Modulation Recognition of

Communication Signals using CNN

Abstract

Digital signal modulation recognition will help people to solve problems such as high complexity, low accuracy and cumbersome manual extraction of features by traditional machine learning algorithms. a convolution neural network combines bidirectional long short-term memory (BiLSTM) and Attention Mechanism to complete the recognition task

Role of each member

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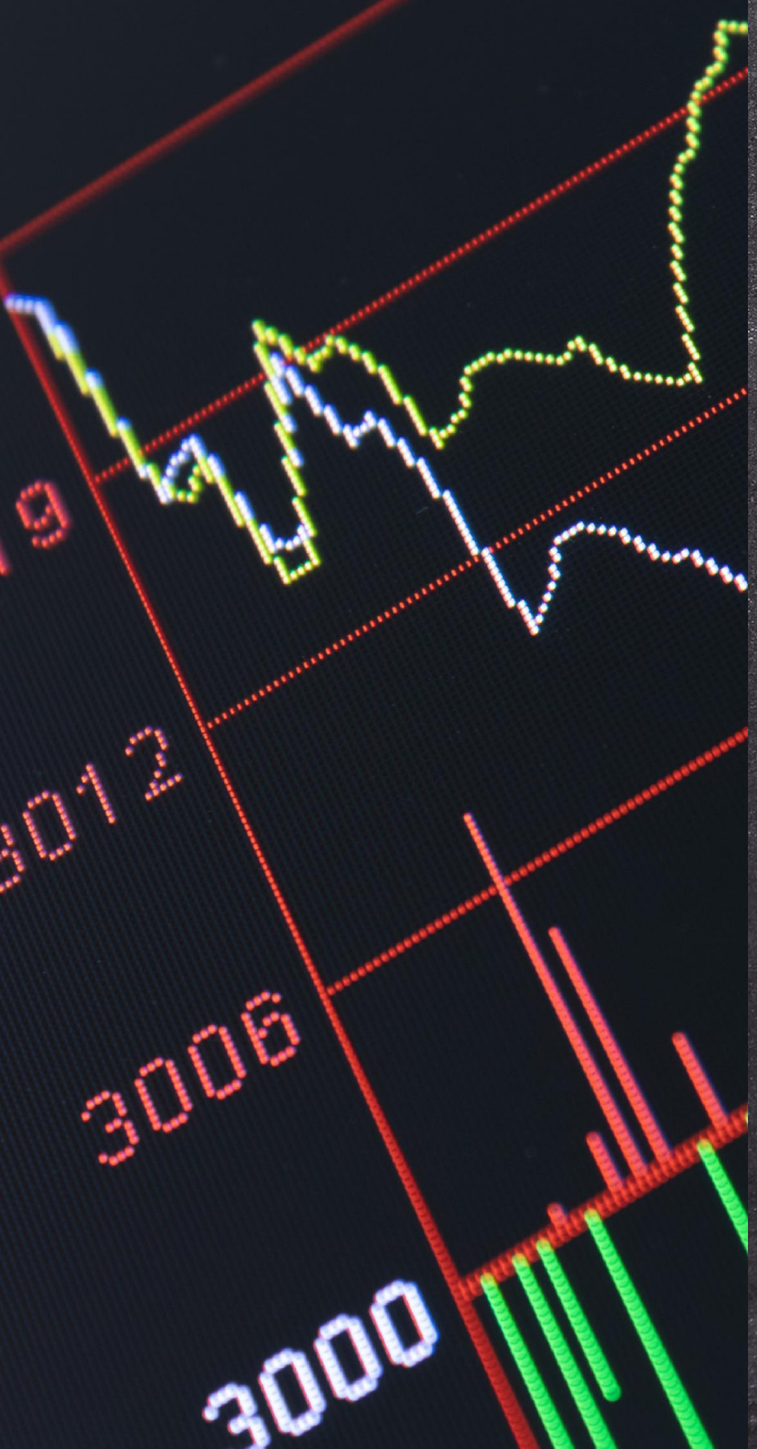
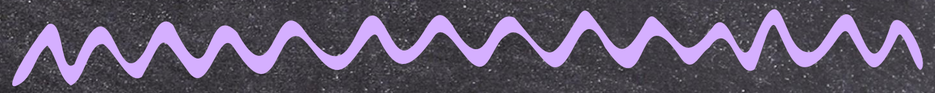


Problem Statement

To show that the combination of ML algorithms with CNN and Attention Mechanism improves recognition accuracy in different communication signals as compared to other traditional ML methods at low SNR.



