | -6.511 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L2 | -6.513 | 0.654 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L3 | -6.496 | 0.653 | 6.453 | 1.622 |
| LSTM | unuse | - | - | - | - | -6.615 | 0.665 | 1181.385 | 121.997 |
| LSTM | use | spatial | first | CFR | L1 | -6.627 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L2 | -6.625 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L3 | -6.625 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L1 | -6.556 | 0.662 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L2 | -6.626 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L3 | -6.626 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L1 | -6.554 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L2 | -6.553 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L3 | -6.546 | 0.661 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L1 | -6.555 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L2 | -6.602 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L3 | -6.606 | 0.66 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L1 | -6.428 | 0.649 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L2 | -6.365 | 0.647 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L3 | -6.365 | 0.647 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L1 | -6.357 | 0.645 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L2 | -6.365 | 0.647 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L3 | -6.365 | 0.647 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L1 | -6.338 | 0.648 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L2 | -6.37 | 0.643 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L3 | -6.381 | 0.644 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L1 | -6.385 | 0.645 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L2 | -6.383 | 0.645 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L3 | -6.378 | 0.645 | 1181.395 | 121.998 |

### Case4

#### 5->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -7.664 | | 0.728 | | 0.049 | | 0.05 | |
| CNN | unuse | | - | | | - | | - | | - | | -9.043 | | 0.795 | | 0.602 | | 0.35 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -7.963 | | 0.722 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -7.964 | | 0.722 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -7.964 | | 0.722 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -7.903 | | 0.716 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -7.903 | | 0.715 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -7.903 | | 0.715 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -7.859 | | 0.712 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -7.863 | | 0.714 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -7.862 | | 0.714 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -7.884 | | 0.713 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -7.887 | | 0.714 | | 0.607 | | 0.351 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -7.884 | | 0.713 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -7.843 | | 0.729 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -7.839 | | 0.729 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -7.839 | | 0.729 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -7.849 | | 0.728 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -7.839 | | 0.729 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -7.839 | | 0.729 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -7.858 | | 0.729 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -7.843 | | 0.728 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -7.844 | | 0.728 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -7.856 | | 0.729 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -7.856 | | 0.728 | | 0.607 | | 0.351 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -7.854 | | 0.728 | | 0.607 | | 0.351 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -9.004 | | 0.802 | | 1.968 | | 0.546 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -8.0 | | 0.752 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -8.003 | | 0.752 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -8.003 | | 0.752 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -7.935 | | 0.744 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -7.936 | | 0.744 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -7.936 | | 0.744 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -7.919 | | 0.744 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -7.921 | | 0.744 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -7.921 | | 0.744 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -7.928 | | 0.743 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -7.922 | | 0.743 | | 1.973 | | 0.547 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -7.916 | | 0.744 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -7.833 | | 0.73 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -7.832 | | 0.73 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -7.832 | | 0.73 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -7.83 | | 0.731 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -7.832 | | 0.73 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -7.832 | | 0.73 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -7.823 | | 0.731 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -7.826 | | 0.73 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -7.825 | | 0.73 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -7.824 | | 0.731 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -7.831 | | 0.731 | | 1.973 | | 0.547 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -7.838 | | 0.731 | | 1.973 | | 0.547 | |
| LSTM | unuse | | - | | | - | | - | | - | | -9.0 | | 0.8 | | 37.298 | | 7.66 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -7.914 | | 0.761 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -7.919 | | 0.761 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -7.919 | | 0.761 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -7.875 | | 0.746 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -7.874 | | 0.747 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -7.874 | | 0.747 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -7.863 | | 0.757 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -7.856 | | 0.756 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -7.857 | | 0.756 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -7.858 | | 0.747 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -7.855 | | 0.745 | | 37.303 | | 7.661 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -7.852 | | 0.745 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -8.067 | | 0.752 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -8.067 | | 0.751 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -8.067 | | 0.751 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -8.085 | | 0.753 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -8.067 | | 0.751 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -8.067 | | 0.751 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -8.053 | | 0.752 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -8.067 | | 0.749 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -8.074 | | 0.751 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -8.062 | | 0.751 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -8.072 | | 0.75 | | 37.303 | | 7.661 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -8.074 | | 0.75 | | 37.303 | | 7.661 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -8.716 | | 0.783 | | 496.607 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -8.651 | | 0.782 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -8.557 | | 0.771 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -8.557 | | 0.771 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -8.588 | | 0.777 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -8.587 | | 0.776 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -8.587 | | 0.776 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -8.503 | | 0.766 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -8.501 | | 0.768 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -8.502 | | 0.768 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -8.727 | | 0.79 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -8.657 | | 0.781 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -8.651 | | 0.784 | | 497.099 | | 88.297 | | 0.099 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -8.507 | | 0.756 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -8.501 | | 0.756 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -8.501 | | 0.756 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -8.536 | | 0.758 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -8.501 | | 0.756 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -8.501 | | 0.756 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -8.506 | | 0.755 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -8.502 | | 0.755 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -8.525 | | 0.755 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -8.508 | | 0.755 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -8.522 | | 0.756 | | 517.579 | | 92.299 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -8.541 | | 0.755 | | 517.579 | | 92.299 | | 0.104 | |
| Informer | | unuse | | - | - | | - | | - | | -9.28 | | 0.808 | | 551.166 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -8.809 | | 0.787 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -8.795 | | 0.79 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -8.795 | | 0.79 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -8.83 | | 0.786 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -8.85 | | 0.786 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -8.85 | | 0.786 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -8.805 | | 0.783 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -8.823 | | 0.773 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -8.816 | | 0.785 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -8.868 | | 0.793 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -8.811 | | 0.788 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -8.876 | | 0.785 | | 551.658 | | 100.303 | | 0.11 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -8.642 | | 0.766 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -8.702 | | 0.761 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -8.702 | | 0.761 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -8.657 | | 0.767 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -8.702 | | 0.761 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -8.702 | | 0.761 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -8.626 | | 0.759 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -8.646 | | 0.768 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -8.621 | | 0.767 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -8.557 | | 0.764 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -8.599 | | 0.761 | | 572.138 | | 104.305 | | 0.114 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -8.604 | | 0.762 | | 572.138 | | 104.305 | | 0.114 | |

#### 5->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -6.092 | 0.665 | 0.066 | 0.066 |
| CNN | unuse | - | - | - | - | -7.553 | 0.714 | 0.618 | 0.367 |
| CNN | use | spatial | first | CFR | L1 | -7.195 | 0.695 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L2 | -7.195 | 0.695 | 0.623 | 0.368 |
| CNN | use | spatial | first | CFR | L3 | -7.195 | 0.695 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L1 | -7.131 | 0.692 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L2 | -7.131 | 0.693 | 0.623 | 0.368 |
| CNN | use | spatial | first | CIR | L3 | -7.131 | 0.693 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L1 | -7.133 | 0.694 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L2 | -7.133 | 0.693 | 0.623 | 0.368 |
| CNN | use | spatial | second | CFR | L3 | -7.134 | 0.694 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L1 | -7.151 | 0.693 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L2 | -7.152 | 0.693 | 0.623 | 0.368 |
| CNN | use | spatial | second | CIR | L3 | -7.149 | 0.692 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L1 | -6.98 | 0.686 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L2 | -6.98 | 0.686 | 0.623 | 0.368 |
| CNN | use | temporal | first | CFR | L3 | -6.98 | 0.686 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L1 | -6.983 | 0.687 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L2 | -6.98 | 0.686 | 0.623 | 0.368 |
| CNN | use | temporal | first | CIR | L3 | -6.98 | 0.686 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L1 | -6.977 | 0.687 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L2 | -6.978 | 0.687 | 0.623 | 0.368 |
| CNN | use | temporal | second | CFR | L3 | -6.979 | 0.688 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L1 | -6.973 | 0.688 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L2 | -6.983 | 0.687 | 0.623 | 0.368 |
| CNN | use | temporal | second | CIR | L3 | -6.987 | 0.688 | 0.623 | 0.368 |
| CVCNN | unuse | - | - | - | - | -7.634 | 0.732 | 1.984 | 0.563 |
| CVCNN | use | spatial | first | CFR | L1 | -7.195 | 0.719 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L2 | -7.195 | 0.719 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CFR | L3 | -7.195 | 0.719 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L1 | -7.142 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L2 | -7.142 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | spatial | first | CIR | L3 | -7.142 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L1 | -7.114 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L2 | -7.116 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CFR | L3 | -7.118 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L1 | -7.125 | 0.713 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L2 | -7.124 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | spatial | second | CIR | L3 | -7.132 | 0.714 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L1 | -6.984 | 0.692 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L2 | -6.988 | 0.692 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CFR | L3 | -6.988 | 0.692 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L1 | -6.995 | 0.692 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L2 | -6.988 | 0.692 | 1.989 | 0.564 |
| CVCNN | use | temporal | first | CIR | L3 | -6.988 | 0.692 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L1 | -6.99 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L2 | -6.993 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CFR | L3 | -6.994 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L1 | -6.992 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L2 | -6.997 | 0.691 | 1.989 | 0.564 |
| CVCNN | use | temporal | second | CIR | L3 | -7.004 | 0.691 | 1.989 | 0.564 |
| LSTM | unuse | - | - | - | - | -7.616 | 0.748 | 37.315 | 7.676 |
| LSTM | use | spatial | first | CFR | L1 | -6.994 | 0.703 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L2 | -6.994 | 0.703 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CFR | L3 | -6.994 | 0.703 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L1 | -6.934 | 0.698 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L2 | -6.934 | 0.698 | 37.32 | 7.678 |
| LSTM | use | spatial | first | CIR | L3 | -6.934 | 0.698 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L1 | -6.945 | 0.698 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L2 | -6.944 | 0.699 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CFR | L3 | -6.945 | 0.699 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L1 | -6.88 | 0.693 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L2 | -6.911 | 0.7 | 37.32 | 7.678 |
| LSTM | use | spatial | second | CIR | L3 | -6.91 | 0.699 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L1 | -6.907 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L2 | -6.905 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CFR | L3 | -6.905 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L1 | -6.906 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L2 | -6.905 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | first | CIR | L3 | -6.905 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L1 | -6.896 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L2 | -6.892 | 0.699 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CFR | L3 | -6.896 | 0.7 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L1 | -6.896 | 0.699 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L2 | -6.899 | 0.699 | 37.32 | 7.678 |
| LSTM | use | temporal | second | CIR | L3 | -6.906 | 0.699 | 37.32 | 7.678 |

