0. Load dependencies

In [1]:
```
import warnings
warnings.simplefilter(action='ignore', category=FutureWarning)

import os
import sys
import h5py
import time
import random
import joblib
import datetime
import numpy as np
import tensorflow as tf
import matplotlib
import matplotlib.pyplot as plt
from shutil import copy
from pathlib import Path

from tensorflow import keras
from tensorflow.keras import activations
from tensorflow.keras import initializers
from tensorflow.keras import regularizers
from tensorflow.keras import constraints
from tensorflow.keras.layers import Input, Dense, Reshape, Flatten, Dropou
t, Concatenate, Lambda
from tensorflow.keras.layers import BatchNormalization, Activation, ZeroPad
ding2D, Add, Subtract, Multiply
from tensorflow.keras.layers import LeakyReLU
from tensorflow.keras.layers import UpSampling2D, Conv2D, SeparableConv2D,
MaxPooling2D
from tensorflow.keras.models import Sequential, Model, load_model
from tensorflow.keras.optimizers import Adam
import tensorflow.keras.backend as K

import Utility.ReadH5 as ReadH5
from Utility.log import logger
from Utility.loss import spectral_loss, combined_loss, hallucination_loss
from DataLoader.data_loader_blind import DataLoader
os.environ["CUDA_VISIBLE_DEVICES"]="0"
```

1. Generate training data

Load the hyperspectral data

Load and plot: hyperspectral microscopy image of CsPbBr3 nanoplatelet film.

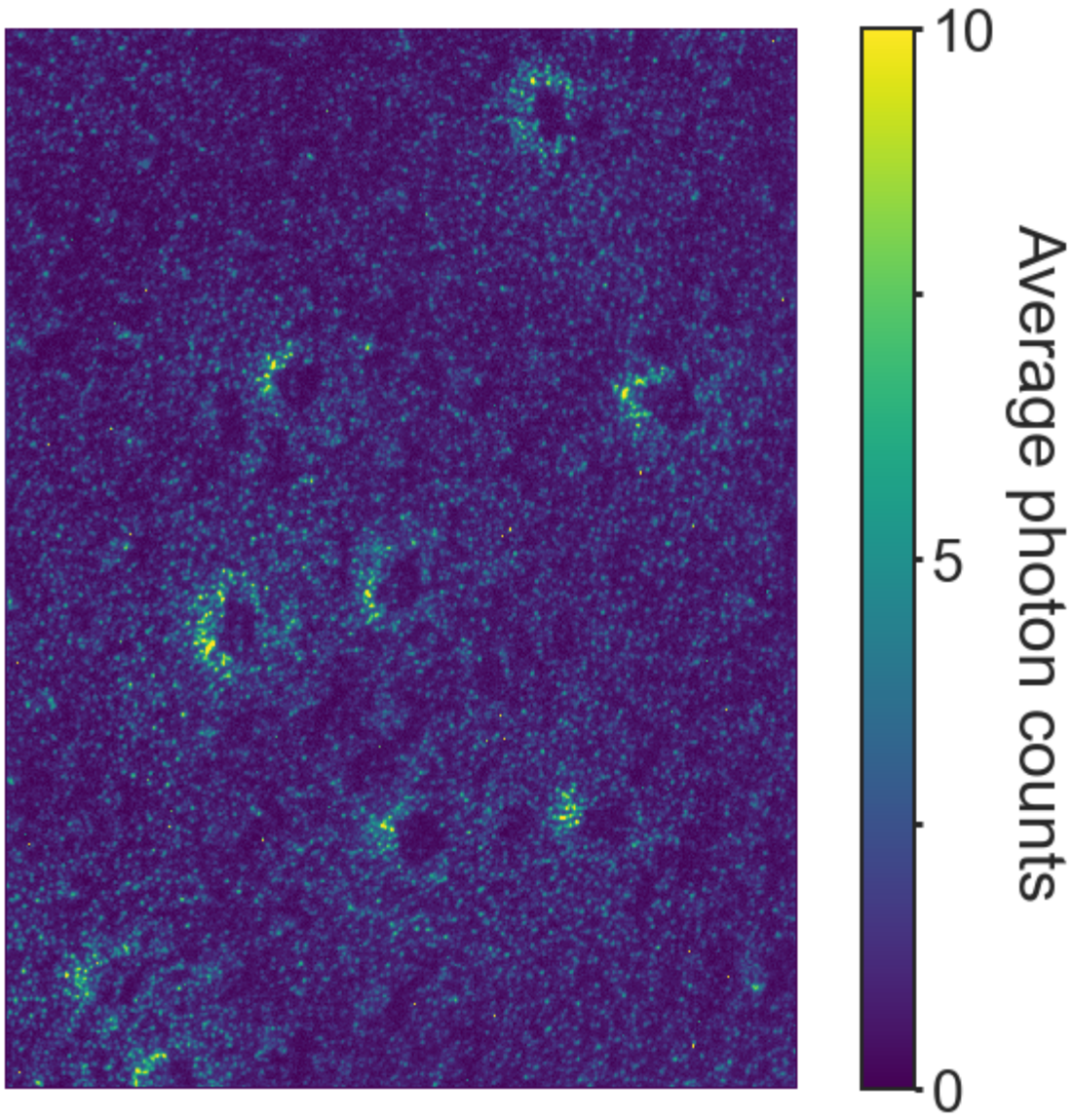
Expect output: SI Figure 6a.

Time cost: 1-3 min

In [2]:

```
# Load data
file = r'CsPbBr3'
script_dir = os.path.dirname(os.path.realpath('__file__'))
path = Path(script_dir)
file_name = file + '.h5'
file_dir = os.path.join(str(path), 'Data', file_name)
with h5py.File(file_dir, 'r') as f:
    image = f['Cube']['Images'][()]
img = image.astype(np.float32)
img = np.swapaxes(np.swapaxes(img, -1, 0),0,1)
print('The image has a size of {} x {} x {} pixels.'.format(img.shape[0],im
g.shape[1],img.shape[2]))

# Plot PL intensity map
plt.style.use('seaborn-white')
matplotlib.rcParams['axes.linewidth'] = 2
font = {'size': 34}
matplotlib.rc('font', **font)
matplotlib.rcParams['xtick.major.pad']='8'
matplotlib.rcParams['ytick.major.pad']='8'
plt.rcParams["font.weight"] = "normal"
plt.rcParams["axes.labelweight"] = "normal"

fig, ax = plt.subplots(figsize = (12,10))
mat = ax.matshow(np.mean(img,axis=2)/2**16*30000, cmap='viridis', vmin=0, v
max=10)  # Calculating effective photons from CCD readings (Supplementary N
ote 7)
cbar = fig.colorbar(mat)
cbar.ax.set_ylabel('Average photon counts',labelpad=35, rotation=-90)
cbar.ax.yaxis.set_major_locator(matplotlib.ticker.MaxNLocator(nbins=3, inte
ger=True, steps=[1, 2, 5, 10]))
cbar.ax.yaxis.set_minor_locator(matplotlib.ticker.AutoMinorLocator(2))
cbar.ax.tick_params(axis='y', direction='out',length=4,width=3,pad=5,labels
ize=30)
cbar.ax.tick_params(axis='y',which='minor',direction='out',length=4,width=
3,pad=5,labelsize=30)
ax.axes.get_xaxis().set_visible(False)
ax.axes.get_yaxis().set_visible(False)
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)
ax.spines['bottom'].set_visible(False)
ax.spines['left'].set_visible(False)
plt.show()
```

```
The image has a size of 1392 x 1040 x 66 pixels.
```



Prepare training data

Preparing training data for learning by adding noise to the already noisy datacube.

We will plot a small section of the PL map corresponding to a region demonstrated in the main text (Figure 2a, 480 nm) to show how the amout of noise in image affect visual preception.

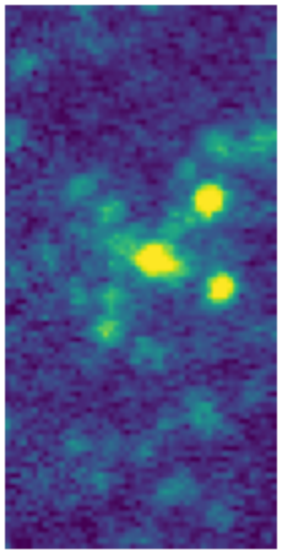
Expected output: a serie of images for training with different noise levels (sigma = 0, 5, 10, 20 or 50).

Time cost: 5 min

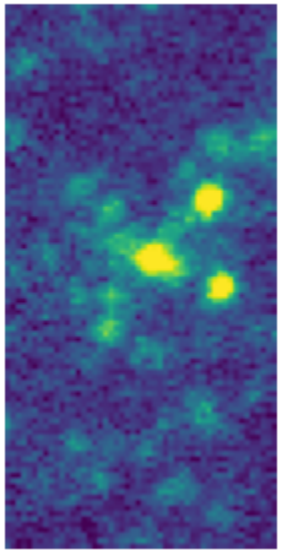
In [3]:

```
# normalize the image to a data range from -1 to 1 for training, and cut th
e high intensity noise from cosmic ray in datacube
img_norm,_,_ = ReadH5.normalization(img, dynamic=0.9999)

# adding noise to the data
noise_list = [0, 5, 10, 20, 50]

for noise_rgb in noise_list:

    noisy_img = np.zeros(img.shape)
    pkl_data = {}
    noise_std = noise_rgb/255*2
    noisy_img = img_norm + np.random.normal(0, noise_std, img.shape)
    noisy_img = np.clip(noisy_img, -1, 1)

    if noise_rgb == 0:
        pkl_data = {'train':{'HR': img_norm[:, :, :],},'valid':{'LR': None,
'HR': None,},'test':{'LR': None, 'HR': None,}}
    else:
        pkl_data = {
            'train':{'LR': noisy_img[:, :, :],},'valid':{'LR': None,'HR': N
one,},'test':{'LR': None,'HR': None,}}

    with open(os.path.join(str(path), 'Data', 'Train', '{}_{}.joblib'.forma
t(file, noise_rgb)), 'wb') as handle:
        joblib.dump(pkl_data, handle)

    # plot images
    fig, ax = plt.subplots(figsize=(6, 5))
    ax.imshow(ReadH5.normalization(noisy_img[1000:1100,468:518,30], dynamic
= 0.99)[0],cmap='viridis',)
    ax.set_frame_on(False)
    ax.set(xticklabels=[])
    ax.axes.get_yaxis().set_visible(False)
    ax.set_xlabel('sigma = {}'.format(noise_rgb), labelpad=10, fontsize=24)
    ax.xaxis.set_label_position('top')

# clean up memory
del img
del img_norm
del noisy_img
del pkl_data
```

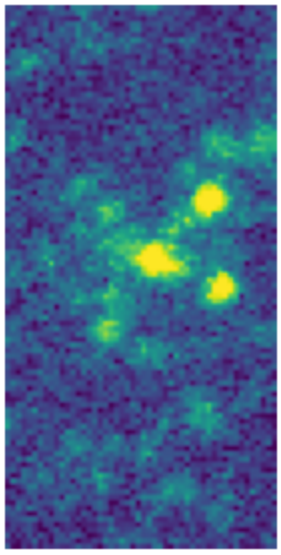
sigma = 0

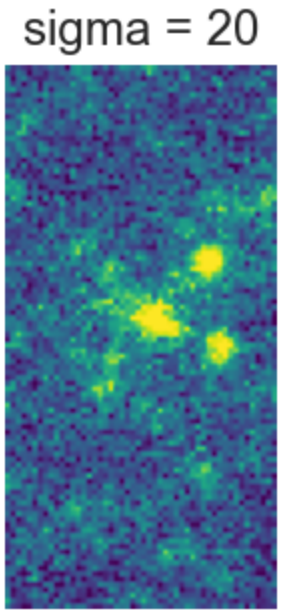


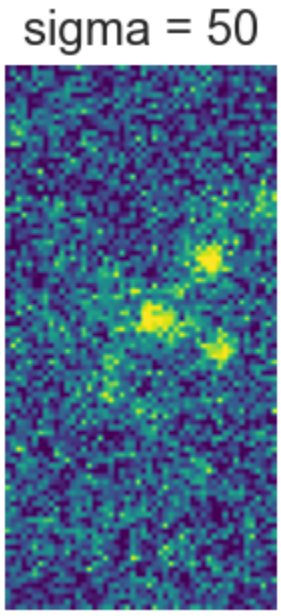
sigma = 5



sigma = 10







2. Train the model

Load the machine learning algorithm and the prepared dataset

Expect output: "Loading completed!" message.