What is Modulation Recognition ?

Identification (modulation scheme) and Analyzation (characteristics of the received signal to determine the modulation technique)

Need of Modulation Recognition ?

Needed in

- Communication System Identification
- Signal Classification
- Signal Intelligence and Surveillance
- Security and Interference Detection
- System Performance Monitoring

What is CNN ?

CNN - Bi-Directional Long Short Term Memory

Convolutional Neural Network Algo (ML Algo) CNN + BiLSTM + Attention Mechanism = C-BiLSTM-A

Need of CNN ?

To solve problems such as high complexity, low accuracy and cumbersome manual extraction of features by traditional machine learning algorithms

CNN + BiLSTM + Attention Mechanism = C-BiLSTM-A

Random Forest, SVM, KNN

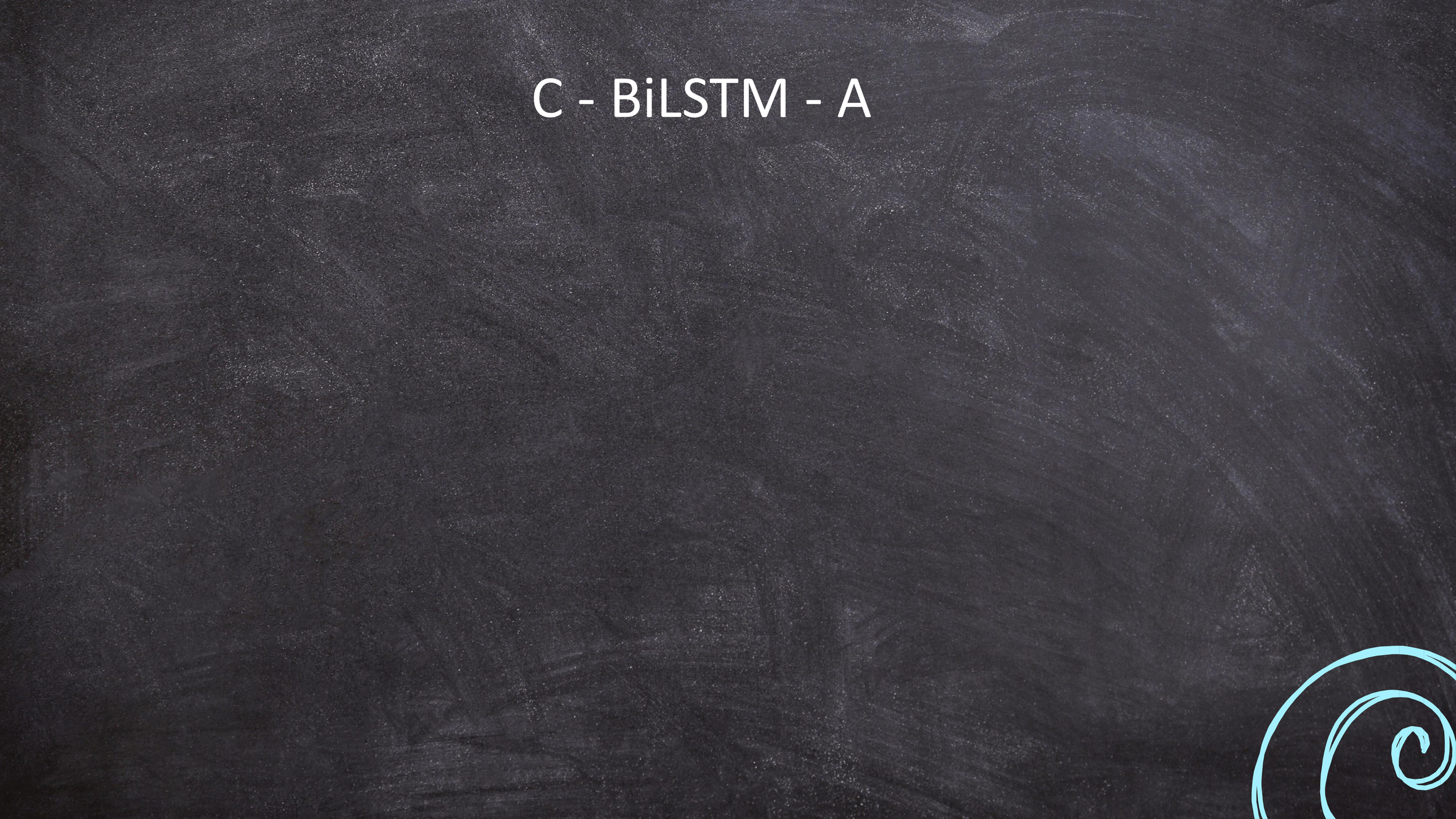
Bi-LSTM

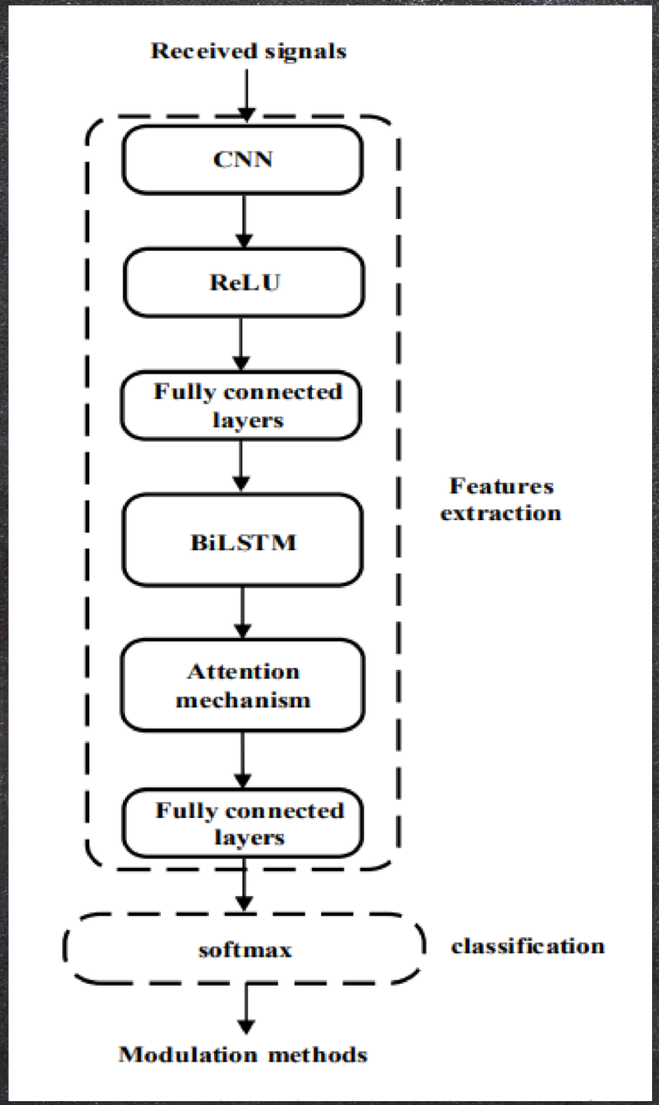
Type of recurrent neural network (RNN) architecture that processes the input sequence in both forward and backward directions simultaneously.