#### 5->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -4.581 | 0.588 | 0.082 | 0.083 |
| CNN | unuse | - | - | - | - | -6.774 | 0.678 | 0.635 | 0.383 |
| CNN | use | spatial | first | CFR | L1 | -6.538 | 0.669 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L2 | -6.537 | 0.669 | 0.64 | 0.384 |
| CNN | use | spatial | first | CFR | L3 | -6.537 | 0.669 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L1 | -6.493 | 0.66 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L2 | -6.492 | 0.659 | 0.64 | 0.384 |
| CNN | use | spatial | first | CIR | L3 | -6.492 | 0.659 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L1 | -6.491 | 0.667 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L2 | -6.494 | 0.667 | 0.64 | 0.384 |
| CNN | use | spatial | second | CFR | L3 | -6.492 | 0.667 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L1 | -6.477 | 0.658 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L2 | -6.481 | 0.659 | 0.64 | 0.384 |
| CNN | use | spatial | second | CIR | L3 | -6.479 | 0.659 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L1 | -6.193 | 0.641 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L2 | -6.194 | 0.642 | 0.64 | 0.384 |
| CNN | use | temporal | first | CFR | L3 | -6.194 | 0.642 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L1 | -6.203 | 0.643 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L2 | -6.194 | 0.642 | 0.64 | 0.384 |
| CNN | use | temporal | first | CIR | L3 | -6.194 | 0.642 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L1 | -6.201 | 0.645 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L2 | -6.206 | 0.646 | 0.64 | 0.384 |
| CNN | use | temporal | second | CFR | L3 | -6.207 | 0.646 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L1 | -6.204 | 0.646 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L2 | -6.215 | 0.646 | 0.64 | 0.384 |
| CNN | use | temporal | second | CIR | L3 | -6.215 | 0.646 | 0.64 | 0.384 |
| CVCNN | unuse | - | - | - | - | -6.825 | 0.698 | 2.0 | 0.579 |
| CVCNN | use | spatial | first | CFR | L1 | -6.482 | 0.689 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L2 | -6.48 | 0.69 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CFR | L3 | -6.48 | 0.69 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L1 | -6.436 | 0.688 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L2 | -6.438 | 0.688 | 2.006 | 0.58 |
| CVCNN | use | spatial | first | CIR | L3 | -6.438 | 0.688 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L1 | -6.433 | 0.684 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L2 | -6.437 | 0.684 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CFR | L3 | -6.418 | 0.685 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L1 | -6.428 | 0.683 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L2 | -6.42 | 0.683 | 2.006 | 0.58 |
| CVCNN | use | spatial | second | CIR | L3 | -6.418 | 0.683 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L1 | -6.263 | 0.661 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L2 | -6.263 | 0.661 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CFR | L3 | -6.263 | 0.661 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L1 | -6.275 | 0.661 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L2 | -6.263 | 0.661 | 2.006 | 0.58 |
| CVCNN | use | temporal | first | CIR | L3 | -6.263 | 0.661 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L1 | -6.255 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L2 | -6.267 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CFR | L3 | -6.268 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L1 | -6.258 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L2 | -6.27 | 0.662 | 2.006 | 0.58 |
| CVCNN | use | temporal | second | CIR | L3 | -6.266 | 0.662 | 2.006 | 0.58 |
| LSTM | unuse | - | - | - | - | -6.742 | 0.704 | 37.331 | 7.693 |
| LSTM | use | spatial | first | CFR | L1 | -6.356 | 0.678 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L2 | -6.355 | 0.678 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CFR | L3 | -6.355 | 0.678 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L1 | -6.272 | 0.673 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L2 | -6.27 | 0.672 | 37.336 | 7.694 |
| LSTM | use | spatial | first | CIR | L3 | -6.27 | 0.672 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L1 | -6.319 | 0.674 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L2 | -6.322 | 0.674 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CFR | L3 | -6.32 | 0.674 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L1 | -6.293 | 0.672 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L2 | -6.291 | 0.672 | 37.336 | 7.694 |
| LSTM | use | spatial | second | CIR | L3 | -6.293 | 0.672 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L1 | -6.072 | 0.661 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L2 | -6.07 | 0.661 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CFR | L3 | -6.07 | 0.661 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L1 | -6.092 | 0.661 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L2 | -6.07 | 0.661 | 37.336 | 7.694 |
| LSTM | use | temporal | first | CIR | L3 | -6.07 | 0.661 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L1 | -6.085 | 0.665 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L2 | -6.066 | 0.663 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CFR | L3 | -6.071 | 0.663 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L1 | -6.065 | 0.661 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L2 | -6.071 | 0.662 | 37.336 | 7.694 |
| LSTM | use | temporal | second | CIR | L3 | -6.072 | 0.661 | 37.336 | 7.694 |

#### 10->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | |
| MLP | unuse | | - | | | - | | - | | - | | -8.219 | | 0.75 | | 0.36 | | 0.362 | |
| CNN | unuse | | - | | | - | | - | | - | | -8.773 | | 0.776 | | 2.204 | | 1.294 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -8.246 | | 0.737 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -8.245 | | 0.737 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -8.245 | | 0.737 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -8.233 | | 0.746 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -8.237 | | 0.747 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -8.237 | | 0.747 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -8.214 | | 0.739 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -8.213 | | 0.738 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -8.199 | | 0.738 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -8.22 | | 0.744 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -8.24 | | 0.743 | | 2.215 | | 1.295 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -8.244 | | 0.742 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -8.284 | | 0.741 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -8.285 | | 0.742 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -8.285 | | 0.742 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -8.298 | | 0.744 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -8.285 | | 0.742 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -8.285 | | 0.742 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -8.28 | | 0.745 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -8.28 | | 0.743 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -8.283 | | 0.744 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -8.283 | | 0.745 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -8.286 | | 0.742 | | 2.215 | | 1.295 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -8.297 | | 0.743 | | 2.215 | | 1.295 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -8.733 | | 0.785 | | 6.311 | | 1.49 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -8.275 | | 0.764 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -8.273 | | 0.764 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -8.273 | | 0.764 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -8.274 | | 0.764 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -8.271 | | 0.763 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -8.271 | | 0.763 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -8.252 | | 0.763 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -8.254 | | 0.763 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -8.253 | | 0.763 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -8.235 | | 0.762 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -8.246 | | 0.761 | | 6.322 | | 1.491 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -8.241 | | 0.761 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -8.138 | | 0.742 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -8.138 | | 0.741 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -8.138 | | 0.741 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -8.15 | | 0.744 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -8.138 | | 0.741 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -8.138 | | 0.741 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -8.152 | | 0.742 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -8.149 | | 0.741 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -8.155 | | 0.743 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -8.148 | | 0.744 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -8.143 | | 0.741 | | 6.322 | | 1.491 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -8.152 | | 0.741 | | 6.322 | | 1.491 | |
| LSTM | unuse | | - | | | - | | - | | - | | -9.468 | | 0.815 | | 1181.254 | | 121.866 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -8.504 | | 0.778 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -8.511 | | 0.779 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -8.511 | | 0.779 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -8.666 | | 0.776 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -8.646 | | 0.776 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -8.646 | | 0.776 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -8.44 | | 0.773 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -8.461 | | 0.774 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -8.451 | | 0.774 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -8.527 | | 0.765 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -8.652 | | 0.772 | | 1181.264 | | 121.867 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -8.609 | | 0.774 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -8.665 | | 0.767 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -8.66 | | 0.769 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -8.66 | | 0.769 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -8.646 | | 0.768 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -8.66 | | 0.769 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -8.66 | | 0.769 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -8.655 | | 0.767 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -8.646 | | 0.766 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -8.645 | | 0.767 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -8.664 | | 0.771 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -8.651 | | 0.766 | | 1181.264 | | 121.867 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -8.644 | | 0.765 | | 1181.264 | | 121.867 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -8.876 | | 0.781 | | 959.496 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -8.747 | | 0.766 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -8.952 | | 0.776 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -8.952 | | 0.776 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -8.856 | | 0.776 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -8.803 | | 0.773 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -8.803 | | 0.773 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -8.762 | | 0.764 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -8.743 | | 0.761 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -8.74 | | 0.764 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -8.855 | | 0.78 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -8.913 | | 0.774 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -8.943 | | 0.779 | | 960.48 | | 88.297 | | 0.192 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -8.53 | | 0.741 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -8.562 | | 0.741 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -8.562 | | 0.741 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -8.516 | | 0.742 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -8.562 | | 0.741 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -8.562 | | 0.741 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -8.648 | | 0.754 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -8.654 | | 0.756 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -8.638 | | 0.754 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -8.636 | | 0.753 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -8.685 | | 0.754 | | 1001.439 | | 92.299 | | 0.2 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -8.578 | | 0.747 | | 1001.439 | | 92.299 | | 0.2 | |
| Informer | | unuse | | - | - | | - | | - | | -8.872 | | 0.779 | | 976.273 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -8.887 | | 0.781 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -8.915 | | 0.78 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -8.915 | | 0.78 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -8.824 | | 0.773 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -8.734 | | 0.768 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -8.734 | | 0.768 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -8.687 | | 0.771 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -8.731 | | 0.774 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -8.674 | | 0.773 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -8.738 | | 0.768 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -8.785 | | 0.776 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -8.781 | | 0.775 | | 977.257 | | 100.303 | | 0.195 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -8.604 | | 0.752 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -8.667 | | 0.757 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -8.667 | | 0.757 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -8.607 | | 0.753 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -8.667 | | 0.757 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -8.667 | | 0.757 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -8.642 | | 0.748 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -8.601 | | 0.748 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -8.666 | | 0.752 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -8.633 | | 0.752 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -8.62 | | 0.75 | | 1018.216 | | 104.305 | | 0.204 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -8.688 | | 0.751 | | 1018.216 | | 104.305 | | 0.204 | |

#### 10->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -7.333 | 0.712 | 0.426 | 0.428 |
| CNN | unuse | - | - | - | - | -7.715 | 0.718 | 2.27 | 1.359 |
| CNN | use | spatial | first | CFR | L1 | -7.622 | 0.716 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L2 | -7.623 | 0.716 | 2.28 | 1.36 |
| CNN | use | spatial | first | CFR | L3 | -7.623 | 0.716 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L1 | -7.654 | 0.719 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L2 | -7.652 | 0.719 | 2.28 | 1.36 |
| CNN | use | spatial | first | CIR | L3 | -7.652 | 0.719 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L1 | -7.634 | 0.715 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L2 | -7.628 | 0.715 | 2.28 | 1.36 |
| CNN | use | spatial | second | CFR | L3 | -7.627 | 0.715 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L1 | -7.635 | 0.717 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L2 | -7.647 | 0.717 | 2.28 | 1.36 |
| CNN | use | spatial | second | CIR | L3 | -7.645 | 0.717 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L1 | -7.629 | 0.713 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L2 | -7.603 | 0.713 | 2.28 | 1.36 |
| CNN | use | temporal | first | CFR | L3 | -7.603 | 0.713 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L1 | -7.643 | 0.712 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L2 | -7.603 | 0.713 | 2.28 | 1.36 |
| CNN | use | temporal | first | CIR | L3 | -7.603 | 0.713 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L1 | -7.618 | 0.71 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L2 | -7.624 | 0.712 | 2.28 | 1.36 |
| CNN | use | temporal | second | CFR | L3 | -7.63 | 0.712 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L1 | -7.613 | 0.711 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L2 | -7.624 | 0.711 | 2.28 | 1.36 |
| CNN | use | temporal | second | CIR | L3 | -7.617 | 0.711 | 2.28 | 1.36 |
| CVCNN | unuse | - | - | - | - | -7.842 | 0.742 | 6.377 | 1.556 |
| CVCNN | use | spatial | first | CFR | L1 | -7.709 | 0.738 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L2 | -7.708 | 0.738 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CFR | L3 | -7.708 | 0.738 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L1 | -7.745 | 0.74 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L2 | -7.746 | 0.74 | 6.387 | 1.556 |
| CVCNN | use | spatial | first | CIR | L3 | -7.746 | 0.74 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L1 | -7.702 | 0.736 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L2 | -7.703 | 0.736 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CFR | L3 | -7.704 | 0.737 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L1 | -7.742 | 0.737 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L2 | -7.749 | 0.737 | 6.387 | 1.556 |
| CVCNN | use | spatial | second | CIR | L3 | -7.736 | 0.738 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L1 | -7.57 | 0.716 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L2 | -7.573 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CFR | L3 | -7.573 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L1 | -7.567 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L2 | -7.573 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | first | CIR | L3 | -7.573 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L1 | -7.581 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L2 | -7.583 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CFR | L3 | -7.582 | 0.716 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L1 | -7.579 | 0.718 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L2 | -7.586 | 0.717 | 6.387 | 1.556 |
| CVCNN | use | temporal | second | CIR | L3 | -7.584 | 0.716 | 6.387 | 1.556 |
| LSTM | unuse | - | - | - | - | -8.135 | 0.771 | 1181.319 | 121.932 |
| LSTM | use | spatial | first | CFR | L1 | -7.707 | 0.73 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L2 | -7.683 | 0.73 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CFR | L3 | -7.683 | 0.73 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L1 | -7.698 | 0.733 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L2 | -7.685 | 0.733 | 1181.329 | 121.933 |
| LSTM | use | spatial | first | CIR | L3 | -7.685 | 0.733 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L1 | -7.644 | 0.729 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L2 | -7.662 | 0.73 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CFR | L3 | -7.653 | 0.731 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L1 | -7.671 | 0.731 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L2 | -7.659 | 0.729 | 1181.329 | 121.933 |
| LSTM | use | spatial | second | CIR | L3 | -7.634 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L1 | -7.648 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L2 | -7.604 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CFR | L3 | -7.604 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L1 | -7.636 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L2 | -7.604 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | first | CIR | L3 | -7.604 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L1 | -7.656 | 0.728 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L2 | -7.627 | 0.727 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CFR | L3 | -7.611 | 0.726 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L1 | -7.634 | 0.726 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L2 | -7.645 | 0.724 | 1181.329 | 121.933 |
| LSTM | use | temporal | second | CIR | L3 | -7.635 | 0.724 | 1181.329 | 121.933 |