Time cost: 3-5 min

In [4]:

```
class PANet():
    def __init__(self, experiment_name, file_name, dataset_name='standard_
1'):
        # Input shape
        self.imgsize = 64
        self.channels = 32
        self.lr_height = self.imgsize  # Low resolution height
        self.lr_width = self.imgsize  # Low resolution width
        self.lr_shape = (None, None, self.channels)
        self.hr_height = self.imgsize  # High resolution height
        self.hr_width = self.imgsize  # High resolution width
        self.hr_shape = (None, None, self.channels)
        self.sigma_shape = (None, None, 1)
        self.noise_list = [5, 10, 20, 50]

        os.makedirs('Model/saved_model/%s' % experiment_name, exist_ok=Tru
e)

        self.file_name = file_name
        self.experiment_name = experiment_name  # The experiment name

        # Number of residual blocks in the generator
        self.n_residual_blocks = 16

        self.default_lr = 0.0002
        optimizer = Adam(self.default_lr, 0.5)

        # Configure data loader
        self.dataset_name = dataset_name
        self.data_loader = DataLoader(self.file_name, self.dataset_name,
                                      img_res=(self.hr_height, self.hr_widt
h), channel=self.channels)

        # Calculate output shape of D (PatchGAN)
        patch = int(self.hr_height / 2 ** 4)
        self.disc_patch = (patch, patch, 1)

        # Number of filters in the first layer of G and D
        self.gf = 32

        # Build the generator
        self.detector = self.build_detector()
        self.detector.compile(loss='mse',
                              optimizer=optimizer,
                              metrics=[])

        self.generator = self.build_generator()
        img_lr = Input(shape=self.lr_shape)
        sigma = self.detector(img_lr)
        gen_hr = self.generator([img_lr, sigma])

        def hallucination_loss(y_true, y_pred):
            y_true = K.cast(y_true, y_pred.dtype)
            den = K.square(y_true + 1) + 0.001
            weights = tf.divide(0.001, den)-0.95
            weights = K.relu(weights)+1
            normal_mse = K.square(y_pred - y_true)
            weighted_loss = normal_mse * weights
            mean_weighted_loss = K.mean(weighted_loss, axis=-1)
```

```
            return mean_weighted_loss

        def spectral_loss(y_true, y_pred):
            y_true = K.cast(y_true, y_pred.dtype)

            # Calculate grad
            grad_HR = y_true[:, :, :, :-1] - y_true[:, :, :, 1:]
            grad_SR = y_pred[:, :, :, :-1] - y_pred[:, :, :, 1:]

            grad_diff = grad_HR - grad_SR
            grad_diff_1 = grad_diff[:, :, :, :-1]
            grad_diff_2 = grad_diff[:, :, :, 1:]

            spec_loss = K.mean(0.5 * K.square(grad_diff_1) +
                               0.5 * K.square(grad_diff_2), axis=-1)

            return spec_loss

        def combined_loss(y_true, y_pred, A=0.1, B=0):
            y_true = K.cast(y_true, y_pred.dtype)

            spec_loss = spectral_loss(y_true, y_pred)
            normal_mse = K.mean(K.square(y_pred - y_true), axis=-1)
            hallu_loss = hallucination_loss(y_true, y_pred)

            # change params here
            merged_loss = normal_mse + A*spec_loss + B*hallu_loss

            return merged_loss

        # Compile combined model
        self.combined = Model([img_lr], [gen_hr, sigma])
        self.combined.compile(loss=[combined_loss, 'mse'],
                              metrics=['mse',],
                              loss_weights=[1,1],
                              optimizer=optimizer)

    def calculate_learning_rate(self, epoch_x_batchsize, c=0.02):
        if epoch_x_batchsize < 1000:
            return self.default_lr
        elif epoch_x_batchsize > 50000:
            return self.default_lr * np.exp(0.01 * (100 - 5000) * c)
        else:
            return self.default_lr * np.exp(0.01 * (100 - epoch_x_batchsiz
e/10) * c)

    def build_generator(self):

        def residual_block(layer_input, filters):
            """Residual block described in paper"""
            d = Conv2D(filters, kernel_size=3, strides=1,
                       padding='same')(layer_input)
            d = Activation('relu')(d)
            d = BatchNormalization(momentum=0.8)(d)
            d = Conv2D(filters, kernel_size=3, strides=1, padding='same')
(d)
            d = BatchNormalization(momentum=0.8)(d)
            d = Add()([d, layer_input])
            return d

        def deconv2d(layer_input):
```

```
            """Layers used during upsampling"""
            u = Conv2D(self.gf*4, kernel_size=3, strides=1,
                       padding='same')(layer_input)
            u = Activation('relu')(u)
            return u

        def pad():
            def func(x):
                x = K.ones_like(x)
                x = x[:, :, :, -1:]
                return x*0.01
            return Lambda(func, output_shape=(None, None, 1))

        # noisy image input
        img_lr = Input(shape=(None, None, self.channels))
        sigma = Input(shape=(None,))
        sigma_reshape = Reshape((1,1,1))(sigma)

        padding = pad()(img_lr)
        padding = Multiply()([padding, sigma_reshape])
        padded_lr = Concatenate(axis=-1)([img_lr, padding])

        # Pre-residual block
        c1 = Conv2D(self.gf*4, kernel_size=3,
                    strides=1, padding='same')(padded_lr)
        c2 = LeakyReLU(alpha=0.2)(c1)
        c2 = Conv2D(self.gf*2, kernel_size=3, strides=1, padding='same')(c
2)
        c3 = LeakyReLU(alpha=0.2)(c2)
        c3 = BatchNormalization(momentum=0.8)(c3)
        c3 = Conv2D(self.gf, kernel_size=3, strides=1, padding='same')(c3)
        c4 = LeakyReLU(alpha=0.2)(c3)
        c4 = BatchNormalization(momentum=0.8)(c4)

        # Propogate through residual blocks
        r = residual_block(c4, self.gf)
        for _ in range(self.n_residual_blocks - 3):
            r = residual_block(r, self.gf)

        # Post-residual block
        c5 = Conv2D(self.gf, kernel_size=3, strides=1, padding='same')(r)
        c5 = LeakyReLU(alpha=0.2)(c5)
        c5 = BatchNormalization(momentum=0.8)(c5)
        c5 = Add()([c5, c3])
        c6 = Conv2D(self.gf*2, kernel_size=3, strides=1, padding='same')(c
5)
        c6 = LeakyReLU(alpha=0.2)(c6)
        c6 = BatchNormalization(momentum=0.8)(c6)
        c6 = Add()([c6, c2])
        c7 = Conv2D(self.gf*4, kernel_size=3, strides=1, padding='same')(c
6)
        c7 = BatchNormalization(momentum=0.8)(c7)
        c7 = Add()([c7, c1])

        # Upsampling
        u1 = deconv2d(c7)
        u2 = deconv2d(u1)

        # Generate high resolution output
        gen_hr = Conv2D(self.channels, kernel_size=3, strides=1,
                        padding='same', activation='tanh')(u2)
```

```
        return Model([img_lr, sigma], gen_hr)

    def build_detector(self):

        def residual_block(layer_input, filters):
            """Residual block described in paper"""
            d = Conv2D(filters, kernel_size=3, strides=1,
                       padding='same')(layer_input)
            d = Activation('relu')(d)
            d = BatchNormalization(momentum=0.8)(d)
            d = Conv2D(filters, kernel_size=3, strides=1, padding='same')
(d)
            d = BatchNormalization(momentum=0.8)(d)
            d = Add()([d, layer_input])
            return d

        def crop(size):
            def func(x):
                return x[:, :size, :size, :]
            return Lambda(func, output_shape=(size,size,self.gf))

        # noisy image input, input x & y size >= 64
        img_lr = Input(shape=(None, None, self.channels))

        # Pre block
        c1 = Conv2D(self.gf, kernel_size=3,
                    strides=1, padding='same')(img_lr)
        c2 = LeakyReLU(alpha=0.2)(c1)

        r = residual_block(c2, self.gf)
        for _ in range(5):
            r = residual_block(r, self.gf)

        c3 = Conv2D(self.gf, kernel_size=3, strides=1, padding='same')(r)
        c3 = Add()([c3, c1])
        # Generate Estimation for Sigma for 64*64 image size
        n1 = crop(64)(c3)
        n1.set_shape(shape=(None, 64, 64, self.gf))
        n2 = Conv2D(self.gf, kernel_size=3, strides=2)(n1)
        n3 = Conv2D(self.gf*2, kernel_size=3, strides=2)(n2)
        n4 = Conv2D(self.gf*4, kernel_size=3, strides=2)(n3)
        n5 = Conv2D(self.gf*4, kernel_size=3, strides=2)(n4)
        n6 = Dense(self.gf*8)(n5)
        n7 = LeakyReLU(alpha=0.2)(n6)
        n8 = Flatten()(n7)
        sigma = Dense(1)(n8)

        return Model(img_lr, sigma)

    def train(self, epochs, batch_size=1, save_interval=100):

        start_time = datetime.datetime.now()

        gen_model_path = r'Model/DCMall_pretrained.h5'
        self.combined.load_weights(gen_model_path)

        for epoch in range(epochs):
            current_epoch = epoch + 1

            sigma_index = np.array([0] * batch_size)
```

```
            sigma = [0] * batch_size

            for i in range(batch_size):
                sigma_index[i] = random.randint(0,len(self.noise_list)-1)
                sigma[i] = self.noise_list[sigma_index[i]]

            imgs_hr, imgs_lr = self.data_loader.load_data(batch_size,sigma=
sigma)

            # Train the generators only
            current_learning_rate = self.calculate_learning_rate(current_ep
och*batch_size)
            K.set_value(self.combined.optimizer.lr, current_learning_rate)

            g_loss = self.combined.train_on_batch(
                imgs_lr, [imgs_hr, np.array(sigma)])
            # NOTE: g_loss[0] is combined model loss

            elapsed_time = datetime.datetime.now() - start_time

            # Plot the progress
            loss_str = ''
            loss_str += 'combined-> '
            for i in range(len(g_loss)):
                loss_str += '{}:{} ||'.format(
                    self.combined.metrics_names[i], g_loss[i])

            logger.info("%d time: %s  %s" %
                        (current_epoch, elapsed_time, loss_str))

            # Save model at save_interval
            if current_epoch % save_interval == 0:
                self.combined.save(
                    'Model/saved_model/{}/'.format(self.experiment_name) +
'gen_model%d.h5' % current_epoch)

        logger.info('Training completed.')

net = PANet(experiment_name='CsPbBr3', file_name='CsPbBr3', dataset_name='s
tandard_1')
print("Loading completed!")
```

```
dict_keys([0, 5, 10, 20, 50]) loaded
Loading completed!
```

In [5]:
```
net.generator.summary()
net.detector.summary()
```

```
Model: "model_1"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
input_2 (InputLayer)            [(None, None, None,  0
__________________________________________________________________________________________________
input_3 (InputLayer)            [(None, None)]       0
__________________________________________________________________________________________________
lambda_1 (Lambda)               (None, None, None, 1 0           input_2[0][0]
__________________________________________________________________________________________________
reshape (Reshape)               (None, 1, 1, 1)      0           input_3[0][0]
__________________________________________________________________________________________________
multiply (Multiply)             (None, None, None, 1 0           lambda_1[0][0]
                                                                 reshape[0][0]
__________________________________________________________________________________________________
concatenate (Concatenate)       (None, None, None, 3 0           input_2[0][0]
                                                                 multiply[0][0]
__________________________________________________________________________________________________
conv2d_18 (Conv2D)              (None, None, None, 1 38144       concatenate[0][0]
__________________________________________________________________________________________________
leaky_re_lu_2 (LeakyReLU)       (None, None, None, 1 0           conv2d_18[0][0]
__________________________________________________________________________________________________
conv2d_19 (Conv2D)              (None, None, None, 6 73792       leaky_re_lu_2[0][0]
__________________________________________________________________________________________________
leaky_re_lu_3 (LeakyReLU)       (None, None, None, 6 0           conv2d_19[0][0]
__________________________________________________________________________________________________
batch_normalization_12 (BatchNo (None, None, None, 6 256         leaky_re_lu_3[0][0]
__________________________________________________________________________________________________
conv2d_20 (Conv2D)              (None, None, None, 3 18464       batch_normalization_12[0][0]
__________________________________________________________________________________________________
leaky_re_lu_4 (LeakyReLU)       (None, None, None, 3 0           conv2d_20[0][0]
__________________________________________________________________________________________________
```

```
batch_normalization_13 (BatchNo (None, None, None, 3 128         leaky_re_
lu_4[0][0]
__________________________________________________________________________
_____________________
conv2d_21 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_13[0][0]
__________________________________________________________________________
_____________________
activation_6 (Activation)       (None, None, None, 3 0           conv2d_21
[0][0]
__________________________________________________________________________
_____________________
batch_normalization_14 (BatchNo (None, None, None, 3 128         activatio
n_6[0][0]
__________________________________________________________________________
_____________________
conv2d_22 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_14[0][0]
__________________________________________________________________________
_____________________
batch_normalization_15 (BatchNo (None, None, None, 3 128         conv2d_22
[0][0]
__________________________________________________________________________
_____________________
add_7 (Add)                     (None, None, None, 3 0           batch_nor
malization_15[0][0]
                                                                 batch_nor
malization_13[0][0]
__________________________________________________________________________
_____________________
conv2d_23 (Conv2D)              (None, None, None, 3 9248        add_7[0]
[0]
__________________________________________________________________________
_____________________
activation_7 (Activation)       (None, None, None, 3 0           conv2d_23
[0][0]
__________________________________________________________________________
_____________________
batch_normalization_16 (BatchNo (None, None, None, 3 128         activatio
n_7[0][0]
__________________________________________________________________________
_____________________
conv2d_24 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_16[0][0]
__________________________________________________________________________
_____________________
batch_normalization_17 (BatchNo (None, None, None, 3 128         conv2d_24
[0][0]
__________________________________________________________________________
_____________________
add_8 (Add)                     (None, None, None, 3 0           batch_nor
malization_17[0][0]
                                                                 add_7[0]
[0]
__________________________________________________________________________
_____________________
conv2d_25 (Conv2D)              (None, None, None, 3 9248        add_8[0]
[0]
__________________________________________________________________________
_____________________
activation_8 (Activation)       (None, None, None, 3 0           conv2d_25
```

```
[0][0]
__________________________________________________________________________________________________
__________________________
batch_normalization_18 (BatchNo (None, None, None, 3 128         activatio
n_8[0][0]
__________________________________________________________________________________________________
__________________________
conv2d_26 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_18[0][0]
__________________________________________________________________________________________________
__________________________
batch_normalization_19 (BatchNo (None, None, None, 3 128         conv2d_26
[0][0]
__________________________________________________________________________________________________
__________________________
add_9 (Add)                     (None, None, None, 3 0           batch_nor
malization_19[0][0]
                                                                 add_8[0]
[0]
__________________________________________________________________________________________________
__________________________
conv2d_27 (Conv2D)              (None, None, None, 3 9248        add_9[0]
[0]
__________________________________________________________________________________________________
__________________________
activation_9 (Activation)       (None, None, None, 3 0           conv2d_27
[0][0]
__________________________________________________________________________________________________
__________________________
batch_normalization_20 (BatchNo (None, None, None, 3 128         activatio
n_9[0][0]
__________________________________________________________________________________________________
__________________________
conv2d_28 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_20[0][0]
__________________________________________________________________________________________________
__________________________
batch_normalization_21 (BatchNo (None, None, None, 3 128         conv2d_28
[0][0]
__________________________________________________________________________________________________
__________________________
add_10 (Add)                    (None, None, None, 3 0           batch_nor
malization_21[0][0]
                                                                 add_9[0]
[0]
__________________________________________________________________________________________________
__________________________
conv2d_29 (Conv2D)              (None, None, None, 3 9248        add_10[0]
[0]
__________________________________________________________________________________________________
__________________________
activation_10 (Activation)      (None, None, None, 3 0           conv2d_29
[0][0]
__________________________________________________________________________________________________
__________________________
batch_normalization_22 (BatchNo (None, None, None, 3 128         activatio
n_10[0][0]
__________________________________________________________________________________________________
__________________________
conv2d_30 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_22[0][0]
```