Attention Mechanism

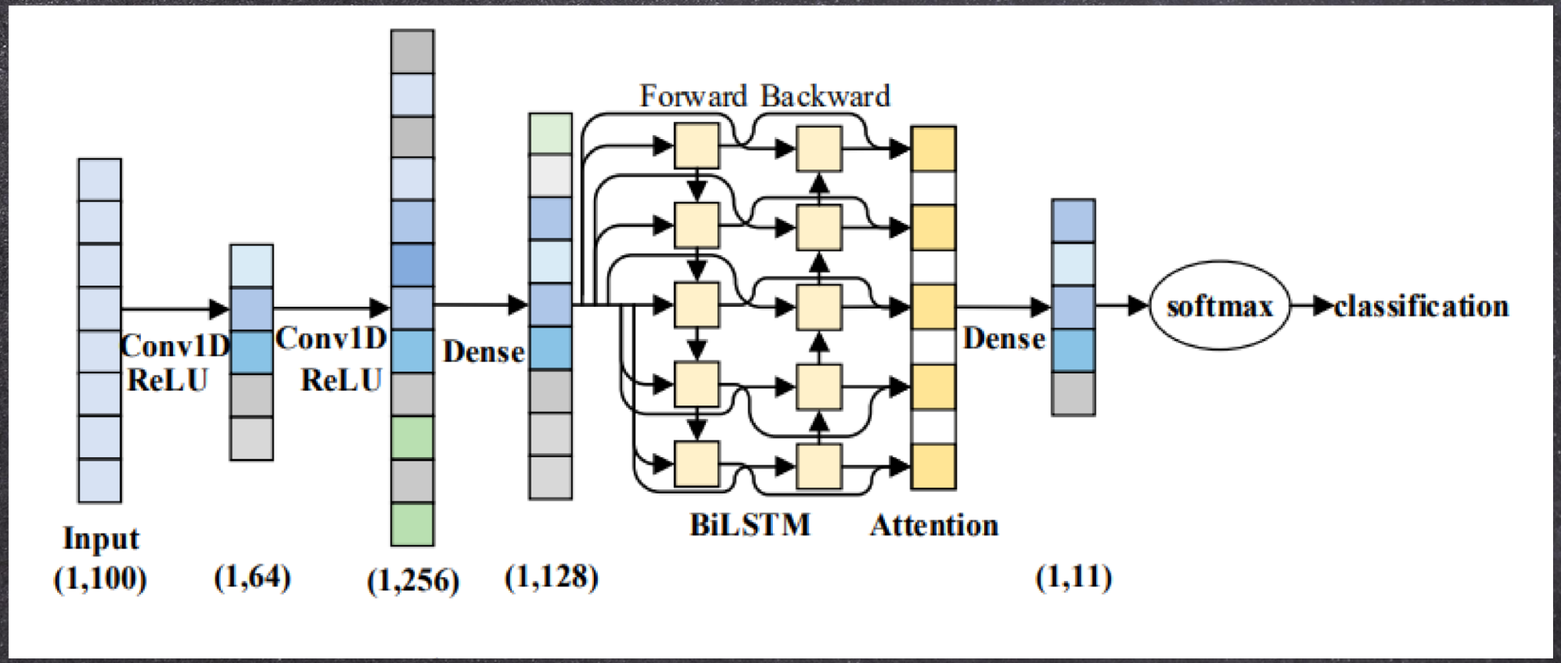
A concept in ML and DL that focusses on some parts of input data of communication signal to make better predictions or decisions