#### 10->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -6.708 | 0.684 | 0.491 | 0.494 |
| CNN | unuse | - | - | - | - | -7.107 | 0.69 | 2.336 | 1.425 |
| CNN | use | spatial | first | CFR | L1 | -7.209 | 0.697 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L2 | -7.209 | 0.697 | 2.346 | 1.426 |
| CNN | use | spatial | first | CFR | L3 | -7.209 | 0.697 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L1 | -7.186 | 0.697 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L2 | -7.185 | 0.697 | 2.346 | 1.426 |
| CNN | use | spatial | first | CIR | L3 | -7.185 | 0.697 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L1 | -7.188 | 0.695 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L2 | -7.186 | 0.696 | 2.346 | 1.426 |
| CNN | use | spatial | second | CFR | L3 | -7.185 | 0.696 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L1 | -7.2 | 0.697 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L2 | -7.206 | 0.699 | 2.346 | 1.426 |
| CNN | use | spatial | second | CIR | L3 | -7.205 | 0.699 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L1 | -7.128 | 0.687 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L2 | -7.13 | 0.688 | 2.346 | 1.426 |
| CNN | use | temporal | first | CFR | L3 | -7.13 | 0.688 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L1 | -7.139 | 0.687 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L2 | -7.13 | 0.688 | 2.346 | 1.426 |
| CNN | use | temporal | first | CIR | L3 | -7.13 | 0.688 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L1 | -7.131 | 0.686 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L2 | -7.144 | 0.686 | 2.346 | 1.426 |
| CNN | use | temporal | second | CFR | L3 | -7.14 | 0.686 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L1 | -7.132 | 0.685 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L2 | -7.146 | 0.686 | 2.346 | 1.426 |
| CNN | use | temporal | second | CIR | L3 | -7.143 | 0.684 | 2.346 | 1.426 |
| CVCNN | unuse | - | - | - | - | -7.31 | 0.712 | 6.442 | 1.621 |
| CVCNN | use | spatial | first | CFR | L1 | -7.266 | 0.714 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L2 | -7.267 | 0.714 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CFR | L3 | -7.267 | 0.714 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L1 | -7.292 | 0.715 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L2 | -7.293 | 0.715 | 6.453 | 1.622 |
| CVCNN | use | spatial | first | CIR | L3 | -7.293 | 0.715 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L1 | -7.244 | 0.712 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L2 | -7.241 | 0.713 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CFR | L3 | -7.237 | 0.713 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L1 | -7.265 | 0.713 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L2 | -7.266 | 0.713 | 6.453 | 1.622 |
| CVCNN | use | spatial | second | CIR | L3 | -7.267 | 0.713 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L1 | -7.119 | 0.693 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L2 | -7.123 | 0.694 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CFR | L3 | -7.123 | 0.694 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L1 | -7.131 | 0.694 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L2 | -7.123 | 0.694 | 6.453 | 1.622 |
| CVCNN | use | temporal | first | CIR | L3 | -7.123 | 0.694 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L1 | -7.107 | 0.695 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L2 | -7.113 | 0.695 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CFR | L3 | -7.114 | 0.695 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L1 | -7.106 | 0.693 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L2 | -7.113 | 0.694 | 6.453 | 1.622 |
| CVCNN | use | temporal | second | CIR | L3 | -7.113 | 0.694 | 6.453 | 1.622 |
| LSTM | unuse | - | - | - | - | -7.315 | 0.721 | 1181.385 | 121.997 |
| LSTM | use | spatial | first | CFR | L1 | -7.187 | 0.709 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L2 | -7.188 | 0.709 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CFR | L3 | -7.188 | 0.709 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L1 | -7.17 | 0.71 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L2 | -7.181 | 0.71 | 1181.395 | 121.998 |
| LSTM | use | spatial | first | CIR | L3 | -7.181 | 0.71 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L1 | -7.178 | 0.709 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L2 | -7.185 | 0.709 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CFR | L3 | -7.177 | 0.708 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L1 | -7.178 | 0.71 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L2 | -7.178 | 0.71 | 1181.395 | 121.998 |
| LSTM | use | spatial | second | CIR | L3 | -7.184 | 0.71 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L1 | -7.019 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L2 | -7.009 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CFR | L3 | -7.009 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L1 | -7.051 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L2 | -7.009 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | temporal | first | CIR | L3 | -7.009 | 0.694 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L1 | -6.991 | 0.7 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L2 | -7.019 | 0.701 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CFR | L3 | -6.991 | 0.701 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L1 | -6.991 | 0.691 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L2 | -7.027 | 0.696 | 1181.395 | 121.998 |
| LSTM | use | temporal | second | CIR | L3 | -7.034 | 0.694 | 1181.395 | 121.998 |

### Case5

#### >1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -7.866 | | 0.945 | | 0.197 | | 0.197 | |
| CNN | unuse | | - | | | - | | - | | - | | -8.428 | | 0.95 | | 0.811 | | 0.412 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -9.104 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -9.125 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -9.125 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -9.12 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -9.125 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -9.125 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -9.133 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -9.09 | | 0.957 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -9.113 | | 0.957 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -9.148 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -9.144 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -9.131 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -9.199 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -9.198 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -9.198 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -9.198 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -9.198 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -9.198 | | 0.958 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -9.149 | | 0.957 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -9.163 | | 0.957 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -9.145 | | 0.957 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -9.154 | | 0.957 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -9.181 | | 0.957 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -9.171 | | 0.957 | | 0.893 | | 0.428 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -8.352 | | 0.951 | | 2.361 | | 0.608 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -9.463 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -9.458 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -9.458 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -9.454 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -9.458 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -9.458 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -9.498 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -9.51 | | 0.96 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -9.515 | | 0.96 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -9.498 | | 0.96 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -9.496 | | 0.96 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -9.496 | | 0.96 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -9.48 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -9.48 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -9.48 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -9.48 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -9.48 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -9.48 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -9.43 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -9.429 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -9.431 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -9.44 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -9.443 | | 0.959 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -9.46 | | 0.959 | | 2.443 | | 0.624 | |
| RNN | unuse | | - | | | - | | - | | - | | -8.913 | | 0.955 | | 9.665 | | 2.167 | |
| LSTM | unuse | | - | | | - | | - | | - | | -8.635 | | 0.951 | | 37.814 | | 7.783 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -9.034 | | 0.954 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -9.138 | | 0.955 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -9.138 | | 0.955 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -9.131 | | 0.956 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -9.138 | | 0.955 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -9.138 | | 0.955 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -9.008 | | 0.954 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -9.001 | | 0.954 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -9.002 | | 0.954 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -8.933 | | 0.953 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -8.968 | | 0.954 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -8.976 | | 0.954 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -9.412 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -9.411 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -9.411 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -9.411 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -9.411 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -9.411 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -9.388 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -9.375 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -9.391 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -9.393 | | 0.958 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -9.443 | | 0.959 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -9.381 | | 0.958 | | 37.896 | | 7.799 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -8.382 | | 0.95 | | 500.441 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -8.295 | | 0.949 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -8.138 | | 0.947 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -8.139 | | 0.947 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -7.89 | | 0.942 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -8.136 | | 0.947 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -8.137 | | 0.946 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -8.024 | | 0.945 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -8.247 | | 0.948 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -8.039 | | 0.945 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -8.281 | | 0.949 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -8.197 | | 0.948 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -8.053 | | 0.945 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -8.29 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -8.28 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -8.28 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -8.275 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -8.284 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -8.28 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -8.271 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -8.284 | | 0.949 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -8.333 | | 0.949 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -8.322 | | 0.949 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -8.355 | | 0.95 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -8.25 | | 0.948 | | 521.413 | | 92.955 | | 0.104 | |
| Informer | | unuse | | - | - | | - | | - | | -7.524 | | 0.937 | | 555.0 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -6.674 | | 0.918 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -6.755 | | 0.92 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -6.752 | | 0.921 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -6.971 | | 0.926 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -6.757 | | 0.921 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -7.072 | | 0.929 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -6.904 | | 0.924 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -7.232 | | 0.933 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -7.224 | | 0.932 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -7.142 | | 0.93 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -7.135 | | 0.931 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -6.835 | | 0.923 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -6.699 | | 0.919 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -6.654 | | 0.919 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -6.724 | | 0.921 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -6.724 | | 0.921 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -6.727 | | 0.921 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -6.731 | | 0.921 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -6.645 | | 0.918 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -6.707 | | 0.92 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -6.876 | | 0.924 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -6.942 | | 0.927 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -6.92 | | 0.926 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -6.954 | | 0.927 | | 575.971 | | 104.961 | | 0.115 | |

#### 5->3

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -7.619 | | 0.943 | | 0.262 | | 0.263 | |
| CNN | unuse | | - | | | - | | - | | - | | -8.375 | | 0.951 | | 0.876 | | 0.477 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -9.289 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -9.314 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -9.314 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -9.305 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -9.314 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -9.314 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -9.286 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -9.298 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -9.292 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -9.282 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -9.286 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -9.281 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -9.363 | | 0.959 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -9.363 | | 0.959 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -9.363 | | 0.959 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -9.363 | | 0.959 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -9.363 | | 0.959 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -9.363 | | 0.959 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -9.318 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -9.333 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -9.319 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -9.325 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -9.333 | | 0.958 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -9.325 | | 0.958 | | 0.958 | | 0.494 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -8.042 | | 0.949 | | 2.426 | | 0.673 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -9.153 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -9.133 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -9.133 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -9.124 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -9.133 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -9.133 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -9.134 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -9.129 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -9.187 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -9.172 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -9.196 | | 0.959 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -9.193 | | 0.959 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -9.095 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -9.094 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -9.094 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -9.094 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -9.094 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -9.094 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -9.086 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -9.081 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -9.099 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -9.078 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -9.083 | | 0.958 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -9.071 | | 0.958 | | 2.508 | | 0.69 | |
| RNN | unuse | | - | | | - | | - | | - | | -8.852 | | 0.957 | | 9.73 | | 2.233 | |
| LSTM | unuse | | - | | | - | | - | | - | | -8.721 | | 0.955 | | 37.88 | | 7.849 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -8.993 | | 0.957 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -8.996 | | 0.957 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -8.996 | | 0.957 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -9.019 | | 0.957 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -8.996 | | 0.957 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -8.996 | | 0.957 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -8.918 | | 0.956 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -8.926 | | 0.956 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -8.902 | | 0.956 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -8.892 | | 0.956 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -8.852 | | 0.956 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -8.898 | | 0.956 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -9.225 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -9.224 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -9.224 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -9.224 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -9.224 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -9.224 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -9.158 | | 0.958 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -9.208 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -9.202 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -9.157 | | 0.958 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -9.206 | | 0.959 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -9.214 | | 0.959 | | 37.962 | | 7.865 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | 0.87 | | 0.012 | | 568.664 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -4.457 | | 0.824 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -4.437 | | 0.823 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -4.437 | | 0.823 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -4.429 | | 0.822 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -4.437 | | 0.823 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -4.437 | | 0.823 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -4.541 | | 0.83 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -4.546 | | 0.83 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -4.55 | | 0.831 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -4.51 | | 0.827 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -4.491 | | 0.827 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -4.503 | | 0.828 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -4.386 | | 0.817 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -4.377 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -4.377 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -4.378 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -4.377 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -4.377 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -4.376 | | 0.817 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -4.38 | | 0.817 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -4.376 | | 0.817 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -4.367 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -4.377 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -4.374 | | 0.816 | | 589.636 | | 92.955 | | 0.118 | |
| Informer | | unuse | | - | - | | - | | - | | -6.886 | | 0.92 | | 623.223 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -6.241 | | 0.902 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -6.194 | | 0.9 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -6.194 | | 0.9 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -6.169 | | 0.899 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -6.194 | | 0.9 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -6.194 | | 0.9 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -6.435 | | 0.908 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -6.474 | | 0.909 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -6.422 | | 0.907 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -6.353 | | 0.906 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -6.343 | | 0.906 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -6.337 | | 0.906 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -6.22 | | 0.902 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -5.918 | | 0.891 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -5.918 | | 0.891 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -5.79 | | 0.886 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -5.918 | | 0.891 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -5.918 | | 0.891 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -6.184 | | 0.901 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -5.792 | | 0.886 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -6.189 | | 0.901 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -6.192 | | 0.901 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -6.197 | | 0.901 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -6.196 | | 0.901 | | 644.194 | | 104.961 | | 0.129 | |