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__________________________________________________________________________________________
__________________________
batch_normalization_23 (BatchNo (None, None, None, 3 128         conv2d_30
[0][0]
__________________________________________________________________________________________
__________________________
add_11 (Add)                    (None, None, None, 3 0           batch_nor
malization_23[0][0]
                                                                 add_10[0]
[0]
__________________________________________________________________________________________
__________________________
conv2d_31 (Conv2D)              (None, None, None, 3 9248        add_11[0]
[0]
__________________________________________________________________________________________
__________________________
activation_11 (Activation)      (None, None, None, 3 0           conv2d_31
[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_24 (BatchNo (None, None, None, 3 128         activatio
n_11[0][0]
__________________________________________________________________________________________
__________________________
conv2d_32 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_24[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_25 (BatchNo (None, None, None, 3 128         conv2d_32
[0][0]
__________________________________________________________________________________________
__________________________
add_12 (Add)                    (None, None, None, 3 0           batch_nor
malization_25[0][0]
                                                                 add_11[0]
[0]
__________________________________________________________________________________________
__________________________
conv2d_33 (Conv2D)              (None, None, None, 3 9248        add_12[0]
[0]
__________________________________________________________________________________________
__________________________
activation_12 (Activation)      (None, None, None, 3 0           conv2d_33
[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_26 (BatchNo (None, None, None, 3 128         activatio
n_12[0][0]
__________________________________________________________________________________________
__________________________
conv2d_34 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_26[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_27 (BatchNo (None, None, None, 3 128         conv2d_34
[0][0]
__________________________________________________________________________________________
__________________________
add_13 (Add)                    (None, None, None, 3 0           batch_nor
malization_27[0][0]
                                                                 add_12[0]
```

```
[0]
__________________________________________________________________________________________
__________________________
conv2d_35 (Conv2D)              (None, None, None, 3 9248        add_13[0]
[0]
__________________________________________________________________________________________
__________________________
activation_13 (Activation)      (None, None, None, 3 0           conv2d_35
[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_28 (BatchNo (None, None, None, 3 128         activatio
n_13[0][0]
__________________________________________________________________________________________
__________________________
conv2d_36 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_28[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_29 (BatchNo (None, None, None, 3 128         conv2d_36
[0][0]
__________________________________________________________________________________________
__________________________
add_14 (Add)                    (None, None, None, 3 0           batch_nor
malization_29[0][0]
                                                                 add_13[0]
[0]
__________________________________________________________________________________________
__________________________
conv2d_37 (Conv2D)              (None, None, None, 3 9248        add_14[0]
[0]
__________________________________________________________________________________________
__________________________
activation_14 (Activation)      (None, None, None, 3 0           conv2d_37
[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_30 (BatchNo (None, None, None, 3 128         activatio
n_14[0][0]
__________________________________________________________________________________________
__________________________
conv2d_38 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_30[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_31 (BatchNo (None, None, None, 3 128         conv2d_38
[0][0]
__________________________________________________________________________________________
__________________________
add_15 (Add)                    (None, None, None, 3 0           batch_nor
malization_31[0][0]
                                                                 add_14[0]
[0]
__________________________________________________________________________________________
__________________________
conv2d_39 (Conv2D)              (None, None, None, 3 9248        add_15[0]
[0]
__________________________________________________________________________________________
__________________________
activation_15 (Activation)      (None, None, None, 3 0           conv2d_39
[0][0]
```

```
__________________________________________________________________________________________
__________________________
batch_normalization_32 (BatchNo (None, None, None, 3 128         activatio
n_15[0][0]
__________________________________________________________________________________________
__________________________
conv2d_40 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_32[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_33 (BatchNo (None, None, None, 3 128         conv2d_40
[0][0]
__________________________________________________________________________________________
__________________________
add_16 (Add)                    (None, None, None, 3 0           batch_nor
malization_33[0][0]
                                                                 add_15[0]
[0]
__________________________________________________________________________________________
__________________________
conv2d_41 (Conv2D)              (None, None, None, 3 9248        add_16[0]
[0]
__________________________________________________________________________________________
__________________________
activation_16 (Activation)      (None, None, None, 3 0           conv2d_41
[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_34 (BatchNo (None, None, None, 3 128         activatio
n_16[0][0]
__________________________________________________________________________________________
__________________________
conv2d_42 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_34[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_35 (BatchNo (None, None, None, 3 128         conv2d_42
[0][0]
__________________________________________________________________________________________
__________________________
add_17 (Add)                    (None, None, None, 3 0           batch_nor
malization_35[0][0]
                                                                 add_16[0]
[0]
__________________________________________________________________________________________
__________________________
conv2d_43 (Conv2D)              (None, None, None, 3 9248        add_17[0]
[0]
__________________________________________________________________________________________
__________________________
activation_17 (Activation)      (None, None, None, 3 0           conv2d_43
[0][0]
__________________________________________________________________________________________
__________________________
batch_normalization_36 (BatchNo (None, None, None, 3 128         activatio
n_17[0][0]
__________________________________________________________________________________________
__________________________
conv2d_44 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_36[0][0]
__________________________________________________________________________________________
```

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__________________________
batch_normalization_37 (BatchNo (None, None, None, 3 128         conv2d_44
[0][0]
__________________________________________________________________________
__________________________
add_18 (Add)                    (None, None, None, 3 0           batch_nor
malization_37[0][0]
                                                                 add_17[0]
[0]
__________________________________________________________________________
__________________________
conv2d_45 (Conv2D)              (None, None, None, 3 9248        add_18[0]
[0]
__________________________________________________________________________
__________________________
activation_18 (Activation)      (None, None, None, 3 0           conv2d_45
[0][0]
__________________________________________________________________________
__________________________
batch_normalization_38 (BatchNo (None, None, None, 3 128         activatio
n_18[0][0]
__________________________________________________________________________
__________________________
conv2d_46 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_38[0][0]
__________________________________________________________________________
__________________________
batch_normalization_39 (BatchNo (None, None, None, 3 128         conv2d_46
[0][0]
__________________________________________________________________________
__________________________
add_19 (Add)                    (None, None, None, 3 0           batch_nor
malization_39[0][0]
                                                                 add_18[0]
[0]
__________________________________________________________________________
__________________________
conv2d_47 (Conv2D)              (None, None, None, 3 9248        add_19[0]
[0]
__________________________________________________________________________
__________________________
activation_19 (Activation)      (None, None, None, 3 0           conv2d_47
[0][0]
__________________________________________________________________________
__________________________
batch_normalization_40 (BatchNo (None, None, None, 3 128         activatio
n_19[0][0]
__________________________________________________________________________
__________________________
conv2d_48 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_40[0][0]
__________________________________________________________________________
__________________________
batch_normalization_41 (BatchNo (None, None, None, 3 128         conv2d_48
[0][0]
__________________________________________________________________________
__________________________
add_20 (Add)                    (None, None, None, 3 0           batch_nor
malization_41[0][0]
                                                                 add_19[0]
[0]
```

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__________________________________________________________________________________________________
conv2d_49 (Conv2D)              (None, None, None, 3 9248        add_20[0][0]
__________________________________________________________________________________________________
leaky_re_lu_5 (LeakyReLU)       (None, None, None, 3 0           conv2d_49[0][0]
__________________________________________________________________________________________________
batch_normalization_42 (BatchNo (None, None, None, 3 128         leaky_re_lu_5[0][0]
__________________________________________________________________________________________________
add_21 (Add)                    (None, None, None, 3 0           batch_normalization_42[0][0]
                                                                 conv2d_20[0][0]
__________________________________________________________________________________________________
conv2d_50 (Conv2D)              (None, None, None, 6 18496       add_21[0][0]
__________________________________________________________________________________________________
leaky_re_lu_6 (LeakyReLU)       (None, None, None, 6 0           conv2d_50[0][0]
__________________________________________________________________________________________________
batch_normalization_43 (BatchNo (None, None, None, 6 256         leaky_re_lu_6[0][0]
__________________________________________________________________________________________________
add_22 (Add)                    (None, None, None, 6 0           batch_normalization_43[0][0]
                                                                 conv2d_19[0][0]
__________________________________________________________________________________________________
conv2d_51 (Conv2D)              (None, None, None, 1 73856       add_22[0][0]
__________________________________________________________________________________________________
batch_normalization_44 (BatchNo (None, None, None, 1 512         conv2d_51[0][0]
__________________________________________________________________________________________________
add_23 (Add)                    (None, None, None, 1 0           batch_normalization_44[0][0]
                                                                 conv2d_18[0][0]
__________________________________________________________________________________________________
conv2d_52 (Conv2D)              (None, None, None, 1 147584      add_23[0][0]
__________________________________________________________________________________________________
activation_20 (Activation)      (None, None, None, 1 0           conv2d_52[0][0]
__________________________________________________________________________________________________
conv2d_53 (Conv2D)              (None, None, None, 1 147584      activatio
```

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n_20[0][0]
__________________________________________________________________________
_____________________
activation_21 (Activation)      (None, None, None, 1 0           conv2d_53
[0][0]
__________________________________________________________________________
_____________________
conv2d_54 (Conv2D)              (None, None, None, 3 36896       activatio
n_21[0][0]
==========================================================================
=======================
Total params: 827,872
Trainable params: 825,440
Non-trainable params: 2,432
__________________________________________________________________________
_____________________
Model: "model"
__________________________________________________________________________
_____________________
Layer (type)                    Output Shape         Param #     Connected
to
==========================================================================
=======================
input_1 (InputLayer)            [(None, None, None,  0
__________________________________________________________________________
_____________________
conv2d (Conv2D)                 (None, None, None, 3 9248        input_1
[0][0]
__________________________________________________________________________
_____________________
leaky_re_lu (LeakyReLU)         (None, None, None, 3 0           conv2d[0]
[0]
__________________________________________________________________________
_____________________
conv2d_1 (Conv2D)               (None, None, None, 3 9248        leaky_re_
lu[0][0]
__________________________________________________________________________
_____________________
activation (Activation)         (None, None, None, 3 0           conv2d_1
[0][0]
__________________________________________________________________________
_____________________
batch_normalization (BatchNorma (None, None, None, 3 128         activatio
n[0][0]
__________________________________________________________________________
_____________________
conv2d_2 (Conv2D)               (None, None, None, 3 9248        batch_nor
malization[0][0]
__________________________________________________________________________
_____________________
batch_normalization_1 (BatchNor (None, None, None, 3 128         conv2d_2
[0][0]
__________________________________________________________________________
_____________________
add (Add)                       (None, None, None, 3 0           batch_nor
malization_1[0][0]
                                                                 leaky_re_
lu[0][0]
__________________________________________________________________________
_____________________
conv2d_3 (Conv2D)               (None, None, None, 3 9248        add[0][0]
```

```
____________________________________________________________________________
____________________
activation_1 (Activation)       (None, None, None, 3 0           conv2d_3
[0][0]
____________________________________________________________________________
____________________
batch_normalization_2 (BatchNor (None, None, None, 3 128         activatio
n_1[0][0]
____________________________________________________________________________
____________________
conv2d_4 (Conv2D)               (None, None, None, 3 9248        batch_nor
malization_2[0][0]
____________________________________________________________________________
____________________
batch_normalization_3 (BatchNor (None, None, None, 3 128         conv2d_4
[0][0]
____________________________________________________________________________
____________________
add_1 (Add)                     (None, None, None, 3 0           batch_nor
malization_3[0][0]
                                                                 add[0][0]
____________________________________________________________________________
____________________
conv2d_5 (Conv2D)               (None, None, None, 3 9248        add_1[0]
[0]
____________________________________________________________________________
____________________
activation_2 (Activation)       (None, None, None, 3 0           conv2d_5
[0][0]
____________________________________________________________________________
____________________
batch_normalization_4 (BatchNor (None, None, None, 3 128         activatio
n_2[0][0]
____________________________________________________________________________
____________________
conv2d_6 (Conv2D)               (None, None, None, 3 9248        batch_nor
malization_4[0][0]
____________________________________________________________________________
____________________
batch_normalization_5 (BatchNor (None, None, None, 3 128         conv2d_6
[0][0]
____________________________________________________________________________
____________________
add_2 (Add)                     (None, None, None, 3 0           batch_nor
malization_5[0][0]
                                                                 add_1[0]
[0]
____________________________________________________________________________
____________________
conv2d_7 (Conv2D)               (None, None, None, 3 9248        add_2[0]
[0]
____________________________________________________________________________
____________________
activation_3 (Activation)       (None, None, None, 3 0           conv2d_7
[0][0]
____________________________________________________________________________
____________________
batch_normalization_6 (BatchNor (None, None, None, 3 128         activatio
n_3[0][0]
____________________________________________________________________________
____________________
```

```
conv2d_8 (Conv2D)               (None, None, None, 3 9248        batch_nor
malization_6[0][0]
__________________________________________________________________________
_____________________________
batch_normalization_7 (BatchNor (None, None, None, 3 128         conv2d_8
[0][0]
__________________________________________________________________________
_____________________________
add_3 (Add)                     (None, None, None, 3 0           batch_nor
malization_7[0][0]
                                                                 add_2[0]
[0]
__________________________________________________________________________
_____________________________
conv2d_9 (Conv2D)               (None, None, None, 3 9248        add_3[0]
[0]
__________________________________________________________________________
_____________________________
activation_4 (Activation)       (None, None, None, 3 0           conv2d_9
[0][0]
__________________________________________________________________________
_____________________________
batch_normalization_8 (BatchNor (None, None, None, 3 128         activatio
n_4[0][0]
__________________________________________________________________________
_____________________________
conv2d_10 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_8[0][0]
__________________________________________________________________________
_____________________________
batch_normalization_9 (BatchNor (None, None, None, 3 128         conv2d_10
[0][0]
__________________________________________________________________________
_____________________________
add_4 (Add)                     (None, None, None, 3 0           batch_nor
malization_9[0][0]
                                                                 add_3[0]
[0]
__________________________________________________________________________
_____________________________
conv2d_11 (Conv2D)              (None, None, None, 3 9248        add_4[0]
[0]
__________________________________________________________________________
_____________________________
activation_5 (Activation)       (None, None, None, 3 0           conv2d_11
[0][0]
__________________________________________________________________________
_____________________________
batch_normalization_10 (BatchNo (None, None, None, 3 128         activatio
n_5[0][0]
__________________________________________________________________________
_____________________________
conv2d_12 (Conv2D)              (None, None, None, 3 9248        batch_nor
malization_10[0][0]
__________________________________________________________________________
_____________________________
batch_normalization_11 (BatchNo (None, None, None, 3 128         conv2d_12
[0][0]
__________________________________________________________________________
_____________________________
add_5 (Add)                     (None, None, None, 3 0           batch_nor
```

```
malization_11[0][0]
                                                                 add_4[0]
[0]
__________________________________________________________________________
_____________________
conv2d_13 (Conv2D)              (None, None, None, 3 9248        add_5[0]
[0]
__________________________________________________________________________
_____________________
add_6 (Add)                     (None, None, None, 3 0           conv2d_13
[0][0]
                                                                 conv2d[0]
[0]
__________________________________________________________________________
_____________________
lambda (Lambda)                 (None, 64, 64, 32)   0           add_6[0]
[0]
__________________________________________________________________________
_____________________
conv2d_14 (Conv2D)              (None, 31, 31, 32)   9248        lambda[0]
[0]
__________________________________________________________________________
_____________________
conv2d_15 (Conv2D)              (None, 15, 15, 64)   18496       conv2d_14
[0][0]
__________________________________________________________________________
_____________________
conv2d_16 (Conv2D)              (None, 7, 7, 128)    73856       conv2d_15
[0][0]
__________________________________________________________________________
_____________________
conv2d_17 (Conv2D)              (None, 3, 3, 128)    147584      conv2d_16
[0][0]
__________________________________________________________________________
_____________________
dense (Dense)                   (None, 3, 3, 256)    33024       conv2d_17
[0][0]
__________________________________________________________________________
_____________________
leaky_re_lu_1 (LeakyReLU)       (None, 3, 3, 256)    0           dense[0]
[0]
__________________________________________________________________________
_____________________
flatten (Flatten)               (None, 2304)         0           leaky_re_
lu_1[0][0]
__________________________________________________________________________
_____________________
dense_1 (Dense)                 (None, 1)            2305        flatten
[0][0]
==========================================================================
========================
Total params: 415,521
Trainable params: 414,753
Non-trainable params: 768
__________________________________________________________________________
_____________________
```