C - BiLSTM - A

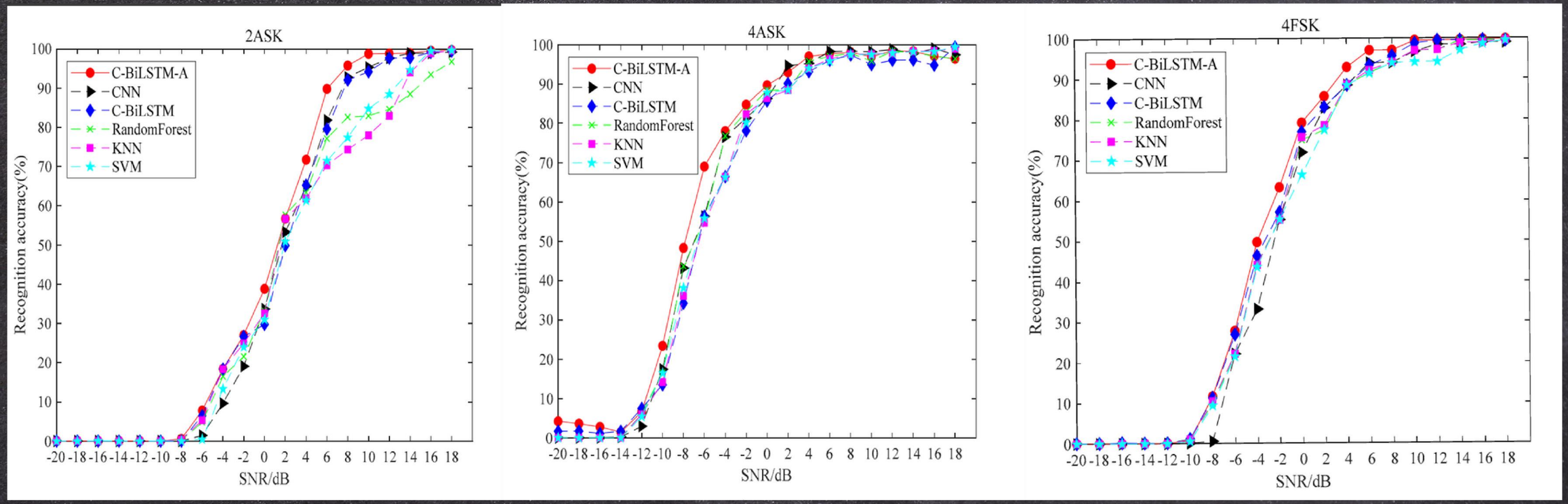


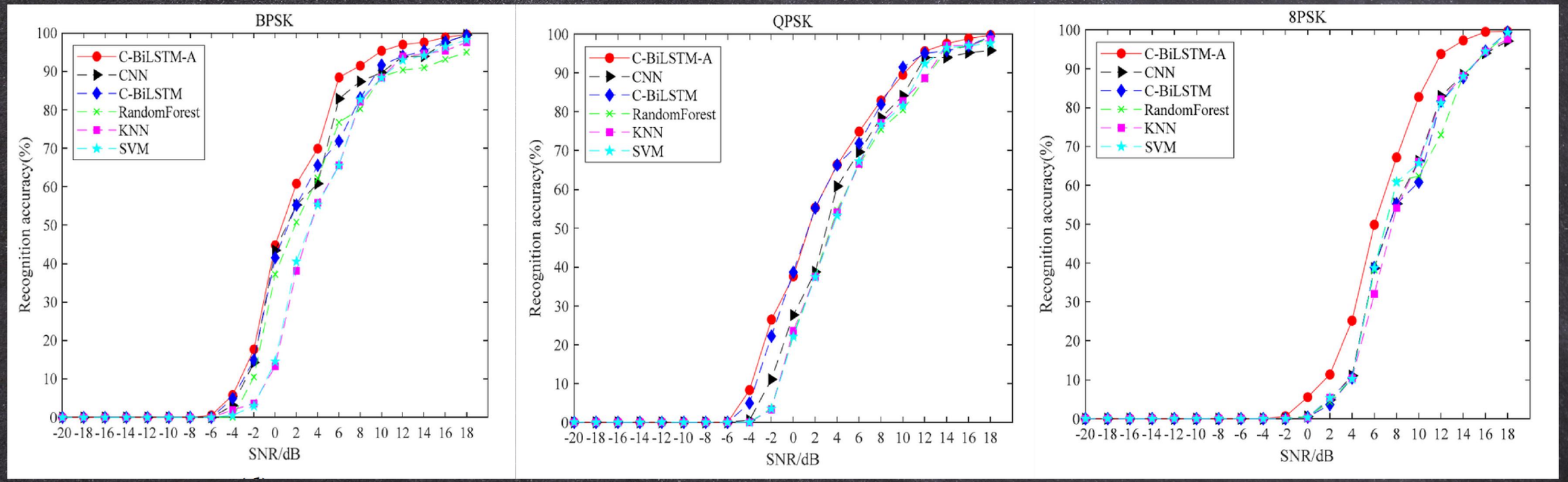


Algorithm



Structure


2ASK
4ASK
4FSK
C-BiLSTM-A
CNN
C-BiLSTM
RandomForest
KNN
SVM
Recognition accuracy(%)
SNR/dB