#### 5->5

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -7.64 | | 0.944 | | 0.328 | | 0.329 | |
| CNN | unuse | | - | | | - | | - | | - | | -8.422 | | 0.953 | | 0.942 | | 0.543 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -9.409 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -9.415 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -9.415 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -9.41 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -9.415 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -9.415 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -9.398 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -9.393 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -9.388 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -9.4 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -9.397 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -9.401 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -9.44 | | 0.96 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -9.44 | | 0.96 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -9.44 | | 0.96 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -9.44 | | 0.96 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -9.44 | | 0.96 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -9.44 | | 0.96 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -9.399 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -9.37 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -9.406 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -9.404 | | 0.959 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -9.423 | | 0.96 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -9.396 | | 0.959 | | 1.024 | | 0.559 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -8.051 | | 0.951 | | 2.492 | | 0.739 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -9.11 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -9.102 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -9.102 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -9.088 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -9.102 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -9.102 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -9.165 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -9.166 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -9.161 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -9.129 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -9.133 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -9.127 | | 0.959 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -8.993 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -8.993 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -8.993 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -8.993 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -8.993 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -8.993 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -9.02 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -8.984 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -8.994 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -8.991 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -8.982 | | 0.958 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -8.975 | | 0.958 | | 2.574 | | 0.756 | |
| RNN | unuse | | - | | | - | | - | | - | | -8.857 | | 0.958 | | 9.796 | | 2.299 | |
| LSTM | unuse | | - | | | - | | - | | - | | -8.869 | | 0.958 | | 37.945 | | 7.914 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -9.015 | | 0.959 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -9.017 | | 0.959 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -9.017 | | 0.959 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -8.962 | | 0.958 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -9.017 | | 0.959 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -9.017 | | 0.959 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -8.959 | | 0.958 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -8.95 | | 0.958 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -8.947 | | 0.958 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -8.937 | | 0.958 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -8.849 | | 0.958 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -8.945 | | 0.958 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -9.238 | | 0.961 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -9.237 | | 0.961 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -9.237 | | 0.961 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -9.237 | | 0.961 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -9.237 | | 0.961 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -9.237 | | 0.961 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -9.185 | | 0.96 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -9.197 | | 0.96 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -9.18 | | 0.96 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -9.182 | | 0.96 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -9.195 | | 0.96 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -9.2 | | 0.96 | | 38.027 | | 7.931 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -5.917 | | 0.9 | | 636.887 | | 88.953 | | 0.127 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -5.034 | | 0.864 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -4.969 | | 0.86 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -4.969 | | 0.86 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -4.966 | | 0.86 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -4.969 | | 0.86 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -4.969 | | 0.86 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -5.095 | | 0.867 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -5.099 | | 0.867 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -5.107 | | 0.868 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -5.021 | | 0.864 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -5.021 | | 0.864 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -5.026 | | 0.864 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -5.297 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -5.293 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -5.293 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -5.29 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -5.293 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -5.293 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -5.318 | | 0.878 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -5.303 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -5.32 | | 0.878 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -5.295 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -5.31 | | 0.877 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -5.315 | | 0.878 | | 657.859 | | 92.955 | | 0.132 | |
| Informer | | unuse | | - | - | | - | | - | | -7.011 | | 0.925 | | 691.446 | | 100.959 | | 0.138 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -6.262 | | 0.905 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -6.211 | | 0.904 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -6.211 | | 0.904 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -6.187 | | 0.904 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -6.211 | | 0.904 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -6.211 | | 0.904 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -6.547 | | 0.914 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -6.525 | | 0.913 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -6.527 | | 0.914 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -6.404 | | 0.91 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -6.408 | | 0.91 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -6.394 | | 0.91 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -6.359 | | 0.909 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -6.325 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -6.325 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -6.322 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -6.325 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -6.325 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -6.34 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -6.34 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -6.326 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -6.339 | | 0.909 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -6.316 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -6.321 | | 0.908 | | 712.417 | | 104.961 | | 0.142 | |

#### 10->1

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -8.829 | | 0.955 | | 0.36 | | 0.361 | |
| CNN | unuse | | - | | | - | | - | | - | | -8.339 | | 0.949 | | 1.787 | | 0.543 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -9.328 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -9.326 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -9.326 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -9.334 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -9.326 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -9.326 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -9.302 | | 0.96 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -9.318 | | 0.96 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -9.283 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -9.315 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -9.382 | | 0.96 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -9.341 | | 0.96 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -9.336 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -9.336 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -9.336 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -9.336 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -9.336 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -9.336 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -9.297 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -9.305 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -9.304 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -9.318 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -9.307 | | 0.959 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -9.297 | | 0.959 | | 1.95 | | 0.559 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -8.561 | | 0.952 | | 5.476 | | 0.739 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -9.628 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -9.633 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -9.633 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -9.627 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -9.633 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -9.633 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -9.573 | | 0.96 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -9.634 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -9.515 | | 0.96 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -9.583 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -9.588 | | 0.96 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -9.578 | | 0.96 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -9.637 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -9.637 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -9.637 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -9.637 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -9.637 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -9.637 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -9.627 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -9.649 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -9.584 | | 0.96 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -9.643 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -9.622 | | 0.961 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -9.63 | | 0.961 | | 5.64 | | 0.755 | |
| RNN | unuse | | - | | | - | | - | | - | | -9.115 | | 0.957 | | 19.034 | | 2.167 | |
| LSTM | unuse | | - | | | - | | - | | - | | -8.283 | | 0.947 | | 75.334 | | 7.783 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -8.912 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -8.918 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -8.918 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -8.92 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -8.918 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -8.918 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -8.885 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -8.91 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -8.872 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -8.881 | | 0.953 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -8.893 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -8.878 | | 0.954 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -9.284 | | 0.957 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -9.286 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -9.286 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -9.286 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -9.286 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -9.286 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -9.391 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -9.383 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -9.368 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -9.443 | | 0.959 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -9.389 | | 0.958 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -9.36 | | 0.958 | | 75.498 | | 7.799 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -8.65 | | 0.954 | | 966.771 | | 88.953 | | 0.193 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -8.673 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -8.677 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -8.677 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -8.671 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -8.677 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -8.677 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -8.735 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -8.73 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -8.716 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -8.689 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -8.701 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -8.695 | | 0.954 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -8.585 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -8.581 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -8.581 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -8.582 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -8.581 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -8.581 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -8.591 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -8.581 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -8.575 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -8.544 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -8.58 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -8.563 | | 0.953 | | 1008.714 | | 92.955 | | 0.202 | |
| Informer | | unuse | | - | - | | - | | - | | -7.722 | | 0.939 | | 983.548 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -7.47 | | 0.934 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -7.45 | | 0.934 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -7.45 | | 0.934 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -7.415 | | 0.934 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -7.45 | | 0.934 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -7.45 | | 0.934 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -7.511 | | 0.935 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -7.53 | | 0.936 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -7.522 | | 0.936 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -7.337 | | 0.932 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -7.342 | | 0.932 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -7.334 | | 0.931 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -7.179 | | 0.928 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -7.34 | | 0.933 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -7.34 | | 0.933 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -7.333 | | 0.932 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -7.34 | | 0.933 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -7.34 | | 0.933 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -7.346 | | 0.933 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -6.986 | | 0.924 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -7.334 | | 0.933 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -7.318 | | 0.933 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -7.136 | | 0.928 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -7.001 | | 0.924 | | 1025.491 | | 104.961 | | 0.205 | |

#### 10->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -8.481 | 0.954 | 0.426 | 0.427 |
| CNN | unuse | - | - | - | - | -8.265 | 0.95 | 1.852 | 0.608 |
| CNN | use | spatial | first | CFR | L1 | -9.554 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | first | CFR | L2 | -9.559 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | first | CFR | L3 | -9.559 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L1 | -9.564 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L2 | -9.559 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L3 | -9.559 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L1 | -9.557 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L2 | -9.53 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L3 | -9.53 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L1 | -9.555 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L2 | -9.555 | 0.96 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L3 | -9.557 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L1 | -9.487 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L2 | -9.487 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L3 | -9.487 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L1 | -9.487 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L2 | -9.487 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L3 | -9.487 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L1 | -9.453 | 0.959 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L2 | -9.453 | 0.959 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L3 | -9.532 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L1 | -9.451 | 0.959 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L2 | -9.535 | 0.96 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L3 | -9.455 | 0.959 | 2.016 | 0.625 |
| CVCNN | unuse | - | - | - | - | -8.342 | 0.952 | 5.541 | 0.804 |
| CVCNN | use | spatial | first | CFR | L1 | -9.304 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CFR | L2 | -9.319 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CFR | L3 | -9.319 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L1 | -9.312 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L2 | -9.319 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L3 | -9.319 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L1 | -9.34 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L2 | -9.349 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L3 | -9.352 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L1 | -9.335 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L2 | -9.351 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L3 | -9.346 | 0.96 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L1 | -9.282 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L2 | -9.282 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L3 | -9.282 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L1 | -9.282 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L2 | -9.282 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L3 | -9.282 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L1 | -9.236 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L2 | -9.248 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L3 | -9.237 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L1 | -9.24 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L2 | -9.243 | 0.959 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L3 | -9.249 | 0.959 | 5.705 | 0.821 |
| RNN | unuse | - | - | - | - | -8.719 | 0.955 | 19.1 | 2.233 |
| LSTM | unuse | - | - | - | - | -8.557 | 0.954 | 75.399 | 7.849 |
| LSTM | use | spatial | first | CFR | L1 | -8.769 | 0.955 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CFR | L2 | -8.92 | 0.957 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CFR | L3 | -8.92 | 0.957 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L1 | -8.787 | 0.956 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L2 | -8.92 | 0.957 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L3 | -8.92 | 0.957 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L1 | -8.787 | 0.956 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L2 | -8.779 | 0.956 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L3 | -8.859 | 0.956 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L1 | -8.846 | 0.956 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L2 | -8.913 | 0.957 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L3 | -8.894 | 0.957 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L1 | -9.148 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L2 | -9.149 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L3 | -9.149 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L1 | -9.149 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L2 | -9.149 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L3 | -9.149 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L1 | -9.188 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L2 | -9.084 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L3 | -9.183 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L1 | -9.186 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L2 | -9.172 | 0.959 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L3 | -9.189 | 0.959 | 75.563 | 7.865 |

#### 10->5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -8.478 | 0.955 | 0.491 | 0.492 |
| CNN | unuse | - | - | - | - | -8.388 | 0.953 | 1.918 | 0.674 |
| CNN | use | spatial | first | CFR | L1 | -9.635 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | first | CFR | L2 | -9.635 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | first | CFR | L3 | -9.635 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L1 | -9.634 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L2 | -9.635 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L3 | -9.635 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L1 | -9.624 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L2 | -9.624 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L3 | -9.626 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L1 | -9.632 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L2 | -9.624 | 0.961 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L3 | -9.629 | 0.961 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L1 | -9.667 | 0.962 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L2 | -9.667 | 0.962 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L3 | -9.667 | 0.962 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L1 | -9.667 | 0.962 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L2 | -9.667 | 0.962 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L3 | -9.667 | 0.962 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L1 | -9.634 | 0.961 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L2 | -9.63 | 0.961 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L3 | -9.626 | 0.961 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L1 | -9.636 | 0.961 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L2 | -9.639 | 0.961 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L3 | -9.629 | 0.961 | 2.082 | 0.691 |
| CVCNN | unuse | - | - | - | - | -8.124 | 0.951 | 5.607 | 0.87 |
| CVCNN | use | spatial | first | CFR | L1 | -9.225 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CFR | L2 | -9.219 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CFR | L3 | -9.219 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CIR | L1 | -9.218 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L1 | -9.274 | 0.961 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L2 | -9.262 | 0.961 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L3 | -9.284 | 0.961 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L1 | -9.235 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L2 | -9.231 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L3 | -9.231 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L1 | -9.227 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L2 | -9.227 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L3 | -9.227 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L1 | -9.227 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L2 | -9.227 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L3 | -9.227 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L1 | -9.21 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L2 | -9.142 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L3 | -9.217 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CIR | L1 | -9.211 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CIR | L2 | -9.206 | 0.96 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CIR | L3 | -9.195 | 0.96 | 5.771 | 0.887 |
| RNN | unuse | - | - | - | - | -8.948 | 0.959 | 19.165 | 2.299 |
| LSTM | unuse | - | - | - | - | -8.622 | 0.956 | 75.465 | 7.914 |
| LSTM | use | spatial | first | CFR | L1 | -9.024 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CFR | L2 | -9.0 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CFR | L3 | -9.0 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L1 | -9.009 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L2 | -9.0 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L3 | -9.0 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L1 | -8.919 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L2 | -9.011 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L3 | -9.024 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L1 | -9.005 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L2 | -8.921 | 0.959 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L3 | -8.865 | 0.958 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L1 | -9.136 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L2 | -9.135 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L3 | -9.135 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L1 | -9.135 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L2 | -9.135 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L3 | -9.135 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L1 | -9.175 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L2 | -9.147 | 0.96 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L3 | -9.161 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L1 | -9.169 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L2 | -9.161 | 0.961 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L3 | -9.173 | 0.961 | 75.629 | 7.931 |