(Optional) Train the algorithm

We also provide an already-trained model for quick data analysis. To do so, skip this section or stop the following code at any time and run later sections.

Expect output: training step reaches 15000 and stops. Combined loss is expected to decrease over time until reaching its local minimum.

Time cost: 1 hours (Nvidia A100), 2.5 hours (Nvidia GeForce RTX 3080) or 85 hours (CPU)

In [ ]:
```
net.train(epochs=20000, batch_size=32, save_interval=1000)
```

2023-10-07 12:45:16,409 - Utility.log - INFO - 1 time: 0:00:16.315807 com
bined-> loss:58.714107513427734 ||model_1_loss:0.012700353749096394 ||mode
l_loss:58.70140838623047 ||model_1_mse:0.01194838434457779 ||model_mse:58.
70140838623047 ||
2023-10-07 12:45:17,069 - Utility.log - INFO - 2 time: 0:00:16.975223 com
bined-> loss:16.874319076538086 ||model_1_loss:0.010981992818415165 ||mode
l_loss:16.86333656311035 ||model_1_mse:0.010177405551075935 ||model_mse:1
6.86333656311035 ||
2023-10-07 12:45:17,703 - Utility.log - INFO - 3 time: 0:00:17.611506 com
bined-> loss:20.92765998840332 ||model_1_loss:0.011416636407375336 ||model
_loss:20.916242599487305 ||model_1_mse:0.010600737296044827 ||model_mse:2
0.916242599487305 ||
2023-10-07 12:45:18,340 - Utility.log - INFO - 4 time: 0:00:18.246749 com
bined-> loss:6.377126216888428 ||model_1_loss:0.008917250670492649 ||model
_loss:6.368208885192871 ||model_1_mse:0.008119400590658188 ||model_mse:6.3
68208885192871 ||
2023-10-07 12:45:18,954 - Utility.log - INFO - 5 time: 0:00:18.862494 com
bined-> loss:5.308716773986816 ||model_1_loss:0.009885862469673157 ||model
_loss:5.298830986022949 ||model_1_mse:0.009101171977818012 ||model_mse:5.2
98830986022949 ||
2023-10-07 12:45:19,614 - Utility.log - INFO - 6 time: 0:00:19.520815 com
bined-> loss:4.171796798706055 ||model_1_loss:0.009959405288100243 ||model
_loss:4.161837577819824 ||model_1_mse:0.009126245975494385 ||model_mse:4.1
61837577819824 ||
2023-10-07 12:45:20,231 - Utility.log - INFO - 7 time: 0:00:20.136146 com
bined-> loss:4.491978645324707 ||model_1_loss:0.009261773899197578 ||model
_loss:4.482717037200928 ||model_1_mse:0.008442020043730736 ||model_mse:4.4
82717037200928 ||
2023-10-07 12:45:20,834 - Utility.log - INFO - 8 time: 0:00:20.741739 com
bined-> loss:4.165926456451416 ||model_1_loss:0.007747374940663576 ||model
_loss:4.15817928314209 ||model_1_mse:0.006976426113396883 ||model_mse:4.15
817928314209 ||
2023-10-07 12:45:21,483 - Utility.log - INFO - 9 time: 0:00:21.392334 com
bined-> loss:2.3840301036834717 ||model_1_loss:0.009000208228826523 ||mode
l_loss:2.3750298023223877 ||model_1_mse:0.008153730072081089 ||model_mse:
2.3750298023223877 ||
2023-10-07 12:45:22,133 - Utility.log - INFO - 10 time: 0:00:22.039967 co
mbined-> loss:1.1031758785247803 ||model_1_loss:0.008068926632404327 ||mod
el_loss:1.0951069593429565 ||model_1_mse:0.007293208502233028 ||model_mse:
1.0951069593429565 ||
2023-10-07 12:45:22,748 - Utility.log - INFO - 11 time: 0:00:22.655712 co
mbined-> loss:1.9018207788467407 ||model_1_loss:0.00769782392308116 ||mode
l_loss:1.8941229581832886 ||model_1_mse:0.006944242864847183 ||model_mse:
1.8941229581832886 ||
2023-10-07 12:45:23,382 - Utility.log - INFO - 12 time: 0:00:23.289976 co
mbined-> loss:3.8185877799987793 ||model_1_loss:0.00952000543475151 ||mode
l_loss:3.809067726135254 ||model_1_mse:0.008706297725439072 ||model_mse:3.
809067726135254 ||
2023-10-07 12:45:24,010 - Utility.log - INFO - 13 time: 0:00:23.917043 co
mbined-> loss:2.4238133430480957 ||model_1_loss:0.0075231632217764854 ||mo
del_loss:2.416290283203125 ||model_1_mse:0.006763939745724201 ||model_mse:
2.416290283203125 ||
2023-10-07 12:45:24,662 - Utility.log - INFO - 14 time: 0:00:24.570082 co
mbined-> loss:2.757963180541992 ||model_1_loss:0.008112508803606033 ||mode
l_loss:2.7498507499694824 ||model_1_mse:0.00733742443844676 ||model_mse:2.
7498507499694824 ||
2023-10-07 12:45:25,301 - Utility.log - INFO - 15 time: 0:00:25.209395 co
mbined-> loss:2.645010471343994 ||model_1_loss:0.008582995273172855 ||mode
l_loss:2.636427402496338 ||model_1_mse:0.007802665699273348 ||model_mse:2.
636427402496338 ||
2023-10-07 12:45:25,929 - Utility.log - INFO - 16 time: 0:00:25.835798 co

mbined-> loss:1.1889301538467407 ||model_1_loss:0.008045089431107044 ||mod
el_loss:1.1808850765228271 ||model_1_mse:0.007250327151268721 ||model_mse:
1.1808850765228271 ||
2023-10-07 12:45:26,578 - Utility.log - INFO - 17 time: 0:00:26.484577 co
mbined-> loss:6.5074028968811035 ||model_1_loss:0.007328317034989595 ||mod
el_loss:6.50007438659668 ||model_1_mse:0.006561744026839733 ||model_mse:6.
50007438659668 ||
2023-10-07 12:45:27,216 - Utility.log - INFO - 18 time: 0:00:27.123652 co
mbined-> loss:0.8931226134300232 ||model_1_loss:0.008319980464875698 ||mod
el_loss:0.8848026394844055 ||model_1_mse:0.007532193325459957 ||model_mse:
0.8848026394844055 ||
2023-10-07 12:45:27,850 - Utility.log - INFO - 19 time: 0:00:27.756261 co
mbined-> loss:2.1702544689178467 ||model_1_loss:0.007277472410351038 ||mod
el_loss:2.1629769802093506 ||model_1_mse:0.006535998545587063 ||model_mse:
2.1629769802093506 ||
2023-10-07 12:45:28,467 - Utility.log - INFO - 20 time: 0:00:28.374752 co
mbined-> loss:3.603792905807495 ||model_1_loss:0.006904794834554195 ||mode
l_loss:3.5968880653381348 ||model_1_mse:0.006138979457318783 ||model_mse:
3.5968880653381348 ||
2023-10-07 12:45:29,097 - Utility.log - INFO - 21 time: 0:00:29.003943 co
mbined-> loss:10.1460542678833 ||model_1_loss:0.007817678153514862 ||model
_loss:10.138236999511719 ||model_1_mse:0.007033929228782654 ||model_mse:1
0.138236999511719 ||
2023-10-07 12:45:29,731 - Utility.log - INFO - 22 time: 0:00:29.639005 co
mbined-> loss:18.65515899658203 ||model_1_loss:0.006912491284310818 ||mode
l_loss:18.64824676513672 ||model_1_mse:0.006152092944830656 ||model_mse:1
8.64824676513672 ||
2023-10-07 12:45:30,374 - Utility.log - INFO - 23 time: 0:00:30.282729 co
mbined-> loss:2.0753915309906006 ||model_1_loss:0.007107255980372429 ||mod
el_loss:2.068284273147583 ||model_1_mse:0.006359732244163752 ||model_mse:
2.068284273147583 ||
2023-10-07 12:45:31,072 - Utility.log - INFO - 24 time: 0:00:30.977631 co
mbined-> loss:2.991238832473755 ||model_1_loss:0.00664445199072361 ||model
_loss:2.9845943450927734 ||model_1_mse:0.005874883383512497 ||model_mse:2.
9845943450927734 ||
2023-10-07 12:45:31,714 - Utility.log - INFO - 25 time: 0:00:31.620331 co
mbined-> loss:1.9604917764663696 ||model_1_loss:0.006651792675256729 ||mod
el_loss:1.9538400173187256 ||model_1_mse:0.005861385725438595 ||model_mse:
1.9538400173187256 ||
2023-10-07 12:45:32,322 - Utility.log - INFO - 26 time: 0:00:32.230430 co
mbined-> loss:1.142460584640503 ||model_1_loss:0.00706095527857542 ||model
_loss:1.135399580001831 ||model_1_mse:0.00627704244107008 ||model_mse:1.13
5399580001831 ||
2023-10-07 12:45:32,962 - Utility.log - INFO - 27 time: 0:00:32.869912 co
mbined-> loss:2.0983660221099854 ||model_1_loss:0.0068571120500564575 ||mo
del_loss:2.0915088653564453 ||model_1_mse:0.006085251457989216 ||model_ms
e:2.0915088653564453 ||
2023-10-07 12:45:33,577 - Utility.log - INFO - 28 time: 0:00:33.485298 co
mbined-> loss:1.4585561752319336 ||model_1_loss:0.007272690534591675 ||mod
el_loss:1.4512834548950195 ||model_1_mse:0.006466278340667486 ||model_mse:
1.4512834548950195 ||
2023-10-07 12:45:34,228 - Utility.log - INFO - 29 time: 0:00:34.134618 co
mbined-> loss:5.854093074798584 ||model_1_loss:0.008343296125531197 ||mode
l_loss:5.845749855041504 ||model_1_mse:0.007520151324570179 ||model_mse:5.
845749855041504 ||
2023-10-07 12:45:34,858 - Utility.log - INFO - 30 time: 0:00:34.767024 co
mbined-> loss:2.614112615585327 ||model_1_loss:0.007669859565794468 ||mode
l_loss:2.60644268989563 ||model_1_mse:0.006893271114677191 ||model_mse:2.6
0644268989563 ||
2023-10-07 12:45:35,480 - Utility.log - INFO - 31 time: 0:00:35.386531 co
mbined-> loss:2.731527805328369 ||model_1_loss:0.006857419852167368 ||mode