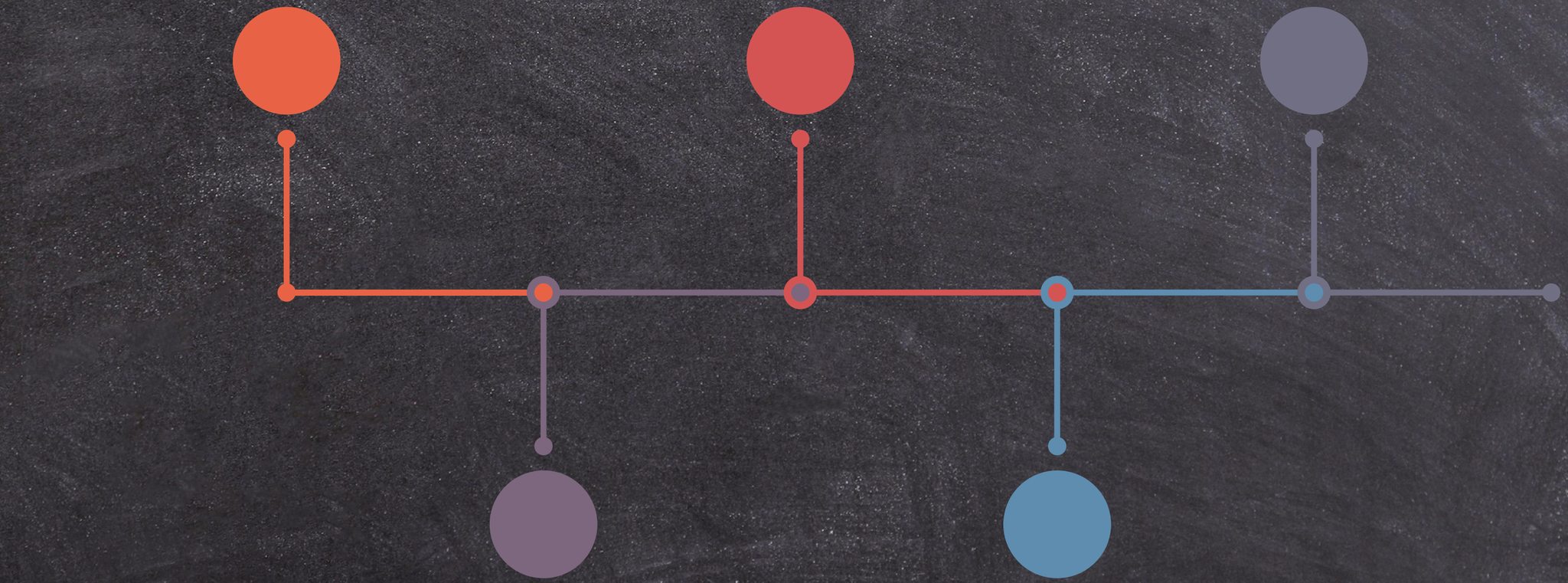

BPSK
QPSK
8PSK
C-BiLSTM-A
CNN
C-BiLSTM
RandomForest
KNN
SVM
Recognition accuracy(%)
SNR/dB
0 10 20 30 40 50 60 70 80 90 100
-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 0 2 4 6 8 10 12 14 16 18

TIMELINE

First time that the recognition of signal modulation mode is essentially a pattern recognition problem
1969

Proposed a robust method for asynchronous modulation recognition
1997

Modulation Recognition of Communication Signal Based on Convolutional Neural Network. Symmetry
2021



First time to identify the modulation pattern of BPSK and QPSK
1988

Proposed a recognition method based on a hybrid likelihood ratio test
2000

Conclusion

The C-BiLSTM-A algorithm, which improves the recognition accuracy of digital signal modulation by combining CNN, BiLSTM and the attention mechanism. C-BiLSTM-A model has achieved good recognition results under the modulation types of 2ASK, 4ASK, 4FSK, BPSK, QPSK, 8PSK and 64QAM, and the recognition accuracy is about 5% higher than that of the comparison algorithm under low signal-to-noise ratio. Adding BiLSTM and attention mechanism to CNN is very helpful to improve the recognition effect of the model. At the same time, it also proves that the deep learning model performs better in universality in the field of digital signal modulation recognition than the traditional machine learning methods.

References

- Modulation Recognition of Communication Signal Based on Convolutional Neural Network by Kaiyuan Jiang, Xvan Qin, Jiawei Zhang and Aili Wang


THANK YOU