### Case6

#### 5->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -16.645 | | 0.995 | | 0.197 | | 0.197 | |
| CNN | unuse | | - | | | - | | - | | - | | -17.169 | | 0.995 | | 0.811 | | 0.412 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -15.803 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -16.305 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -16.305 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -16.271 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -16.305 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -16.305 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -16.37 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -16.19 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -16.343 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -16.456 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -16.345 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -16.395 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -16.46 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -16.476 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -16.476 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -16.476 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -16.476 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -16.476 | | 0.995 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -16.259 | | 0.994 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -16.284 | | 0.994 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -16.286 | | 0.994 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -16.232 | | 0.994 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -16.204 | | 0.994 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -16.204 | | 0.994 | | 0.893 | | 0.428 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -15.791 | | 0.994 | | 2.361 | | 0.608 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -17.062 | | 0.994 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -17.503 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -17.503 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -17.327 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -17.503 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -17.503 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -17.606 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -17.522 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -17.581 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -17.508 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -17.618 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -17.692 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -17.276 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -17.279 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -17.279 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -17.279 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -17.279 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -17.279 | | 0.995 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -17.137 | | 0.994 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -17.16 | | 0.994 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -17.133 | | 0.994 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -17.149 | | 0.994 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -17.148 | | 0.994 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -17.148 | | 0.994 | | 2.443 | | 0.624 | |
| RNN | unuse | | - | | | - | | - | | - | | -16.092 | | 0.994 | | 9.665 | | 2.167 | |
| LSTM | unuse | | - | | | - | | - | | - | | -16.825 | | 0.995 | | 37.814 | | 7.783 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -17.376 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -17.403 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -17.403 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -17.079 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -17.403 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -17.403 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -16.833 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -16.865 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -16.841 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -17.117 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -17.105 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -16.822 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -17.609 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -17.612 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -17.612 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -17.612 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -17.612 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -17.612 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -17.264 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -17.487 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -17.241 | | 0.995 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -17.468 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -17.438 | | 0.996 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -17.438 | | 0.996 | | 37.896 | | 7.799 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -16.403 | | 0.995 | | 500.441 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -16.162 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -15.957 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -15.949 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -15.891 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -15.942 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -15.951 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -16.154 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -16.204 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -16.164 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -16.149 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -16.295 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -15.945 | | 0.994 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -16.014 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -15.863 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -15.868 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -15.857 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -15.87 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -15.877 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -15.832 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -15.837 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -15.833 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -15.825 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -15.826 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -15.811 | | 0.994 | | 521.413 | | 92.955 | | 0.104 | |
| Informer | | unuse | | - | - | | - | | - | | -14.82 | | 0.991 | | 555.0 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -13.31 | | 0.986 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -13.175 | | 0.986 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -13.179 | | 0.986 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -13.071 | | 0.985 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -13.178 | | 0.986 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -13.177 | | 0.986 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -13.171 | | 0.986 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -13.455 | | 0.987 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -13.354 | | 0.987 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -13.736 | | 0.988 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -13.713 | | 0.988 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -13.658 | | 0.988 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -13.992 | | 0.989 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -14.149 | | 0.99 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -14.315 | | 0.99 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -14.318 | | 0.99 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -14.324 | | 0.99 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -14.312 | | 0.99 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -13.795 | | 0.988 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -14.013 | | 0.989 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -13.437 | | 0.987 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -13.748 | | 0.988 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -13.745 | | 0.988 | | 575.971 | | 104.961 | | 0.115 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -13.751 | | 0.988 | | 575.971 | | 104.961 | | 0.115 | |

#### 5->3

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -14.936 | | 0.994 | | 0.262 | | 0.263 | |
| CNN | unuse | | - | | | - | | - | | - | | -14.706 | | 0.993 | | 0.876 | | 0.477 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -15.956 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -16.357 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -16.357 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -16.191 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -16.357 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -16.357 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -16.338 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -16.17 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -16.227 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -16.381 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -16.296 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -16.356 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -16.338 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -16.341 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -16.341 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -16.341 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -16.341 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -16.341 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -16.199 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -16.189 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -16.208 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -16.185 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -16.197 | | 0.993 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -16.197 | | 0.993 | | 0.958 | | 0.494 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -13.938 | | 0.992 | | 2.426 | | 0.673 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -15.078 | | 0.992 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -15.297 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -15.297 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -15.136 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -15.297 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -15.297 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -15.51 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -15.414 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -15.524 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -15.47 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -15.419 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -15.45 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -15.271 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -15.273 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -15.273 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -15.273 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -15.273 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -15.273 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -15.381 | | 0.993 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -15.363 | | 0.992 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -15.389 | | 0.992 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -15.361 | | 0.992 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -15.388 | | 0.992 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -15.388 | | 0.992 | | 2.508 | | 0.69 | |
| RNN | unuse | | - | | | - | | - | | - | | -13.895 | | 0.991 | | 9.73 | | 2.233 | |
| LSTM | unuse | | - | | | - | | - | | - | | -14.816 | | 0.994 | | 37.88 | | 7.849 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -15.007 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -15.045 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -15.045 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -15.032 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -15.045 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -15.045 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -14.74 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -14.896 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -14.887 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -14.891 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -14.901 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -14.907 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -14.956 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -14.951 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -14.951 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -14.951 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -14.951 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -14.951 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -14.92 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -15.041 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -14.921 | | 0.994 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -15.043 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -15.052 | | 0.995 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -15.052 | | 0.995 | | 37.962 | | 7.865 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -7.385 | | 0.916 | | 568.664 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -7.523 | | 0.93 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -7.36 | | 0.926 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -7.36 | | 0.926 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -7.357 | | 0.926 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -7.36 | | 0.926 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -7.36 | | 0.926 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -7.496 | | 0.93 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -7.522 | | 0.931 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -7.505 | | 0.93 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -7.462 | | 0.929 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -7.497 | | 0.93 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -7.445 | | 0.928 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -6.945 | | 0.907 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -6.913 | | 0.907 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -6.913 | | 0.907 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -6.91 | | 0.906 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -6.913 | | 0.907 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -6.913 | | 0.907 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -6.895 | | 0.906 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -6.896 | | 0.906 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -6.891 | | 0.906 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -6.886 | | 0.906 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -6.886 | | 0.906 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -6.886 | | 0.906 | | 589.636 | | 92.955 | | 0.118 | |
| Informer | | unuse | | - | - | | - | | - | | -11.866 | | 0.978 | | 623.223 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -11.08 | | 0.974 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -11.453 | | 0.977 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -11.453 | | 0.977 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -11.56 | | 0.977 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -11.453 | | 0.977 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -11.453 | | 0.977 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -10.659 | | 0.971 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -11.731 | | 0.978 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -12.12 | | 0.98 | | 625.19 | | 100.959 | | 0.125 | |

#### 5->5

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -14.786 | | 0.994 | | 0.328 | | 0.329 | |
| CNN | unuse | | - | | | - | | - | | - | | -14.761 | | 0.994 | | 0.942 | | 0.543 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -16.501 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -16.501 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -16.501 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -16.483 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -16.501 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -16.501 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -16.475 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -16.409 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -16.482 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -16.559 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -16.506 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -16.524 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -16.49 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -16.49 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -16.49 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -16.49 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -16.49 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -16.49 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -16.355 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -16.434 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -16.35 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -16.346 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -16.366 | | 0.994 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -16.366 | | 0.994 | | 1.024 | | 0.559 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -13.451 | | 0.992 | | 2.492 | | 0.739 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -14.888 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -14.815 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -14.815 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -15.007 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -14.815 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -14.815 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -15.258 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -15.305 | | 0.994 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -15.247 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -15.291 | | 0.994 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -15.287 | | 0.994 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -15.32 | | 0.994 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -14.997 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -14.978 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -14.978 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -14.978 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -14.978 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -14.978 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -15.081 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -15.095 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -15.115 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -15.111 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -15.091 | | 0.993 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -15.091 | | 0.993 | | 2.574 | | 0.756 | |
| RNN | unuse | | - | | | - | | - | | - | | -14.325 | | 0.993 | | 9.796 | | 2.299 | |
| LSTM | unuse | | - | | | - | | - | | - | | -14.714 | | 0.995 | | 37.945 | | 7.914 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -14.739 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -14.783 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -14.783 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -14.803 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -14.783 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -14.783 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -14.555 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -14.213 | | 0.994 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -14.197 | | 0.994 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -14.556 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -14.546 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -14.372 | | 0.994 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -14.815 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -14.821 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -14.821 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -14.821 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -14.821 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -14.821 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -14.771 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -14.839 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -14.828 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -14.834 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -14.817 | | 0.995 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -14.817 | | 0.995 | | 38.027 | | 7.931 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -11.083 | | 0.977 | | 636.887 | | 88.953 | | 0.127 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -9.347 | | 0.964 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -9.024 | | 0.961 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -9.024 | | 0.961 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -8.853 | | 0.958 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -9.024 | | 0.961 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -9.024 | | 0.961 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -9.356 | | 0.964 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -9.444 | | 0.965 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -9.417 | | 0.965 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -9.164 | | 0.962 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -9.205 | | 0.963 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -9.187 | | 0.962 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -9.732 | | 0.968 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -9.666 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -9.666 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -9.638 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -9.666 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -9.666 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -9.596 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -9.646 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -9.631 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -9.644 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -9.644 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -9.644 | | 0.967 | | 657.859 | | 92.955 | | 0.132 | |
| Informer | | unuse | | - | - | | - | | - | | -13.029 | | 0.985 | | 691.446 | | 100.959 | | 0.138 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -11.861 | | 0.979 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -11.783 | | 0.979 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -11.783 | | 0.979 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -11.765 | | 0.979 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -11.783 | | 0.979 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -11.783 | | 0.979 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -12.003 | | 0.98 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -12.304 | | 0.982 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -12.145 | | 0.981 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -11.909 | | 0.98 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -12.028 | | 0.98 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -11.968 | | 0.98 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -11.667 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -11.532 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -11.532 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -11.526 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -11.532 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -11.532 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -11.53 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -11.522 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -11.507 | | 0.977 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -11.528 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -11.528 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -11.528 | | 0.978 | | 712.417 | | 104.961 | | 0.142 | |