l_loss:2.72467041015625 ||model_1_mse:0.006093839183449745 ||model_mse:2.7
2467041015625 ||
2023-10-07 12:45:36,131 - Utility.log - INFO - 32 time: 0:00:36.037495 co
mbined-> loss:0.9579576849937439 ||model_1_loss:0.00726382527500391 ||mode
l_loss:0.9506938457489014 ||model_1_mse:0.006483226083219051 ||model_mse:
0.9506938457489014 ||
2023-10-07 12:45:36,807 - Utility.log - INFO - 33 time: 0:00:36.715329 co
mbined-> loss:2.832698106765747 ||model_1_loss:0.005910506006330252 ||mode
l_loss:2.8267877101898193 ||model_1_mse:0.005203782580792904 ||model_mse:
2.8267877101898193 ||
2023-10-07 12:45:37,423 - Utility.log - INFO - 34 time: 0:00:37.330506 co
mbined-> loss:3.1466081142425537 ||model_1_loss:0.00685929087921977 ||mode
l_loss:3.1397488117218018 ||model_1_mse:0.006081691011786461 ||model_mse:
3.1397488117218018 ||
2023-10-07 12:45:38,005 - Utility.log - INFO - 35 time: 0:00:37.913231 co
mbined-> loss:1.5973756313323975 ||model_1_loss:0.00748093705624342 ||mode
l_loss:1.5898946523666382 ||model_1_mse:0.006640369072556496 ||model_mse:
1.5898946523666382 ||
2023-10-07 12:45:38,617 - Utility.log - INFO - 36 time: 0:00:38.523474 co
mbined-> loss:3.5925405025482178 ||model_1_loss:0.006853706669062376 ||mod
el_loss:3.585686683654785 ||model_1_mse:0.006055308040231466 ||model_mse:
3.585686683654785 ||
2023-10-07 12:45:39,224 - Utility.log - INFO - 37 time: 0:00:39.133270 co
mbined-> loss:2.198593854904175 ||model_1_loss:0.009163177572190762 ||mode
l_loss:2.1894307136535645 ||model_1_mse:0.008290369063615799 ||model_mse:
2.1894307136535645 ||
2023-10-07 12:45:39,841 - Utility.log - INFO - 38 time: 0:00:39.748747 co
mbined-> loss:1.048019528388977 ||model_1_loss:0.008887866511940956 ||mode
l_loss:1.0391316413879395 ||model_1_mse:0.008025762625038624 ||model_mse:
1.0391316413879395 ||
2023-10-07 12:45:40,480 - Utility.log - INFO - 39 time: 0:00:40.387956 co
mbined-> loss:5.626871585845947 ||model_1_loss:0.007729855366051197 ||mode
l_loss:5.619141578674316 ||model_1_mse:0.006913147866725922 ||model_mse:5.
619141578674316 ||
2023-10-07 12:45:41,147 - Utility.log - INFO - 40 time: 0:00:41.051326 co
mbined-> loss:11.105260848999023 ||model_1_loss:0.006074878387153149 ||mod
el_loss:11.099185943603516 ||model_1_mse:0.005367058329284191 ||model_mse:
11.099185943603516 ||
2023-10-07 12:45:41,816 - Utility.log - INFO - 41 time: 0:00:41.724196 co
mbined-> loss:6.0863213539123535 ||model_1_loss:0.006514611188322306 ||mod
el_loss:6.079806804656982 ||model_1_mse:0.005761938169598579 ||model_mse:
6.079806804656982 ||
2023-10-07 12:45:42,476 - Utility.log - INFO - 42 time: 0:00:42.382592 co
mbined-> loss:3.3981990814208984 ||model_1_loss:0.007389099337160587 ||mod
el_loss:3.390810012817383 ||model_1_mse:0.006553163286298513 ||model_mse:
3.390810012817383 ||
2023-10-07 12:45:43,126 - Utility.log - INFO - 43 time: 0:00:43.032548 co
mbined-> loss:9.447086334228516 ||model_1_loss:0.00700409896671772 ||model
_loss:9.440082550048828 ||model_1_mse:0.006197392009198666 ||model_mse:9.4
40082550048828 ||
2023-10-07 12:45:43,768 - Utility.log - INFO - 44 time: 0:00:43.676175 co
mbined-> loss:2.649348020553589 ||model_1_loss:0.006637274753302336 ||mode
l_loss:2.6427106857299805 ||model_1_mse:0.005843842402100563 ||model_mse:
2.6427106857299805 ||
2023-10-07 12:45:44,394 - Utility.log - INFO - 45 time: 0:00:44.302657 co
mbined-> loss:4.527265548706055 ||model_1_loss:0.006594114936888218 ||mode
l_loss:4.520671367645264 ||model_1_mse:0.005812657997012138 ||model_mse:4.
520671367645264 ||
2023-10-07 12:45:45,050 - Utility.log - INFO - 46 time: 0:00:44.956358 co
mbined-> loss:0.9947249293327332 ||model_1_loss:0.00687157828360796 ||mode
l_loss:0.9878533482551575 ||model_1_mse:0.006069371476769447 ||model_mse:

0.9878533482551575 ||
2023-10-07 12:45:45,729 - Utility.log - INFO - 47 time: 0:00:45.636436 co
mbined-> loss:5.058658599853516 ||model_1_loss:0.007118402514606714 ||mode
l_loss:5.051540374755859 ||model_1_mse:0.006289723329246044 ||model_mse:5.
051540374755859 ||
2023-10-07 12:45:46,421 - Utility.log - INFO - 48 time: 0:00:46.326915 co
mbined-> loss:1.4459456205368042 ||model_1_loss:0.0067869569174945354 ||mo
del_loss:1.4391586780548096 ||model_1_mse:0.0059846555814146996 ||model_ms
e:1.4391586780548096 ||
2023-10-07 12:45:47,101 - Utility.log - INFO - 49 time: 0:00:47.007958 co
mbined-> loss:3.26424241065979 ||model_1_loss:0.006509106140583754 ||model
_loss:3.2577333450317383 ||model_1_mse:0.00573385413736105 ||model_mse:3.2
577333450317383 ||
2023-10-07 12:45:47,758 - Utility.log - INFO - 50 time: 0:00:47.664269 co
mbined-> loss:5.061578750610352 ||model_1_loss:0.00804534088820219 ||model
_loss:5.053533554077148 ||model_1_mse:0.007213567849248648 ||model_mse:5.0
53533554077148 ||
2023-10-07 12:45:48,419 - Utility.log - INFO - 51 time: 0:00:48.325759 co
mbined-> loss:1.2763773202896118 ||model_1_loss:0.006662436760962009 ||mod
el_loss:1.2697148323059082 ||model_1_mse:0.005914305802434683 ||model_mse:
1.2697148323059082 ||
2023-10-07 12:45:49,065 - Utility.log - INFO - 52 time: 0:00:48.972573 co
mbined-> loss:3.708915948867798 ||model_1_loss:0.0071354699321091175 ||mod
el_loss:3.7017805576324463 ||model_1_mse:0.00633942149579525 ||model_mse:
3.7017805576324463 ||
2023-10-07 12:45:49,727 - Utility.log - INFO - 53 time: 0:00:49.632620 co
mbined-> loss:0.777603268623352 ||model_1_loss:0.006777832750231028 ||mode
l_loss:0.7708254456520081 ||model_1_mse:0.0060355146415531635 ||model_mse:
0.7708254456520081 ||
2023-10-07 12:45:50,384 - Utility.log - INFO - 54 time: 0:00:50.291932 co
mbined-> loss:3.8486874103546143 ||model_1_loss:0.006422186736017466 ||mod
el_loss:3.8422651290893555 ||model_1_mse:0.005681583657860756 ||model_mse:
3.8422651290893555 ||
2023-10-07 12:45:51,039 - Utility.log - INFO - 55 time: 0:00:50.945964 co
mbined-> loss:1.8706772327423096 ||model_1_loss:0.006314786616712809 ||mod
el_loss:1.8643624782562256 ||model_1_mse:0.005547690205276012 ||model_mse:
1.8643624782562256 ||
2023-10-07 12:45:51,716 - Utility.log - INFO - 56 time: 0:00:51.622880 co
mbined-> loss:5.087892055511475 ||model_1_loss:0.006622003391385078 ||mode
l_loss:5.081270217895508 ||model_1_mse:0.005830820649862289 ||model_mse:5.
081270217895508 ||
2023-10-07 12:45:52,389 - Utility.log - INFO - 57 time: 0:00:52.296413 co
mbined-> loss:10.755314826965332 ||model_1_loss:0.0064549753442406654 ||mo
del_loss:10.748859405517578 ||model_1_mse:0.005715023726224899 ||model_ms
e:10.748859405517578 ||
2023-10-07 12:45:53,031 - Utility.log - INFO - 58 time: 0:00:52.939583 co
mbined-> loss:2.1231956481933594 ||model_1_loss:0.006843504961580038 ||mod
el_loss:2.116352081298828 ||model_1_mse:0.006041624583303928 ||model_mse:
2.116352081298828 ||
2023-10-07 12:45:53,641 - Utility.log - INFO - 59 time: 0:00:53.547700 co
mbined-> loss:4.655604839324951 ||model_1_loss:0.006266120821237564 ||mode
l_loss:4.649338722229004 ||model_1_mse:0.005539899226278067 ||model_mse:4.
649338722229004 ||
2023-10-07 12:45:54,260 - Utility.log - INFO - 60 time: 0:00:54.168670 co
mbined-> loss:5.706491947174072 ||model_1_loss:0.006608741823583841 ||mode
l_loss:5.699882984161377 ||model_1_mse:0.005846838932484388 ||model_mse:5.
699882984161377 ||
2023-10-07 12:45:54,864 - Utility.log - INFO - 61 time: 0:00:54.771721 co
mbined-> loss:1.011804223060608 ||model_1_loss:0.0060877264477312565 ||mod
el_loss:1.0057164430618286 ||model_1_mse:0.005331754218786955 ||model_mse:
1.0057164430618286 ||

2023-10-07 12:45:55,429 - Utility.log - INFO - 62 time: 0:00:55.338231 co
mbined-> loss:7.213890075683594 ||model_1_loss:0.006364829838275909 ||mode
l_loss:7.207525253295898 ||model_1_mse:0.0055967532098293304 ||model_mse:
7.207525253295898 ||
2023-10-07 12:45:56,044 - Utility.log - INFO - 63 time: 0:00:55.950353 co
mbined-> loss:3.9862148761749268 ||model_1_loss:0.006156458985060453 ||mod
el_loss:3.980058431625366 ||model_1_mse:0.005415169056504965 ||model_mse:
3.980058431625366 ||
2023-10-07 12:45:56,655 - Utility.log - INFO - 64 time: 0:00:56.563824 co
mbined-> loss:1.1290615797042847 ||model_1_loss:0.006395936012268066 ||mod
el_loss:1.1226656436920166 ||model_1_mse:0.0056210351176559925 ||model_ms
e:1.1226656436920166 ||
2023-10-07 12:45:57,273 - Utility.log - INFO - 65 time: 0:00:57.181527 co
mbined-> loss:2.088811159133911 ||model_1_loss:0.006507536396384239 ||mode
l_loss:2.082303524017334 ||model_1_mse:0.005757395178079605 ||model_mse:2.
082303524017334 ||
2023-10-07 12:45:57,907 - Utility.log - INFO - 66 time: 0:00:57.813370 co
mbined-> loss:0.6437506675720215 ||model_1_loss:0.006411333102732897 ||mod
el_loss:0.6373393535614014 ||model_1_mse:0.005621329415589571 ||model_mse:
0.6373393535614014 ||
2023-10-07 12:45:58,517 - Utility.log - INFO - 67 time: 0:00:58.423292 co
mbined-> loss:1.4561522006988525 ||model_1_loss:0.006071599666029215 ||mod
el_loss:1.4500806331634521 ||model_1_mse:0.005330539308488369 ||model_mse:
1.4500806331634521 ||
2023-10-07 12:45:59,142 - Utility.log - INFO - 68 time: 0:00:59.050214 co
mbined-> loss:1.860509991645813 ||model_1_loss:0.005915367975831032 ||mode
l_loss:1.8545945882797241 ||model_1_mse:0.005172860808670521 ||model_mse:
1.8545945882797241 ||
2023-10-07 12:45:59,761 - Utility.log - INFO - 69 time: 0:00:59.669312 co
mbined-> loss:1.3433488607406616 ||model_1_loss:0.00600830651819706 ||mode
l_loss:1.3373405933380127 ||model_1_mse:0.005258738063275814 ||model_mse:
1.3373405933380127 ||
2023-10-07 12:46:00,375 - Utility.log - INFO - 70 time: 0:01:00.282945 co
mbined-> loss:1.9039332866668701 ||model_1_loss:0.006377968937158585 ||mod
el_loss:1.8975553512573242 ||model_1_mse:0.0055839791893959045 ||model_ms
e:1.8975553512573242 ||
2023-10-07 12:46:01,001 - Utility.log - INFO - 71 time: 0:01:00.908617 co
mbined-> loss:4.803183078765869 ||model_1_loss:0.0064863171428442 ||model_
loss:4.796696662902832 ||model_1_mse:0.005673813633620739 ||model_mse:4.79
6696662902832 ||
2023-10-07 12:46:01,636 - Utility.log - INFO - 72 time: 0:01:01.543152 co
mbined-> loss:3.3818278312683105 ||model_1_loss:0.006540725938975811 ||mod
el_loss:3.3752870559692383 ||model_1_mse:0.005761695094406605 ||model_mse:
3.3752870559692383 ||
2023-10-07 12:46:02,288 - Utility.log - INFO - 73 time: 0:01:02.193881 co
mbined-> loss:1.411513090133667 ||model_1_loss:0.006401490420103073 ||mode
l_loss:1.40511155128479 ||model_1_mse:0.00562835019081831 ||model_mse:1.40
511155128479 ||
2023-10-07 12:46:02,942 - Utility.log - INFO - 74 time: 0:01:02.849754 co
mbined-> loss:0.6448350548744202 ||model_1_loss:0.0057670678943395615 ||mo
del_loss:0.6390680074691772 ||model_1_mse:0.005035717505961657 ||model_ms
e:0.6390680074691772 ||
2023-10-07 12:46:03,582 - Utility.log - INFO - 75 time: 0:01:03.491251 co
mbined-> loss:0.7169846892356873 ||model_1_loss:0.006270710378885269 ||mod
el_loss:0.7107139825820923 ||model_1_mse:0.005539366044104099 ||model_mse:
0.7107139825820923 ||
2023-10-07 12:46:04,220 - Utility.log - INFO - 76 time: 0:01:04.126247 co
mbined-> loss:1.0220969915390015 ||model_1_loss:0.006490777246654034 ||mod
el_loss:1.015606164932251 ||model_1_mse:0.005676043685525656 ||model_mse:
1.015606164932251 ||
2023-10-07 12:46:04,866 - Utility.log - INFO - 77 time: 0:01:04.773761 co

mbined-> loss:1.1202846765518188 ||model_1_loss:0.00591934472322464 ||mode
l_loss:1.1143653392791748 ||model_1_mse:0.005175734870135784 ||model_mse:
1.1143653392791748 ||
2023-10-07 12:46:05,579 - Utility.log - INFO - 78 time: 0:01:05.484672 co
mbined-> loss:2.055774688720703 ||model_1_loss:0.00646193465217948 ||model
_loss:2.0493128299713135 ||model_1_mse:0.005698521621525288 ||model_mse:2.
0493128299713135 ||
2023-10-07 12:46:06,276 - Utility.log - INFO - 79 time: 0:01:06.183791 co
mbined-> loss:1.2592524290084839 ||model_1_loss:0.006694182753562927 ||mod
el_loss:1.2525582313537598 ||model_1_mse:0.005881352350115776 ||model_mse:
1.2525582313537598 ||
2023-10-07 12:46:06,972 - Utility.log - INFO - 80 time: 0:01:06.878499 co
mbined-> loss:1.1163510084152222 ||model_1_loss:0.006760193966329098 ||mod
el_loss:1.109590768814087 ||model_1_mse:0.0059578800573945045 ||model_mse:
1.109590768814087 ||
2023-10-07 12:46:07,593 - Utility.log - INFO - 81 time: 0:01:07.500860 co
mbined-> loss:0.9659532904624939 ||model_1_loss:0.007189613301306963 ||mod
el_loss:0.9587636590003967 ||model_1_mse:0.00640271557494998 ||model_mse:
0.9587636590003967 ||
2023-10-07 12:46:08,200 - Utility.log - INFO - 82 time: 0:01:08.106329 co
mbined-> loss:1.9930148124694824 ||model_1_loss:0.007349598221480846 ||mod
el_loss:1.985665202140808 ||model_1_mse:0.006564457900822163 ||model_mse:
1.985665202140808 ||
2023-10-07 12:46:08,828 - Utility.log - INFO - 83 time: 0:01:08.736609 co
mbined-> loss:1.8960779905319214 ||model_1_loss:0.0063846418634057045 ||mo
del_loss:1.8896933794021606 ||model_1_mse:0.0056053465232253075 ||model_ms
e:1.8896933794021606 ||
2023-10-07 12:46:09,474 - Utility.log - INFO - 84 time: 0:01:09.381546 co
mbined-> loss:2.940671682357788 ||model_1_loss:0.006233728490769863 ||mode
l_loss:2.9344379901885986 ||model_1_mse:0.005478699691593647 ||model_mse:
2.9344379901885986 ||
2023-10-07 12:46:10,107 - Utility.log - INFO - 85 time: 0:01:10.012270 co
mbined-> loss:4.354822158813477 ||model_1_loss:0.006514961831271648 ||mode
l_loss:4.348307132720947 ||model_1_mse:0.00570909958332777 ||model_mse:4.3
48307132720947 ||
2023-10-07 12:46:10,808 - Utility.log - INFO - 86 time: 0:01:10.713474 co
mbined-> loss:3.4422194957733154 ||model_1_loss:0.006197606213390827 ||mod
el_loss:3.4360218048095703 ||model_1_mse:0.005484068766236305 ||model_mse:
3.4360218048095703 ||
2023-10-07 12:46:11,505 - Utility.log - INFO - 87 time: 0:01:11.409929 co
mbined-> loss:2.923997163772583 ||model_1_loss:0.006277692504227161 ||mode
l_loss:2.9177193641662598 ||model_1_mse:0.005515540484338999 ||model_mse:
2.9177193641662598 ||
2023-10-07 12:46:12,180 - Utility.log - INFO - 88 time: 0:01:12.084836 co
mbined-> loss:2.314650058746338 ||model_1_loss:0.006695907562971115 ||mode
l_loss:2.3079540729522705 ||model_1_mse:0.0059492322616279125 ||model_mse:
2.3079540729522705 ||
2023-10-07 12:46:12,880 - Utility.log - INFO - 89 time: 0:01:12.787697 co
mbined-> loss:1.9188148975372314 ||model_1_loss:0.006093694362789392 5||mo
del_loss:1.9127211570739746 ||model_1_mse:0.005348947364836931 ||model_ms
e:1.9127211570739746 ||
2023-10-07 12:46:13,493 - Utility.log - INFO - 90 time: 0:01:13.400751 co
mbined-> loss:1.1016583442687988 ||model_1_loss:0.005903503391891718 ||mod
el_loss:1.095754861831665 ||model_1_mse:0.00520076509565115 ||model_mse:1.
095754861831665 ||
2023-10-07 12:46:14,177 - Utility.log - INFO - 91 time: 0:01:14.083074 co
mbined-> loss:2.112825870513916 ||model_1_loss:0.006286495365202427 ||mode
l_loss:2.106539487838745 ||model_1_mse:0.005530175752937794 ||model_mse:2.
106539487838745 ||
2023-10-07 12:46:14,833 - Utility.log - INFO - 92 time: 0:01:14.742105 co
mbined-> loss:3.7838261127471924 ||model_1_loss:0.00642658956348896 ||mode

l_loss:3.7773995399475098 ||model_1_mse:0.005650411359965801 ||model_mse:
3.7773995399475098 ||
2023-10-07 12:46:15,527 - Utility.log - INFO - 93 time: 0:01:15.433858 co
mbined-> loss:1.4883290529251099 ||model_1_loss:0.005999011918902397 ||mod
el_loss:1.482330083847046 ||model_1_mse:0.005275208968669176 ||model_mse:
1.482330083847046 ||
2023-10-07 12:46:16,233 - Utility.log - INFO - 94 time: 0:01:16.137667 co
mbined-> loss:7.248187065124512 ||model_1_loss:0.007184747606515884 ||mode
l_loss:7.241002082824707 ||model_1_mse:0.006346503272652626 ||model_mse:7.
241002082824707 ||
2023-10-07 12:46:16,968 - Utility.log - INFO - 95 time: 0:01:16.873670 co
mbined-> loss:3.271256923675537 ||model_1_loss:0.006406485568732023 ||mode
l_loss:3.264850378036499 ||model_1_mse:0.005638210102915764 ||model_mse:3.
264850378036499 ||
2023-10-07 12:46:17,692 - Utility.log - INFO - 96 time: 0:01:17.598480 co
mbined-> loss:0.6051844358444214 ||model_1_loss:0.0069794119335711 ||model
_loss:0.598205029964447 ||model_1_mse:0.006201420910656452 ||model_mse:0.5
98205029964447 ||
2023-10-07 12:46:18,310 - Utility.log - INFO - 97 time: 0:01:18.216516 co
mbined-> loss:1.4616668224334717 ||model_1_loss:0.00667925737798214 ||mode
l_loss:1.4549875259399414 ||model_1_mse:0.005911076907068491 ||model_mse:
1.4549875259399414 ||
2023-10-07 12:46:18,939 - Utility.log - INFO - 98 time: 0:01:18.847850 co
mbined-> loss:0.6029191613197327 ||model_1_loss:0.006202070042490959 ||mod
el_loss:0.596717119216919 ||model_1_mse:0.005459323059767485 ||model_mse:
0.596717119216919 ||
2023-10-07 12:46:19,571 - Utility.log - INFO - 99 time: 0:01:19.477488 co
mbined-> loss:0.47517406940460205 ||model_1_loss:0.006095742341130972 ||mo
del_loss:0.46907833218574524 ||model_1_mse:0.005335938651114702 ||model_ms
e:0.46907833218574524 ||
2023-10-07 12:46:20,196 - Utility.log - INFO - 100 time: 0:01:20.103016 c
ombined-> loss:4.3824968338012695 ||model_1_loss:0.006096629425883293 ||mo
del_loss:4.376399993896484 ||model_1_mse:0.005323998164385557 ||model_mse:
4.376399993896484 ||
2023-10-07 12:46:20,897 - Utility.log - INFO - 101 time: 0:01:20.804997 c
ombined-> loss:5.196263790130615 ||model_1_loss:0.006125860847532749 ||mod
el_loss:5.19013786315918 ||model_1_mse:0.005364489741623402 ||model_mse:5.
19013786315918 ||
2023-10-07 12:46:21,643 - Utility.log - INFO - 102 time: 0:01:21.550459 c
ombined-> loss:1.649746298789978 ||model_1_loss:0.00570466835051775 ||mode
l_loss:1.644041657447815 ||model_1_mse:0.004971010610461235 ||model_mse:1.
644041657447815 ||
2023-10-07 12:46:22,360 - Utility.log - INFO - 103 time: 0:01:22.265291 c
ombined-> loss:1.5947673320770264 ||model_1_loss:0.006474614609032869 ||mo
del_loss:1.5882927179336548 ||model_1_mse:0.005664908327162266 ||model_ms
e:1.5882927179336548 ||
2023-10-07 12:46:23,022 - Utility.log - INFO - 104 time: 0:01:22.928652 c
ombined-> loss:0.9589101076126099 ||model_1_loss:0.006319384090602398 ||mo
del_loss:0.9525907039642334 ||model_1_mse:0.005538522731512785 ||model_ms
e:0.9525907039642334 ||
2023-10-07 12:46:23,638 - Utility.log - INFO - 105 time: 0:01:23.546230 c
ombined-> loss:0.595685601234436 ||model_1_loss:0.005967993289232254 ||mod
el_loss:0.5897176265716553 ||model_1_mse:0.005226419307291508 ||model_mse:
0.5897176265716553 ||
2023-10-07 12:46:24,266 - Utility.log - INFO - 106 time: 0:01:24.172616 c
ombined-> loss:1.5240917205810547 ||model_1_loss:0.005915127694606781 ||mo
del_loss:1.518176555633545 ||model_1_mse:0.0051704589277505875 ||model_ms
e:1.518176555633545 ||
2023-10-07 12:46:24,886 - Utility.log - INFO - 107 time: 0:01:24.793778 c
ombined-> loss:2.0732054710388184 ||model_1_loss:0.006350208539515734 ||mo
del_loss:2.0668551921844482 ||model_1_mse:0.005568862892687321 ||model_ms

e:2.0668551921844482 ||
2023-10-07 12:46:25,604 - Utility.log - INFO - 108 time: 0:01:25.508327 c
ombined-> loss:0.657548725605011 ||model_1_loss:0.00594499334692955 ||mode
l_loss:0.6516037583351135 ||model_1_mse:0.005210917443037033 ||model_mse:
0.6516037583351135 ||
2023-10-07 12:46:26,272 - Utility.log - INFO - 109 time: 0:01:26.181053 c
ombined-> loss:1.7313804626464844 ||model_1_loss:0.006463793572038412 ||mo
del_loss:1.724916696548462 ||model_1_mse:0.005692044738680124 ||model_mse:
1.724916696548462 ||
2023-10-07 12:46:26,857 - Utility.log - INFO - 110 time: 0:01:26.764374 c
ombined-> loss:3.5148935317993164 ||model_1_loss:0.005878496915102005 ||mo
del_loss:3.5090150833129883 ||model_1_mse:0.0051157427951693535 ||model_ms
e:3.5090150833129883 ||
2023-10-07 12:46:27,519 - Utility.log - INFO - 111 time: 0:01:27.426910 c
ombined-> loss:1.5538101196289062 ||model_1_loss:0.006294768303632736 ||mo
del_loss:1.5475153923034668 ||model_1_mse:0.00551298912614584 ||model_mse:
1.5475153923034668 ||
2023-10-07 12:46:28,163 - Utility.log - INFO - 112 time: 0:01:28.070095 c
ombined-> loss:1.2870842218399048 ||model_1_loss:0.005817176774144173 ||mo
del_loss:1.2812670469284058 ||model_1_mse:0.00507612619549036 ||model_mse:
1.2812670469284058 ||
2023-10-07 12:46:28,783 - Utility.log - INFO - 113 time: 0:01:28.690350 c
ombined-> loss:0.8431562185287476 ||model_1_loss:0.006009451113641262 ||mo
del_loss:0.8371467590332031 ||model_1_mse:0.0052750264294445515 ||model_ms
e:0.8371467590332031 ||
2023-10-07 12:46:29,446 - Utility.log - INFO - 114 time: 0:01:29.353867 c
ombined-> loss:1.1735032796859741 ||model_1_loss:0.006160404998809099 ||mo
del_loss:1.1673429012298584 ||model_1_mse:0.005392041988670826 ||model_ms
e:1.1673429012298584 ||
2023-10-07 12:46:30,070 - Utility.log - INFO - 115 time: 0:01:29.975938 c
ombined-> loss:1.5354487895965576 ||model_1_loss:0.006284902337938547 ||mo
del_loss:1.5291638374328613 ||model_1_mse:0.00549833569675684 ||model_mse:
1.5291638374328613 ||
2023-10-07 12:46:30,649 - Utility.log - INFO - 116 time: 0:01:30.556430 c
ombined-> loss:0.5665285587310791 ||model_1_loss:0.005583544261753559 ||mo
del_loss:0.5609450340270996 ||model_1_mse:0.004882259294390678 ||model_ms
e:0.5609450340270996 ||
2023-10-07 12:46:31,311 - Utility.log - INFO - 117 time: 0:01:31.218382 c
ombined-> loss:0.7769045829772949 ||model_1_loss:0.005965942982584238 ||mo
del_loss:0.7709386348724365 ||model_1_mse:0.005230193957686424 ||model_ms
e:0.7709386348724365 ||
2023-10-07 12:46:31,919 - Utility.log - INFO - 118 time: 0:01:31.828142 c
ombined-> loss:2.6410396099090576 ||model_1_loss:0.006634722929447889 ||mo
del_loss:2.6344048976898193 ||model_1_mse:0.0058373212814331055 ||model_ms
e:2.6344048976898193 ||
2023-10-07 12:46:32,604 - Utility.log - INFO - 119 time: 0:01:32.511637 c
ombined-> loss:5.483959674835205 ||model_1_loss:0.006463364232331514 ||mod
el_loss:5.477496147155762 ||model_1_mse:0.005716274026781321 ||model_mse:
5.477496147155762 ||
2023-10-07 12:46:33,238 - Utility.log - INFO - 120 time: 0:01:33.146332 c
ombined-> loss:0.6584659218788147 ||model_1_loss:0.006659672595560551 ||mo
del_loss:0.6518062353134155 ||model_1_mse:0.005903041455894709 ||model_ms
e:0.6518062353134155 ||
2023-10-07 12:46:33,881 - Utility.log - INFO - 121 time: 0:01:33.789762 c
ombined-> loss:3.841623306274414 ||model_1_loss:0.006475990172475576 ||mod
el_loss:3.8351473808288574 ||model_1_mse:0.005700843408703804 ||model_mse:
3.8351473808288574 ||
2023-10-07 12:46:34,531 - Utility.log - INFO - 122 time: 0:01:34.438049 c
ombined-> loss:1.589250087738037 ||model_1_loss:0.006136038340628147 ||mod
el_loss:1.5831140279769897 ||model_1_mse:0.005390872713178396 ||model_mse:
1.5831140279769897 ||