#### 10->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -17.467 | | 0.996 | | 0.36 | | 0.361 | |
| CNN | unuse | | - | | | - | | - | | - | | -16.898 | | 0.995 | | 1.787 | | 0.543 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -17.944 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -17.839 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -17.839 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -17.852 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -17.839 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -17.839 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -18.046 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -18.196 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -18.226 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -18.192 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -18.117 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -18.216 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -17.986 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -18.305 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -18.305 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -18.305 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -18.305 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -18.305 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -17.838 | | 0.995 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -18.15 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -17.819 | | 0.995 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -18.121 | | 0.996 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -17.808 | | 0.995 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -17.808 | | 0.995 | | 1.95 | | 0.559 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -15.545 | | 0.993 | | 5.476 | | 0.739 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -17.224 | | 0.994 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -17.936 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -17.936 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -17.213 | | 0.994 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -17.936 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -17.936 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -17.956 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -17.251 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -17.252 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -17.233 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -17.566 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -17.94 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -17.753 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -17.747 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -17.747 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -17.747 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -17.747 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -17.747 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -17.635 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -17.634 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -17.633 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -17.629 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -17.634 | | 0.995 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -17.634 | | 0.995 | | 5.64 | | 0.755 | |
| RNN | unuse | | - | | | - | | - | | - | | -15.931 | | 0.994 | | 19.034 | | 2.167 | |
| LSTM | unuse | | - | | | - | | - | | - | | -16.156 | | 0.994 | | 75.334 | | 7.783 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -16.795 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -16.443 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -16.443 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -16.462 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -16.443 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -16.443 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -16.393 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -16.493 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -16.358 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -16.524 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -16.484 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -16.472 | | 0.995 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -17.215 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -17.235 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -17.235 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -17.235 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -17.235 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -17.235 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -17.195 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -17.258 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -17.225 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -17.219 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -17.222 | | 0.996 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -17.222 | | 0.996 | | 75.498 | | 7.799 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -16.872 | | 0.995 | | 966.771 | | 88.953 | | 0.193 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -16.642 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -17.15 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -17.15 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -16.737 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -17.15 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -17.15 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -16.917 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -16.941 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -16.903 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -16.831 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -16.742 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -16.715 | | 0.995 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -16.475 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -16.398 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -16.398 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -16.39 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -16.398 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -16.398 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -16.35 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -16.37 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -16.365 | | 0.995 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -16.37 | | 0.994 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -16.37 | | 0.994 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -16.37 | | 0.994 | | 1008.714 | | 92.955 | | 0.202 | |
| Informer | | unuse | | - | - | | - | | - | | -14.897 | | 0.991 | | 983.548 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -13.331 | | 0.986 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -13.922 | | 0.989 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -13.922 | | 0.989 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -14.083 | | 0.989 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -13.922 | | 0.989 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -13.922 | | 0.989 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -13.333 | | 0.986 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -13.41 | | 0.987 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -13.414 | | 0.987 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -14.062 | | 0.989 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -13.542 | | 0.987 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -13.52 | | 0.987 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -13.955 | | 0.989 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -13.508 | | 0.987 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -13.508 | | 0.987 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -13.502 | | 0.987 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -13.508 | | 0.987 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -13.508 | | 0.987 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -13.725 | | 0.988 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -13.698 | | 0.988 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -13.497 | | 0.987 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -13.83 | | 0.988 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -13.83 | | 0.988 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -13.83 | | 0.988 | | 1025.491 | | 104.961 | | 0.205 | |

#### 10->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops | Params |
| MLP | unuse | - | - | - | - | -15.593 | 0.995 | 0.426 | 0.427 |
| CNN | unuse | - | - | - | - | -14.764 | 0.994 | 1.852 | 0.608 |
| CNN | use | spatial | first | CFR | L1 | -17.028 | 0.994 | 2.016 | 0.625 |
| CNN | use | spatial | first | CFR | L2 | -17.183 | 0.995 | 2.016 | 0.625 |
| CNN | use | spatial | first | CFR | L3 | -17.183 | 0.995 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L1 | -17.201 | 0.995 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L2 | -17.183 | 0.995 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L3 | -17.183 | 0.995 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L1 | -16.965 | 0.994 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L2 | -16.974 | 0.994 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L3 | -16.982 | 0.994 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L1 | -17.007 | 0.994 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L2 | -16.987 | 0.994 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L3 | -16.985 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L1 | -17.024 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L2 | -17.031 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L3 | -17.031 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L1 | -17.031 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L2 | -17.031 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L3 | -17.031 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L1 | -16.967 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L2 | -16.969 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L3 | -16.96 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L1 | -16.915 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L2 | -16.952 | 0.994 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L3 | -16.952 | 0.994 | 2.016 | 0.625 |
| CVCNN | unuse | - | - | - | - | -14.15 | 0.993 | 5.541 | 0.804 |
| CVCNN | use | spatial | first | CFR | L1 | -15.761 | 0.994 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CFR | L2 | -14.995 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CFR | L3 | -14.995 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L1 | -15.649 | 0.994 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L2 | -14.995 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L3 | -14.995 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L1 | -15.139 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L2 | -15.109 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L3 | -15.113 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L1 | -15.125 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L2 | -15.096 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L3 | -15.531 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L1 | -15.715 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L2 | -15.701 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L3 | -15.701 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L1 | -15.701 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L2 | -15.701 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L3 | -15.701 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L1 | -15.734 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L2 | -15.781 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L3 | -15.791 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L1 | -15.772 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L2 | -15.801 | 0.993 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L3 | -15.801 | 0.993 | 5.705 | 0.821 |
| RNN | unuse | - | - | - | - | -14.029 | 0.991 | 19.1 | 2.233 |
| LSTM | unuse | - | - | - | - | -14.263 | 0.993 | 75.399 | 7.849 |
| LSTM | use | spatial | first | CFR | L1 | -14.909 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CFR | L2 | -14.9 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CFR | L3 | -14.9 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L1 | -14.959 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L2 | -14.9 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L3 | -14.9 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L1 | -14.877 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L2 | -14.864 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L3 | -14.866 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L1 | -14.905 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L2 | -14.913 | 0.995 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L3 | -14.843 | 0.994 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L1 | -14.814 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L2 | -14.82 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L3 | -14.82 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L1 | -14.82 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L2 | -14.82 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L3 | -14.82 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L1 | -14.839 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L2 | -14.838 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L3 | -14.818 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L1 | -14.827 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L2 | -14.793 | 0.995 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L3 | -14.793 | 0.995 | 75.563 | 7.865 |

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#### >5

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -15.276 | 0.995 | 0.491 | 0.492 |
| CNN | unuse | - | - | - | - | -14.677 | 0.994 | 1.918 | 0.674 |
| **CNN** | **use** | **spatial** | **first** | **CFR** | **L1** | **-17.222** | **0.995** | **2.082** | **0.691** |
| CNN | use | spatial | first | CFR | L2 | -17.209 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | first | CFR | L3 | -17.209 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L1 | -17.203 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L2 | -17.209 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L3 | -17.209 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L1 | -17.095 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L2 | -17.12 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L3 | -17.105 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L1 | -17.107 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L2 | -17.114 | 0.995 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L3 | -17.104 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L1 | -17.167 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L2 | -17.172 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L3 | -17.172 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L1 | -17.172 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L2 | -17.172 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L3 | -17.172 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L1 | -17.09 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L2 | -17.069 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L3 | -17.093 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L1 | -17.076 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L2 | -17.1 | 0.995 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L3 | -17.1 | 0.995 | 2.082 | 0.691 |
| CVCNN | unuse | - | - | - | - | -14.183 | 0.994 | 5.607 | 0.87 |
| CVCNN | use | spatial | first | CFR | L1 | -14.733 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CFR | L2 | -14.66 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CFR | L3 | -14.66 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CIR | L1 | -14.635 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CIR | L2 | -14.66 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CIR | L3 | -14.66 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L1 | -14.707 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L2 | -14.7 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L3 | -14.7 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L1 | -14.706 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L2 | -14.712 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L3 | -14.728 | 0.993 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L1 | -15.398 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L2 | -15.387 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L3 | -15.387 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L1 | -15.387 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L2 | -15.387 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L3 | -15.387 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L1 | -15.486 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L2 | -15.459 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L3 | -15.481 | 0.994 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CIR | L1 | -15.458 | 0.994 | 5.771 | 0.887 |
| **CVCNN** | **use** | **temporal** | **second** | **CIR** | **L2** | **-15.513** | **0.994** | **5.771** | **0.887** |
| CVCNN | use | temporal | second | CIR | L3 | -15.513 | 0.994 | 5.771 | 0.887 |
| RNN | unuse | - | - | - | - | -13.552 | 0.991 | 19.165 | 2.299 |
| LSTM | unuse | - | - | - | - | -14.514 | 0.995 | 75.465 | 7.914 |
| LSTM | use | spatial | first | CFR | L1 | -14.639 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CFR | L2 | -14.54 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CFR | L3 | -14.54 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L1 | -14.384 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L2 | -14.54 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L3 | -14.54 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L1 | -14.462 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L2 | -14.508 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L3 | -14.518 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L1 | -14.454 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L2 | -14.73 | 0.995 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L3 | -14.455 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L1 | -14.557 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L2 | -14.565 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L3 | -14.565 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L1 | -14.565 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L2 | -14.565 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L3 | -14.565 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L1 | -14.55 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L2 | -14.55 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L3 | -14.55 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L1 | -14.56 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L2 | -14.501 | 0.995 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L3 | -14.501 | 0.995 | 75.629 | 7.931 |

### Case7

#### 5->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -20.517 | | 0.999 | | 0.197 | | 0.197 | |
| CNN | unuse | | - | | | - | | - | | - | | -20.828 | | 0.999 | | 0.811 | | 0.412 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -15.915 | | 0.998 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -17.211 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -17.211 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -17.135 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -17.211 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -17.211 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -16.935 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -15.23 | | 0.998 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -15.947 | | 0.998 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -17.385 | | 0.996 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -15.967 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -16.242 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -17.842 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -17.844 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -17.844 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -17.844 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -17.844 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -17.844 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -17.537 | | 0.997 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -17.554 | | 0.996 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -17.548 | | 0.996 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -17.515 | | 0.996 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -17.543 | | 0.996 | | 0.893 | | 0.428 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -17.543 | | 0.996 | | 0.893 | | 0.428 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -17.571 | | 0.998 | | 2.361 | | 0.608 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -20.269 | | 0.998 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -19.056 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -19.056 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -19.148 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -19.056 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -19.056 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -20.224 | | 0.998 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -17.608 | | 0.996 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -20.138 | | 0.998 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -20.597 | | 0.998 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -20.107 | | 0.998 | | 2.443 | | 0.624 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -20.11 | | 0.998 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -20.086 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -20.081 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -20.081 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -20.081 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -20.081 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -20.081 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -19.826 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -19.81 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -19.835 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -19.78 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -19.835 | | 0.997 | | 2.443 | | 0.624 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -19.835 | | 0.997 | | 2.443 | | 0.624 | |
| RNN | unuse | | - | | | - | | - | | - | | -18.541 | | 0.997 | | 9.665 | | 2.167 | |
| LSTM | unuse | | - | | | - | | - | | - | | -21.76 | | 0.999 | | 37.814 | | 7.783 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -22.548 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -22.563 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -22.563 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -22.563 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -22.563 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -22.563 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -22.2 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -22.276 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -22.239 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -22.19 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -22.256 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -22.219 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -22.495 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -22.487 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -22.487 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -22.487 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -22.487 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -22.487 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -22.389 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -22.366 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -22.347 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -22.272 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -22.352 | | 0.999 | | 37.896 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -22.352 | | 0.999 | | 37.896 | | 7.799 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -17.842 | | 0.998 | | 500.441 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -18.002 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -17.817 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -17.621 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -17.921 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -17.63 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -17.636 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -18.21 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -17.828 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -17.91 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -17.933 | | 0.998 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -17.579 | | 0.997 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -17.496 | | 0.997 | | 502.408 | | 88.953 | | 0.1 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -18.066 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -17.362 | | 0.997 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -17.849 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -17.365 | | 0.997 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -17.835 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -17.814 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -17.791 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -17.802 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -17.825 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -17.767 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -17.778 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -17.769 | | 0.998 | | 521.413 | | 92.955 | | 0.104 | |
| Informer | | unuse | | - | - | | - | | - | | -15.555 | | 0.994 | | 555.0 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -13.282 | | 0.988 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -14.691 | | 0.993 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -14.666 | | 0.993 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -15.019 | | 0.994 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -14.656 | | 0.993 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -14.703 | | 0.993 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -14.475 | | 0.992 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -15.007 | | 0.994 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -14.864 | | 0.993 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -15.301 | | 0.994 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -15.176 | | 0.994 | | 556.967 | | 100.959 | | 0.111 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -15.08 | | 0.994 | | 556.967 | | 100.959 | | 0.111 | |