2023-10-07 12:46:35,193 - Utility.log - INFO - 123 time: 0:01:35.101728 c
ombined-> loss:3.2736122608184814 ||model_1_loss:0.006069398019462824 ||mo
del_loss:3.267542839050293 ||model_1_mse:0.0053328415378928185 ||model_ms
e:3.267542839050293 ||
2023-10-07 12:46:35,890 - Utility.log - INFO - 124 time: 0:01:35.795005 c
ombined-> loss:2.0977535247802734 ||model_1_loss:0.00604035472497344 ||mod
el_loss:2.0917131900787354 ||model_1_mse:0.005281876772642136 ||model_mse:
2.0917131900787354 ||
2023-10-07 12:46:36,599 - Utility.log - INFO - 125 time: 0:01:36.504984 c
ombined-> loss:0.8811625242233276 ||model_1_loss:0.006172467488795519 ||mo
del_loss:0.8749900460243225 ||model_1_mse:0.005378824658691883 ||model_ms
e:0.8749900460243225 ||
2023-10-07 12:46:37,243 - Utility.log - INFO - 126 time: 0:01:37.147557 c
ombined-> loss:0.9134865403175354 ||model_1_loss:0.00617559626698494 ||mod
el_loss:0.907310962677002 ||model_1_mse:0.005410097539424896 ||model_mse:
0.907310962677002 ||
2023-10-07 12:46:37,872 - Utility.log - INFO - 127 time: 0:01:37.779424 c
ombined-> loss:0.8282670378684998 ||model_1_loss:0.005988432094454765 ||mo
del_loss:0.822278618812561 ||model_1_mse:0.0052216751500964165 ||model_ms
e:0.822278618812561 ||
2023-10-07 12:46:38,498 - Utility.log - INFO - 128 time: 0:01:38.406741 c
ombined-> loss:0.9775081872940063 ||model_1_loss:0.006356226745992899 ||mo
del_loss:0.9711519479751587 ||model_1_mse:0.005557800643146038 ||model_ms
e:0.9711519479751587 ||
2023-10-07 12:46:39,157 - Utility.log - INFO - 129 time: 0:01:39.063234 c
ombined-> loss:1.0927925109863281 ||model_1_loss:0.005947832018136978 ||mo
del_loss:1.0868446826934814 ||model_1_mse:0.00519995391368866 ||model_mse:
1.0868446826934814 ||
2023-10-07 12:46:39,792 - Utility.log - INFO - 130 time: 0:01:39.699502 c
ombined-> loss:0.7309353351593018 ||model_1_loss:0.0058336867950856686 ||m
odel_loss:0.7251016497612 ||model_1_mse:0.005104490090161562 ||model_mse:
0.7251016497612 ||
2023-10-07 12:46:40,468 - Utility.log - INFO - 131 time: 0:01:40.372505 c
ombined-> loss:0.7364963293075562 ||model_1_loss:0.005949243903160095 ||mo
del_loss:0.7305470705032349 ||model_1_mse:0.005225800909101963 ||model_ms
e:0.7305470705032349 ||
2023-10-07 12:46:41,084 - Utility.log - INFO - 132 time: 0:01:40.990919 c
ombined-> loss:1.4936890602111816 ||model_1_loss:0.0060898661613464355 ||m
odel_loss:1.4875991344451904 ||model_1_mse:0.005344889126718044 ||model_ms
e:1.4875991344451904 ||
2023-10-07 12:46:41,722 - Utility.log - INFO - 133 time: 0:01:41.630997 c
ombined-> loss:0.904811680316925 ||model_1_loss:0.0063089849427342415 ||mo
del_loss:0.8985027074813843 ||model_1_mse:0.005525532178580761 ||model_ms
e:0.8985027074813843 ||
2023-10-07 12:46:42,400 - Utility.log - INFO - 134 time: 0:01:42.307858 c
ombined-> loss:0.7617806792259216 ||model_1_loss:0.005599535070359707 ||mo
del_loss:0.7561811208724976 ||model_1_mse:0.004882436245679855 ||model_ms
e:0.7561811208724976 ||
2023-10-07 12:46:43,018 - Utility.log - INFO - 135 time: 0:01:42.925572 c
ombined-> loss:1.775542140007019 ||model_1_loss:0.005766136106103659 ||mod
el_loss:1.7697759866714478 ||model_1_mse:0.005023246165364981 ||model_mse:
1.7697759866714478 ||
2023-10-07 12:46:43,658 - Utility.log - INFO - 136 time: 0:01:43.563840 c
ombined-> loss:1.2597936391830444 ||model_1_loss:0.006089640315622091 ||mo
del_loss:1.2537039518356323 ||model_1_mse:0.005312454886734486 ||model_ms
e:1.2537039518356323 ||
2023-10-07 12:46:44,303 - Utility.log - INFO - 137 time: 0:01:44.209927 c
ombined-> loss:0.678563117980957 ||model_1_loss:0.005910876207053661 ||mod
el_loss:0.6726522445678711 ||model_1_mse:0.005167970433831215 ||model_mse:
0.6726522445678711 ||
2023-10-07 12:46:44,962 - Utility.log - INFO - 138 time: 0:01:44.868999 c

ombined-> loss:1.2190345525741577 ||model_1_loss:0.005950574297457933 ||mo
del_loss:1.2130839824676514 ||model_1_mse:0.005212345160543919 ||model_ms
e:1.2130839824676514 ||
2023-10-07 12:46:45,630 - Utility.log - INFO - 139 time: 0:01:45.535253 c
ombined-> loss:1.3732582330703735 ||model_1_loss:0.0061362795531749725 ||m
odel_loss:1.367121934890747 ||model_1_mse:0.00538252480328083 ||model_mse:
1.367121934890747 ||
2023-10-07 12:46:46,320 - Utility.log - INFO - 140 time: 0:01:46.225628 c
ombined-> loss:0.8618313670158386 ||model_1_loss:0.006067103706300259 ||mo
del_loss:0.8557642698287964 ||model_1_mse:0.005317870527505875 ||model_ms
e:0.8557642698287964 ||
2023-10-07 12:46:47,044 - Utility.log - INFO - 141 time: 0:01:46.949527 c
ombined-> loss:1.3274915218353271 ||model_1_loss:0.005691751837730408 ||mo
del_loss:1.3217997550964355 ||model_1_mse:0.004973553121089935 ||model_ms
e:1.3217997550964355 ||
2023-10-07 12:46:47,702 - Utility.log - INFO - 142 time: 0:01:47.610746 c
ombined-> loss:0.6631447672843933 ||model_1_loss:0.00638311542570591 ||mod
el_loss:0.656761646270752 ||model_1_mse:0.005581961944699287 ||model_mse:
0.656761646270752 ||
2023-10-07 12:46:48,315 - Utility.log - INFO - 143 time: 0:01:48.222320 c
ombined-> loss:0.8032843470573425 ||model_1_loss:0.006492120213806629 ||mo
del_loss:0.796792209148407 ||model_1_mse:0.005660383030772209 ||model_mse:
0.796792209148407 ||
2023-10-07 12:46:48,958 - Utility.log - INFO - 144 time: 0:01:48.866757 c
ombined-> loss:2.07148814201355 ||model_1_loss:0.006026122719049454 ||mode
l_loss:2.065462112426758 ||model_1_mse:0.00526264775544405 ||model_mse:2.0
65462112426758 ||
2023-10-07 12:46:49,570 - Utility.log - INFO - 145 time: 0:01:49.476239 c
ombined-> loss:1.1164871454238892 ||model_1_loss:0.005908963270485401 ||mo
del_loss:1.110578179359436 ||model_1_mse:0.005168154835700989 ||model_mse:
1.110578179359436 ||
2023-10-07 12:46:50,202 - Utility.log - INFO - 146 time: 0:01:50.109677 c
ombined-> loss:0.5722249746322632 ||model_1_loss:0.006175283342599869 ||mo
del_loss:0.5660496950149536 ||model_1_mse:0.005394169129431248 ||model_ms
e:0.5660496950149536 ||
2023-10-07 12:46:50,888 - Utility.log - INFO - 147 time: 0:01:50.794987 c
ombined-> loss:2.008404493331909 ||model_1_loss:0.006463758181780577 ||mod
el_loss:2.0019407272338867 ||model_1_mse:0.005653277039527893 ||model_mse:
2.0019407272338867 ||
2023-10-07 12:46:51,522 - Utility.log - INFO - 148 time: 0:01:51.429028 c
ombined-> loss:2.8537559509277344 ||model_1_loss:0.006166229955852032 ||mo
del_loss:2.8475897312164307 ||model_1_mse:0.005403156392276287 ||model_ms
e:2.8475897312164307 ||
2023-10-07 12:46:52,170 - Utility.log - INFO - 149 time: 0:01:52.075893 c
ombined-> loss:0.5256779789924622 ||model_1_loss:0.0061029354110360146 ||m
odel_loss:0.5195750594139099 ||model_1_mse:0.005384837277233601 ||model_ms
e:0.5195750594139099 ||
2023-10-07 12:46:52,823 - Utility.log - INFO - 150 time: 0:01:52.729041 c
ombined-> loss:1.8172646760940552 ||model_1_loss:0.0062039862386882305 ||m
odel_loss:1.8110606670379639 ||model_1_mse:0.005469615571200848 ||model_ms
e:1.8110606670379639 ||
2023-10-07 12:46:53,444 - Utility.log - INFO - 151 time: 0:01:53.351707 c
ombined-> loss:2.6429286003112793 ||model_1_loss:0.0066309962421655655 ||m
odel_loss:2.6362977027893066 ||model_1_mse:0.005828201305121183 ||model_ms
e:2.6362977027893066 ||
2023-10-07 12:46:54,107 - Utility.log - INFO - 152 time: 0:01:54.014082 c
ombined-> loss:0.9723606109619141 ||model_1_loss:0.005418195854872465 ||mo
del_loss:0.9669424295425415 ||model_1_mse:0.004712730646133423 ||model_ms
e:0.9669424295425415 ||
2023-10-07 12:46:54,722 - Utility.log - INFO - 153 time: 0:01:54.629453 c
ombined-> loss:1.3751657009124756 ||model_1_loss:0.006197233684360981 ||mo