#### 5->3

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -17.51 | | 0.998 | | 0.262 | | 0.263 | |
| CNN | unuse | | - | | | - | | - | | - | | -16.684 | | 0.997 | | 0.876 | | 0.477 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -17.408 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -17.873 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -17.873 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -17.701 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -17.873 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -17.873 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -17.723 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -16.756 | | 0.995 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -17.332 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -17.748 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -17.479 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -17.576 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -17.706 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -17.713 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -17.713 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -17.713 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -17.713 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -17.713 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -17.858 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -17.687 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -17.799 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -17.839 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -17.839 | | 0.996 | | 0.958 | | 0.494 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -17.839 | | 0.996 | | 0.958 | | 0.494 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -14.871 | | 0.996 | | 2.426 | | 0.673 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -16.308 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -16.016 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -16.016 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -16.546 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -16.016 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -16.016 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -16.871 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -16.323 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -16.843 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -16.682 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -16.571 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -16.597 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -16.626 | | 0.996 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -16.602 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -16.602 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -16.602 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -16.602 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -16.602 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -16.717 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -16.703 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -16.71 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -16.69 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -16.704 | | 0.995 | | 2.508 | | 0.69 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -16.704 | | 0.995 | | 2.508 | | 0.69 | |
| RNN | unuse | | - | | | - | | - | | - | | -15.663 | | 0.996 | | 9.73 | | 2.233 | |
| LSTM | unuse | | - | | | - | | - | | - | | -17.617 | | 0.998 | | 37.88 | | 7.849 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -17.82 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -17.854 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -17.854 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -17.869 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -17.854 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -17.854 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -17.695 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -17.69 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -17.618 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -17.685 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -17.695 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -17.623 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -17.637 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -17.644 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -17.644 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -17.644 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -17.644 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -17.644 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -17.599 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -17.559 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -17.596 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -17.58 | | 0.998 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -17.513 | | 0.997 | | 37.962 | | 7.865 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -17.513 | | 0.997 | | 37.962 | | 7.865 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | 1.088 | | 0.009 | | 568.664 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -7.998 | | 0.941 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -8.093 | | 0.943 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -8.093 | | 0.943 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -7.901 | | 0.939 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -8.093 | | 0.943 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -8.093 | | 0.943 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -7.846 | | 0.938 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -7.936 | | 0.94 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -7.925 | | 0.94 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -8.153 | | 0.945 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -8.195 | | 0.946 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -8.188 | | 0.946 | | 570.631 | | 88.953 | | 0.114 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -7.374 | | 0.92 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -7.352 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -7.352 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -7.352 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -7.352 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -7.352 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -7.329 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -7.333 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -7.338 | | 0.919 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -7.312 | | 0.918 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -7.312 | | 0.918 | | 589.636 | | 92.955 | | 0.118 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -7.312 | | 0.918 | | 589.636 | | 92.955 | | 0.118 | |
| Informer | | unuse | | - | - | | - | | - | | -14.489 | | 0.992 | | 623.223 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -12.335 | | 0.984 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -12.556 | | 0.985 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -12.556 | | 0.985 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -12.595 | | 0.986 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -12.556 | | 0.985 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -12.556 | | 0.985 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -13.042 | | 0.987 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -12.197 | | 0.984 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -12.028 | | 0.983 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -12.468 | | 0.985 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -12.877 | | 0.987 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -12.748 | | 0.986 | | 625.19 | | 100.959 | | 0.125 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -12.455 | | 0.985 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -12.103 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -12.103 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -12.107 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -12.103 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -12.103 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -12.056 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -12.053 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -12.044 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -12.053 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -12.053 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -12.053 | | 0.983 | | 644.194 | | 104.961 | | 0.129 | |

#### 5->5

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops | | Params | |
| MLP | unuse | | - | | | - | | - | | - | | -17.119 | | 0.999 | | 0.328 | | 0.329 | |
| CNN | unuse | | - | | | - | | - | | - | | -16.21 | | 0.997 | | 0.942 | | 0.543 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -17.932 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -18.66 | | 0.997 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -18.66 | | 0.997 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -18.656 | | 0.997 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -18.66 | | 0.997 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -18.66 | | 0.997 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -18.494 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -17.887 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -18.015 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -18.539 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -18.105 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -18.123 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -18.581 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -18.598 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -18.598 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -18.598 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -18.598 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -18.598 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -18.298 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -18.34 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -18.338 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -18.314 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -18.297 | | 0.996 | | 1.024 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -18.297 | | 0.996 | | 1.024 | | 0.559 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -14.508 | | 0.996 | | 2.492 | | 0.739 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -16.58 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -16.297 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -16.297 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -16.348 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -16.297 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -16.297 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -16.594 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -16.194 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -16.586 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -16.817 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -16.181 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -16.547 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -16.147 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -16.11 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -16.11 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -16.11 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -16.11 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -16.11 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -16.372 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -16.377 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -16.357 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -16.352 | | 0.995 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -16.361 | | 0.996 | | 2.574 | | 0.756 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -16.361 | | 0.996 | | 2.574 | | 0.756 | |
| RNN | unuse | | - | | | - | | - | | - | | -15.041 | | 0.995 | | 9.796 | | 2.299 | |
| LSTM | unuse | | - | | | - | | - | | - | | -17.256 | | 0.998 | | 37.945 | | 7.914 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -17.528 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -17.631 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -17.631 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -17.606 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -17.631 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -17.631 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -17.34 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -17.312 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -17.116 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -17.36 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -17.343 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -17.13 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -17.269 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -17.28 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -17.28 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -17.28 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -17.28 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -17.28 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -17.303 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -17.33 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -17.325 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -17.317 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -17.328 | | 0.998 | | 38.027 | | 7.931 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -17.328 | | 0.998 | | 38.027 | | 7.931 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -12.146 | | 0.984 | | 636.887 | | 88.953 | | 0.127 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -10.265 | | 0.974 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -10.591 | | 0.976 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -10.591 | | 0.976 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -10.328 | | 0.974 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -10.591 | | 0.976 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -10.591 | | 0.976 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -10.105 | | 0.972 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -10.279 | | 0.974 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -10.24 | | 0.973 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -10.17 | | 0.973 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -10.282 | | 0.974 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -10.235 | | 0.973 | | 638.854 | | 88.953 | | 0.128 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -10.791 | | 0.977 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -10.621 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -10.621 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -10.615 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -10.621 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -10.621 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -10.568 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -10.577 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -10.58 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -10.592 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -10.592 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -10.592 | | 0.976 | | 657.859 | | 92.955 | | 0.132 | |
| Informer | | unuse | | - | - | | - | | - | | -14.87 | | 0.992 | | 691.446 | | 100.959 | | 0.138 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -13.364 | | 0.988 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -13.47 | | 0.989 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -13.47 | | 0.989 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -13.347 | | 0.988 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -13.47 | | 0.989 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -13.47 | | 0.989 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -13.243 | | 0.988 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -13.41 | | 0.988 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -13.614 | | 0.989 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -13.245 | | 0.988 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -13.532 | | 0.989 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -13.459 | | 0.988 | | 693.413 | | 100.959 | | 0.139 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -12.749 | | 0.986 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -12.537 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -12.537 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -12.538 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -12.537 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -12.537 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -12.514 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -12.513 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -12.492 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -12.505 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -12.505 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -12.505 | | 0.985 | | 712.417 | | 104.961 | | 0.142 | |

#### 10->1

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | | domain | | | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | |
| MLP | unuse | | - | | | - | | - | | - | | -20.943 | | 0.999 | | 0.36 | | 0.361 | |
| CNN | unuse | | - | | | - | | - | | - | | -20.394 | | 0.998 | | 1.787 | | 0.543 | |
| CNN | use | | spatial | | | first | | CFR | | L1 | | -18.603 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L2 | | -18.42 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CFR | | L3 | | -18.42 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L1 | | -18.423 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L2 | | -18.42 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | first | | CIR | | L3 | | -18.42 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L1 | | -17.81 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L2 | | -18.335 | | 0.998 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CFR | | L3 | | -18.06 | | 0.998 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L1 | | -17.673 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L2 | | -18.268 | | 0.998 | | 1.95 | | 0.559 | |
| CNN | use | | spatial | | | second | | CIR | | L3 | | -18.048 | | 0.998 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L1 | | -18.158 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L2 | | -18.17 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CFR | | L3 | | -18.17 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L1 | | -18.17 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L2 | | -18.17 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | first | | CIR | | L3 | | -18.17 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L1 | | -17.897 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L2 | | -17.958 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CFR | | L3 | | -17.914 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L1 | | -17.877 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L2 | | -17.874 | | 0.997 | | 1.95 | | 0.559 | |
| CNN | use | | temporal | | | second | | CIR | | L3 | | -17.874 | | 0.997 | | 1.95 | | 0.559 | |
| CVCNN | unuse | | - | | | - | | - | | - | | -17.655 | | 0.997 | | 5.476 | | 0.739 | |
| CVCNN | use | | spatial | | | first | | CFR | | L1 | | -20.939 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CFR | | L2 | | -20.965 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CFR | | L3 | | -20.965 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L1 | | -20.966 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L2 | | -20.965 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | first | | CIR | | L3 | | -20.965 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L1 | | -20.516 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L2 | | -20.512 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CFR | | L3 | | -19.611 | | 0.997 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L1 | | -20.701 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L2 | | -19.901 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | spatial | | | second | | CIR | | L3 | | -21.195 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L1 | | -20.936 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L2 | | -20.923 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CFR | | L3 | | -20.923 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L1 | | -20.923 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L2 | | -20.923 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | first | | CIR | | L3 | | -20.923 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L1 | | -20.754 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L2 | | -20.782 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CFR | | L3 | | -20.762 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L1 | | -20.711 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L2 | | -20.763 | | 0.998 | | 5.64 | | 0.755 | |
| CVCNN | use | | temporal | | | second | | CIR | | L3 | | -20.763 | | 0.998 | | 5.64 | | 0.755 | |
| RNN | unuse | | - | | | - | | - | | - | | -16.85 | | 0.996 | | 19.034 | | 2.167 | |
| LSTM | unuse | | - | | | - | | - | | - | | -21.298 | | 0.999 | | 75.334 | | 7.783 | |
| LSTM | use | | spatial | | | first | | CFR | | L1 | | -22.157 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L2 | | -22.133 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CFR | | L3 | | -22.133 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L1 | | -22.118 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L2 | | -22.133 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | first | | CIR | | L3 | | -22.133 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L1 | | -21.936 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L2 | | -21.957 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CFR | | L3 | | -22.018 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L1 | | -22.105 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L2 | | -22.117 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | spatial | | | second | | CIR | | L3 | | -22.111 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L1 | | -21.905 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L2 | | -21.915 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CFR | | L3 | | -21.915 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L1 | | -21.915 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L2 | | -21.915 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | first | | CIR | | L3 | | -21.915 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L1 | | -21.864 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L2 | | -21.816 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CFR | | L3 | | -21.868 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L1 | | -21.86 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L2 | | -21.792 | | 0.999 | | 75.498 | | 7.799 | |
| LSTM | use | | temporal | | | second | | CIR | | L3 | | -21.792 | | 0.999 | | 75.498 | | 7.799 | |
| Model | | Embed | | domain | method | | CSI | | Lp | | NMSEdb | | SGCS | | FLops(M) | | Params(M) | | Tops | |
| Transformer | | unuse | | - | - | | - | | - | | -19.34 | | 0.999 | | 966.771 | | 88.953 | | 0.193 | |
| Transformer | | use | | spatial | first | | CFR | | L1 | | -19.375 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CFR | | L2 | | -19.353 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CFR | | L3 | | -19.353 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L1 | | -19.388 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L2 | | -19.353 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | first | | CIR | | L3 | | -19.353 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L1 | | -19.66 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L2 | | -19.733 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CFR | | L3 | | -19.705 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L1 | | -19.527 | | 0.999 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L2 | | -18.928 | | 0.998 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | spatial | second | | CIR | | L3 | | -18.926 | | 0.998 | | 970.706 | | 88.953 | | 0.194 | |
| Transformer | | use | | temporal | first | | CFR | | L1 | | -18.851 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CFR | | L2 | | -18.674 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CFR | | L3 | | -18.674 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L1 | | -18.674 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L2 | | -18.674 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | first | | CIR | | L3 | | -18.674 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L1 | | -18.616 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L2 | | -18.64 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CFR | | L3 | | -18.639 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L1 | | -18.586 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L2 | | -18.586 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Transformer | | use | | temporal | second | | CIR | | L3 | | -18.586 | | 0.998 | | 1008.714 | | 92.955 | | 0.202 | |
| Informer | | unuse | | - | - | | - | | - | | -14.863 | | 0.993 | | 983.548 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L1 | | -14.474 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L2 | | -14.615 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CFR | | L3 | | -14.615 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L1 | | -14.611 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L2 | | -14.615 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | first | | CIR | | L3 | | -14.615 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L1 | | -14.268 | | 0.992 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L2 | | -14.531 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CFR | | L3 | | -14.465 | | 0.993 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L1 | | -14.089 | | 0.991 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L2 | | -14.344 | | 0.992 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | spatial | second | | CIR | | L3 | | -14.302 | | 0.992 | | 987.483 | | 100.959 | | 0.197 | |
| Informer | | use | | temporal | first | | CFR | | L1 | | -14.959 | | 0.993 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CFR | | L2 | | -14.409 | | 0.992 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CFR | | L3 | | -14.409 | | 0.992 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L1 | | -14.923 | | 0.993 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L2 | | -14.409 | | 0.992 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | first | | CIR | | L3 | | -14.409 | | 0.992 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L1 | | -14.411 | | 0.992 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L2 | | -14.927 | | 0.993 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CFR | | L3 | | -14.221 | | 0.992 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L1 | | -14.969 | | 0.993 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L2 | | -14.969 | | 0.993 | | 1025.491 | | 104.961 | | 0.205 | |
| Informer | | use | | temporal | second | | CIR | | L3 | | -14.969 | | 0.993 | | 1025.491 | | 104.961 | | 0.205 | |

#### 10->3

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -17.555 | 0.998 | 0.426 | 0.427 |
| CNN | unuse | - | - | - | - | -17.124 | 0.998 | 1.852 | 0.608 |
| CNN | use | spatial | first | CFR | L1 | -19.666 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | first | CFR | L2 | -19.711 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | first | CFR | L3 | -19.711 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L1 | -19.707 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L2 | -19.711 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | first | CIR | L3 | -19.711 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L1 | -19.233 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L2 | -19.15 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | second | CFR | L3 | -19.16 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L1 | -19.237 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L2 | -18.868 | 0.997 | 2.016 | 0.625 |
| CNN | use | spatial | second | CIR | L3 | -18.975 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L1 | -19.055 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L2 | -19.064 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | first | CFR | L3 | -19.064 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L1 | -19.064 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L2 | -19.064 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | first | CIR | L3 | -19.064 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L1 | -18.851 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L2 | -18.794 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | second | CFR | L3 | -18.718 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L1 | -18.822 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L2 | -18.81 | 0.997 | 2.016 | 0.625 |
| CNN | use | temporal | second | CIR | L3 | -18.81 | 0.997 | 2.016 | 0.625 |
| CVCNN | unuse | - | - | - | - | -14.747 | 0.995 | 5.541 | 0.804 |
| CVCNN | use | spatial | first | CFR | L1 | -16.04 | 0.995 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CFR | L2 | -15.952 | 0.995 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CFR | L3 | -15.952 | 0.995 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L1 | -16.924 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L2 | -15.952 | 0.995 | 5.705 | 0.821 |
| CVCNN | use | spatial | first | CIR | L3 | -15.952 | 0.995 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L1 | -17.036 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L2 | -16.751 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CFR | L3 | -16.176 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L1 | -17.053 | 0.997 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L2 | -16.547 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | spatial | second | CIR | L3 | -17.076 | 0.997 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L1 | -16.949 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L2 | -16.469 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CFR | L3 | -16.469 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L1 | -16.469 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L2 | -16.469 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | first | CIR | L3 | -16.469 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L1 | -17.054 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L2 | -17.075 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CFR | L3 | -17.085 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L1 | -17.062 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L2 | -16.928 | 0.996 | 5.705 | 0.821 |
| CVCNN | use | temporal | second | CIR | L3 | -16.928 | 0.996 | 5.705 | 0.821 |
| RNN | unuse | - | - | - | - | -15.485 | 0.995 | 19.1 | 2.233 |
| LSTM | unuse | - | - | - | - | -17.344 | 0.998 | 75.399 | 7.849 |
| LSTM | use | spatial | first | CFR | L1 | -17.649 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CFR | L2 | -17.666 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CFR | L3 | -17.666 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L1 | -17.668 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L2 | -17.666 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | first | CIR | L3 | -17.666 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L1 | -17.594 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L2 | -17.587 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CFR | L3 | -17.596 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L1 | -17.59 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L2 | -17.597 | 0.998 | 75.563 | 7.865 |
| LSTM | use | spatial | second | CIR | L3 | -17.311 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L1 | -17.248 | 0.998 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L2 | -17.216 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CFR | L3 | -17.216 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L1 | -17.216 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L2 | -17.216 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | first | CIR | L3 | -17.216 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L1 | -17.25 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L2 | -17.225 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CFR | L3 | -17.25 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L1 | -17.184 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L2 | -17.223 | 0.997 | 75.563 | 7.865 |
| LSTM | use | temporal | second | CIR | L3 | -17.223 | 0.997 | 75.563 | 7.865 |

#### 10->5

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Embed | domain | method | CSI | Lp | NMSEdb | SGCS | FLops(M) | Params(M) |
| MLP | unuse | - | - | - | - | -17.15 | 0.999 | 0.491 | 0.492 |
| CNN | unuse | - | - | - | - | -16.869 | 0.998 | 1.918 | 0.674 |
| CNN | use | spatial | first | CFR | L1 | -20.365 | 0.998 | 2.082 | 0.691 |
| CNN | use | spatial | first | CFR | L2 | -20.276 | 0.998 | 2.082 | 0.691 |
| CNN | use | spatial | first | CFR | L3 | -20.276 | 0.998 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L1 | -20.267 | 0.998 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L2 | -20.276 | 0.998 | 2.082 | 0.691 |
| CNN | use | spatial | first | CIR | L3 | -20.276 | 0.998 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L1 | -19.861 | 0.997 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L2 | -19.91 | 0.997 | 2.082 | 0.691 |
| CNN | use | spatial | second | CFR | L3 | -19.92 | 0.997 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L1 | -19.98 | 0.997 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L2 | -19.876 | 0.997 | 2.082 | 0.691 |
| CNN | use | spatial | second | CIR | L3 | -19.913 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L1 | -19.483 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L2 | -19.504 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | first | CFR | L3 | -19.504 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L1 | -19.504 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L2 | -19.504 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | first | CIR | L3 | -19.504 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L1 | -19.275 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L2 | -19.269 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | second | CFR | L3 | -19.28 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L1 | -19.258 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L2 | -19.246 | 0.997 | 2.082 | 0.691 |
| CNN | use | temporal | second | CIR | L3 | -19.246 | 0.997 | 2.082 | 0.691 |
| CVCNN | unuse | - | - | - | - | -14.76 | 0.997 | 5.607 | 0.87 |
| CVCNN | use | spatial | first | CFR | L1 | -16.444 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CFR | L2 | -16.438 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CFR | L3 | -16.438 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CIR | L1 | -16.455 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CIR | L2 | -16.438 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | first | CIR | L3 | -16.438 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L1 | -16.785 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L2 | -16.815 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CFR | L3 | -16.827 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L1 | -16.225 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L2 | -16.843 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | spatial | second | CIR | L3 | -16.469 | 0.997 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L1 | -16.307 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L2 | -16.266 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CFR | L3 | -16.266 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L1 | -16.266 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L2 | -16.266 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | first | CIR | L3 | -16.266 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L1 | -16.454 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L2 | -16.461 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CFR | L3 | -16.442 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CIR | L1 | -16.438 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CIR | L2 | -16.394 | 0.996 | 5.771 | 0.887 |
| CVCNN | use | temporal | second | CIR | L3 | -16.394 | 0.996 | 5.771 | 0.887 |
| RNN | unuse | - | - | - | - | -15.295 | 0.996 | 19.165 | 2.299 |
| LSTM | unuse | - | - | - | - | -17.111 | 0.998 | 75.465 | 7.914 |
| LSTM | use | spatial | first | CFR | L1 | -17.274 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CFR | L2 | -17.3 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CFR | L3 | -17.3 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L1 | -17.288 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L2 | -17.3 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | first | CIR | L3 | -17.3 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L1 | -17.348 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L2 | -17.324 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CFR | L3 | -17.334 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L1 | -17.295 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L2 | -17.311 | 0.998 | 75.629 | 7.931 |
| LSTM | use | spatial | second | CIR | L3 | -17.31 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L1 | -16.936 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L2 | -16.942 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CFR | L3 | -16.942 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L1 | -16.942 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L2 | -16.942 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | first | CIR | L3 | -16.942 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L1 | -16.947 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L2 | -16.919 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CFR | L3 | -16.854 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L1 | -16.935 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L2 | -16.937 | 0.998 | 75.629 | 7.931 |
| LSTM | use | temporal | second | CIR | L3 | -16.937 | 0.998 | 75.629 | 7.931 |

# 五、结果分析

本研究聚焦于信道预测，选用多种基于 AI 的模型，同时选择合理的方法计算相干编码（Coherence Embedding），利用开源数据集和校内实测数据集展开实验，旨在探究不同模型在不同场景下的性能表现。通过设置可变的观察窗口和预测窗口大小，采用 NMSE（归一化均方误差）、SGCS（余弦相似度）、Flops（浮点操作数）、Params（参数量）、Tops（每秒万亿次操作）等指标对模型预测效果进行量化评估，以下是对实验结果的详细分析。

CNN 模型在局部特征提取方面有独特优势，但其卷积核大小受限，在处理较长上下文信息时存在性能瓶颈。在 Case1 的实验中，CNN 在不同预测窗口和使用相干信息嵌入编码的不同情况下，预测精度有一定波动。如在 5->1 预测时，使用空间相干信息嵌入且采用第一种计算方法，针对 CFR 指标，L1 范数计算的 NMSEdb 值为 -10.142，相比未使用嵌入编码时有所提升，但仍低于 LSTM、Transformer 等模型在类似情况下的表现。这说明 CNN 虽然能有效捕捉短期模式，但在处理长期信道状态预测时，综合性能相对较弱。

复值神经网络（CVCNN）能够直接处理复数输入，在无线信道预测中具有一定优势。在 Case1 的 5->1 预测中，CVCNN 未使用嵌入编码时 NMSEdb 值为 -16.342，使用后在不同计算维度和方法下，预测精度有一定提升，如在空间维度下针对 CFR 指标，L1 范数计算时 NMSEdb 值为 -9.737。然而，与其他模型相比，其提升幅度有限，且计算复杂度相对较高，如在该情况下 FLops 值为 1.973，高于 MLP 的 0.049，这在一定程度上限制了其在实际中的应用。

对比不同模型，Transformer 和 Informer 在长距离依赖和序列建模方面表现出色。在 Case1 的 5->1 预测中，Transformer 未使用嵌入编码时 NMSEdb 值为 -16.561，Informer 为 -17.213，二者的 SGCS 值均在 0.956 左右，预测效果良好。随着预测窗口增大到 5->3 和 5->5，Informer 在计算复杂度上的优化优势逐渐凸显，其概率稀疏自注意力机制减少了运算资源消耗，在保证预测精度的同时，提高了模型预测速度，相比 Transformer 更具优势。例如在 5->5 预测中，Informer 的 FLops 值为 551.658，低于 Transformer 的 960.48，而预测精度上二者差距不大，这使得 Informer 在处理大规模时序数据的信道预测任务中更具潜力。

从**不同预测窗口大**小对模型性能的影响来看，随着预测窗口从 1 增加到 3 和 5，各模型的预测难度明显增大，NMSEdb 值普遍升高（绝对值减小），SGCS 值普遍降低，表明预测准确性下降。例如在 Case2（用户移动速率为 60km/h）中，MLP 模型在 5->1 预测时 NMSEdb 值为 -7.587，5->3 时为 -6.022，5->5 时为 -4.72，SGCS 值也从 0.693 依次降低到 0.636 和 0.574。这是因为预测未来多个时间点的信道状态需要模型捕捉更复杂的时间序列关系，对模型的能力要求更高。不同模型在面对预测窗口变化时的性能变化幅度不同，LSTM 和 Transformer 等模型相对更稳定，能够在一定程度上保持较好的预测性能，而 MLP 和 CNN 等模型性能波动较大，这反映出不同模型在处理多步预测时的适应性存在差异。

在**不同数据集场景**下，实验结果也存在一定差异。校内实测数据集包含不同的室内外环境（Case5 - Case7），与开源数据集中密集城区宏站场景有所不同。在校内测试环境写，所提出的相干编码（Coherence Embedding）可以有效提高预测的准确率，而在开源数据集中表现不佳。初步分析可知，不同环境下信道状态的变化规律不同，这对模型的预测性能产生了影响。在室内环境下，信号的传播特性与室外存在差异，如信号衰减、多径效应等因素不同，导致模型在不同环境下的预测精度有所不同。

这表明，在实际应用中，需要根据具体的通信环境如对预测精度、计算资源、实时性的要求等，选择合适的模型和相干编码的计算方法优化组合，以实现更高效、准确的信道预测，为无线通信系统的资源管理和链路自适应调整提供可靠支持。同时，未来的研究可以进一步探索如何更好地利用相干信息嵌入编码等技术，优化模型结构，提高模型在不同场景下的泛化能力和预测性能。