del_loss:1.3689684867858887 ||model_1_mse:0.0054202210158109665 ||model_ms
e:1.3689684867858887 ||
2023-10-07 12:46:55,365 - Utility.log - INFO - 154 time: 0:01:55.271632 c
ombined-> loss:0.701839029788971 ||model_1_loss:0.006002138368785381 ||mod
el_loss:0.6958369016647339 ||model_1_mse:0.005262219347059727 ||model_mse:
0.6958369016647339 ||
2023-10-07 12:46:55,993 - Utility.log - INFO - 155 time: 0:01:55.897399 c
ombined-> loss:1.0556682348251343 ||model_1_loss:0.005854279734194279 ||mo
del_loss:1.049813985824585 ||model_1_mse:0.005118710454553366 ||model_mse:
1.049813985824585 ||
2023-10-07 12:46:56,702 - Utility.log - INFO - 156 time: 0:01:56.611034 c
ombined-> loss:0.580734133720398 ||model_1_loss:0.006433473899960518 ||mod
el_loss:0.5743006467819214 ||model_1_mse:0.005619536619633436 ||model_mse:
0.5743006467819214 ||
2023-10-07 12:46:57,376 - Utility.log - INFO - 157 time: 0:01:57.283476 c
ombined-> loss:2.061659097671509 ||model_1_loss:0.006747609470039606 ||mod
el_loss:2.0549113750457764 ||model_1_mse:0.005972487851977348 ||model_mse:
2.0549113750457764 ||
2023-10-07 12:46:57,992 - Utility.log - INFO - 158 time: 0:01:57.899932 c
ombined-> loss:0.4818565845489502 ||model_1_loss:0.006028706207871437 ||mo
del_loss:0.4758278727531433 ||model_1_mse:0.005266302265226841 ||model_ms
e:0.4758278727531433 ||
2023-10-07 12:46:58,615 - Utility.log - INFO - 159 time: 0:01:58.521571 c
ombined-> loss:1.3873908519744873 ||model_1_loss:0.006228870712220669 ||mo
del_loss:1.3811619281768799 ||model_1_mse:0.005488370079547167 ||model_ms
e:1.3811619281768799 ||
2023-10-07 12:46:59,278 - Utility.log - INFO - 160 time: 0:01:59.184383 c
ombined-> loss:1.3704122304916382 ||model_1_loss:0.006254428531974554 ||mo
del_loss:1.364157795906067 ||model_1_mse:0.005521015264093876 ||model_mse:
1.364157795906067 ||
2023-10-07 12:46:59,919 - Utility.log - INFO - 161 time: 0:01:59.825187 c
ombined-> loss:0.8001927137374878 ||model_1_loss:0.0063003296963870525 ||m
odel_loss:0.7938923835754395 ||model_1_mse:0.00551249785348773 ||model_ms
e:0.7938923835754395 ||
2023-10-07 12:47:00,533 - Utility.log - INFO - 162 time: 0:02:00.439380 c
ombined-> loss:1.2003509998321533 ||model_1_loss:0.006587544456124306 ||mo
del_loss:1.1937634944915771 ||model_1_mse:0.0057909926399588585 ||model_ms
e:1.1937634944915771 ||
2023-10-07 12:47:01,215 - Utility.log - INFO - 163 time: 0:02:01.120597 c
ombined-> loss:1.125440239906311 ||model_1_loss:0.006412572227418423 ||mod
el_loss:1.1190276145935059 ||model_1_mse:0.005630292929708958 ||model_mse:
1.1190276145935059 ||
2023-10-07 12:47:01,837 - Utility.log - INFO - 164 time: 0:02:01.743844 c
ombined-> loss:0.9693066477775574 ||model_1_loss:0.006156520918011665 ||mo
del_loss:0.963150143623352 ||model_1_mse:0.005420081317424774 ||model_mse:
0.963150143623352 ||
2023-10-07 12:47:02,446 - Utility.log - INFO - 165 time: 0:02:02.353917 c
ombined-> loss:1.0238139629364014 ||model_1_loss:0.006111562252044678 ||mo
del_loss:1.0177024602890015 ||model_1_mse:0.005334785208106041 ||model_ms
e:1.0177024602890015 ||
2023-10-07 12:47:03,020 - Utility.log - INFO - 166 time: 0:02:02.927582 c
ombined-> loss:0.8196533918380737 ||model_1_loss:0.005525031127035618 ||mo
del_loss:0.8141283392906189 ||model_1_mse:0.00483810855075717 ||model_mse:
0.8141283392906189 ||
2023-10-07 12:47:03,604 - Utility.log - INFO - 167 time: 0:02:03.511199 c
ombined-> loss:0.4005712568759918 ||model_1_loss:0.005773236975073814 ||mo
del_loss:0.39479801058769226 ||model_1_mse:0.005039532203227282 ||model_ms
e:0.39479801058769226 ||
2023-10-07 12:47:04,263 - Utility.log - INFO - 168 time: 0:02:04.170335 c
ombined-> loss:1.8501290082931519 ||model_1_loss:0.005864750128239393 ||mo
del_loss:1.844264268875122 ||model_1_mse:0.005115406587719917 ||model_mse:

1.844264268875122 ||
2023-10-07 12:47:04,916 - Utility.log - INFO - 169 time: 0:02:04.821289 combined-> loss:1.5900508165359497 ||model_1_loss:0.005837997421622276 ||model_loss:1.5842127799987793 ||model_1_mse:0.00509618129581213 ||model_mse:1.5842127799987793 ||
2023-10-07 12:47:05,577 - Utility.log - INFO - 170 time: 0:02:05.484638 combined-> loss:0.8085522055625916 ||model_1_loss:0.005829378496855497 ||model_loss:0.8027228116989136 ||model_1_mse:0.005086211487650871 ||model_mse:0.8027228116989136 ||
2023-10-07 12:47:06,238 - Utility.log - INFO - 171 time: 0:02:06.146026 combined-> loss:4.2715349197387695 ||model_1_loss:0.006345032714307308 ||model_loss:4.265190124511719 ||model_1_mse:0.005553052760660648 ||model_mse:4.265190124511719 ||
2023-10-07 12:47:06,852 - Utility.log - INFO - 172 time: 0:02:06.760668 combined-> loss:3.2259254455566406 ||model_1_loss:0.006670461036264896 ||model_loss:3.219254970550537 ||model_1_mse:0.005874580703675747 ||model_mse:3.219254970550537 ||
2023-10-07 12:47:07,497 - Utility.log - INFO - 173 time: 0:02:07.404430 combined-> loss:0.8592884540557861 ||model_1_loss:0.006662614643573761 ||model_loss:0.852625846862793 ||model_1_mse:0.005892139859497547 ||model_mse:0.852625846862793 ||
2023-10-07 12:47:08,096 - Utility.log - INFO - 174 time: 0:02:08.002420 combined-> loss:1.5236568450927734 ||model_1_loss:0.00560593418776989 ||model_loss:1.5180509090423584 ||model_1_mse:0.004902216140180826 ||model_mse:1.5180509090423584 ||
2023-10-07 12:47:08,741 - Utility.log - INFO - 175 time: 0:02:08.649031 combined-> loss:2.6632814407348633 ||model_1_loss:0.006440043915063143 ||model_loss:2.656841278076172 ||model_1_mse:0.005685102194547653 ||model_mse:2.656841278076172 ||
2023-10-07 12:47:09,380 - Utility.log - INFO - 176 time: 0:02:09.286250 combined-> loss:4.709089756011963 ||model_1_loss:0.006784631870687008 ||model_loss:4.702305316925049 ||model_1_mse:0.006037117913365364 ||model_mse:4.702305316925049 ||
2023-10-07 12:47:10,027 - Utility.log - INFO - 177 time: 0:02:09.934442 combined-> loss:3.652639865875244 ||model_1_loss:0.0060449750162661076 ||model_loss:3.646595001220703 ||model_1_mse:0.00535953463986516 ||model_mse:3.646595001220703 ||
2023-10-07 12:47:10,736 - Utility.log - INFO - 178 time: 0:02:10.642617 combined-> loss:6.4711432456970215 ||model_1_loss:0.006474575027823448 ||model_loss:6.4646687507629395 ||model_1_mse:0.005716918036341667 ||model_mse:6.4646687507629395 ||
2023-10-07 12:47:11,455 - Utility.log - INFO - 179 time: 0:02:11.361022 combined-> loss:4.04425573348999 ||model_1_loss:0.005758065264672041 ||model_loss:4.038497447967529 ||model_1_mse:0.005056364461779594 ||model_mse:4.038497447967529 ||
2023-10-07 12:47:12,150 - Utility.log - INFO - 180 time: 0:02:12.054784 combined-> loss:1.9384697675704956 ||model_1_loss:0.006094981450587511 ||model_loss:1.9323748350143433 ||model_1_mse:0.005334761459380388 ||model_mse:1.9323748350143433 ||
2023-10-07 12:47:12,789 - Utility.log - INFO - 181 time: 0:02:12.695357 combined-> loss:1.7551931142807007 ||model_1_loss:0.005923831835389137 ||model_loss:1.7492692470550537 ||model_1_mse:0.005174105986952782 ||model_mse:1.7492692470550537 ||
2023-10-07 12:47:13,407 - Utility.log - INFO - 182 time: 0:02:13.314761 combined-> loss:0.4791645407676697 ||model_1_loss:0.006111922673881054 ||model_loss:0.47305262088775635 ||model_1_mse:0.005387115757912397 ||model_mse:0.47305262088775635 ||
2023-10-07 12:47:14,002 - Utility.log - INFO - 183 time: 0:02:13.910130 combined-> loss:0.921766996383667 ||model_1_loss:0.00653081014752388 ||model_loss:0.9152361750602722 ||model_1_mse:0.0057509890757501125 ||model_mse:0.9152361750602722 ||

```
2023-10-07 12:47:14,632 - Utility.log - INFO - 184 time: 0:02:14.538492  c
ombined-> loss:0.8210748434066772 ||model_1_loss:0.005988005083054304 ||mo
del_loss:0.815086841583252 ||model_1_mse:0.00523013761267066 ||model_mse:
0.815086841583252 ||
2023-10-07 12:47:15,243 - Utility.log - INFO - 185 time: 0:02:15.150095  c
ombined-> loss:0.46903562545776367 ||model_1_loss:0.005727277137339115 ||m
odel_loss:0.46330833435058594 ||model_1_mse:0.004999903496354818 ||model_m
se:0.46330833435058594 ||
2023-10-07 12:47:15,952 - Utility.log - INFO - 186 time: 0:02:15.861281  c
ombined-> loss:1.0863150358200073 ||model_1_loss:0.0060041812248528 ||mode
l_loss:1.0803108215332031 ||model_1_mse:0.005245914217084646 ||model_mse:
1.0803108215332031 ||
2023-10-07 12:47:16,604 - Utility.log - INFO - 187 time: 0:02:16.511335  c
ombined-> loss:1.0203354358673096 ||model_1_loss:0.0059191882610321045 ||m
odel_loss:1.014416217803955 ||model_1_mse:0.005144762806594372 ||model_ms
e:1.014416217803955 ||
2023-10-07 12:47:17,270 - Utility.log - INFO - 188 time: 0:02:17.178033  c
ombined-> loss:0.6994844675064087 ||model_1_loss:0.005892532877624035 ||mo
del_loss:0.6935919523239136 ||model_1_mse:0.005123785696923733 ||model_ms
e:0.6935919523239136 ||
2023-10-07 12:47:17,932 - Utility.log - INFO - 189 time: 0:02:17.839841  c
ombined-> loss:1.0445321798324585 ||model_1_loss:0.00584192480891943 ||mod
el_loss:1.038690209388733 ||model_1_mse:0.005094341933727264 ||model_mse:
1.038690209388733 ||
2023-10-07 12:47:18,518 - Utility.log - INFO - 190 time: 0:02:18.425979  c
ombined-> loss:3.3244080543518066 ||model_1_loss:0.0055997176095843315 ||m
odel_loss:3.3188083171844482 ||model_1_mse:0.004877195227891207 ||model_ms
e:3.3188083171844482 ||
2023-10-07 12:47:19,139 - Utility.log - INFO - 191 time: 0:02:19.046759  c
ombined-> loss:2.249521493911743 ||model_1_loss:0.006021109409630299 ||mod
el_loss:2.2435004711151123 ||model_1_mse:0.005254627205431461 ||model_mse:
2.2435004711151123 ||
2023-10-07 12:47:19,789 - Utility.log - INFO - 192 time: 0:02:19.693193  c
ombined-> loss:1.2470508813858032 ||model_1_loss:0.005862351506948471 ||mo
del_loss:1.2411885261535645 ||model_1_mse:0.005116201937198639 ||model_ms
e:1.2411885261535645 ||
2023-10-07 12:47:20,410 - Utility.log - INFO - 193 time: 0:02:20.318105  c
ombined-> loss:0.9228208065032959 ||model_1_loss:0.005572417750954628 ||mo
del_loss:0.9172483682632446 ||model_1_mse:0.004849263932555914 ||model_ms
e:0.9172483682632446 ||
2023-10-07 12:47:21,111 - Utility.log - INFO - 194 time: 0:02:21.016011  c
ombined-> loss:0.7080093622207642 ||model_1_loss:0.005913849920034409 ||mo
del_loss:0.7020955085754395 ||model_1_mse:0.00515805184841156 ||model_mse:
0.7020955085754395 ||
2023-10-07 12:47:21,822 - Utility.log - INFO - 195 time: 0:02:21.730565  c
ombined-> loss:1.0125960111618042 ||model_1_loss:0.005828704684972763 ||mo
del_loss:1.0067672729492188 ||model_1_mse:0.005081503186374903 ||model_ms
e:1.0067672729492188 ||
2023-10-07 12:47:22,455 - Utility.log - INFO - 196 time: 0:02:22.362704  c
ombined-> loss:0.8317702412605286 ||model_1_loss:0.006062022410333157 ||mo
del_loss:0.8257082104682922 ||model_1_mse:0.005284493323415518 ||model_ms
e:0.8257082104682922 ||
```

3. Process the raw image

Load the trained model

To reproduce the paper results, the provided trained model can be loaded by running the following code.

Expect output: "Loading completed!" message.

Time cost: 1-3 min

In [12]:
```
# clear unused memories
del net.data_loader

# load model
load_model_path = r'Model/CsPbBr3_blind.h5'
net.combined.load_weights(load_model_path)
print("Loading completed!")
```

```
Loading completed!
```

... or load the current trained model from the previous step

In [6]:
```
load_model_path = r'Model/saved_model/CsPbBr3/gen_model10000.h5'
net.combined.load_weights(load_model_path)
print("Loading completed!")
```

```
Loading completed!
```

Run denoising

Expect output: "Denoising completed!" message

Time cost: 3-5 min

In [13]:
```
# load raw data
file = r'CsPbBr3'
channel = 32
script_dir = os.path.dirname(os.path.realpath('__file__'))
path = Path(script_dir)
file_name = file + '.h5'
file_dir = os.path.join(str(path), 'Data', file_name)
with h5py.File(file_dir, 'r') as f:
    img = f['Cube']['Images'][()]
img_max = np.max(img)
img,img_max,img_min = ReadH5.normalization(np.expand_dims(np.swapaxes(np.sw
apaxes(img, -1, 0),0,1),0), dynamic=0.9999)
shape = img.shape
mid = int(shape[-1]/2)

division_factor = np.zeros((img.shape[-1]))
output_img = np.zeros(img.shape)
total_noise_level = np.zeros((max(1,img.shape[-1]-channel+1)))
start_time = time.time()

# denoising
for i in range(max(1,img.shape[-1]-channel+1)):
    division_factor[i:i+channel] += np.ones((channel))
    result,noise_level = net.combined.predict(img[:,:,:,i:i+channel])
    output_img[:,:,:,i:i+channel] += result
    total_noise_level[i] = noise_level

for i in range(shape[-1]):
    output_img[:,:,:,i] = output_img[:,:,:,i]/division_factor[i]

print('Denoising completed! Time cost {} s per frame.'.format((time.time()
- start_time)/img.shape[-1]))
del img
```

```
Denoising completed! Time cost 0.6350601441932447 s per frame.
```

Save the data

Expect output: a .h5 file containing denoised image.

Time cost: <1 min

In [14]:
```
def write_H5(filename, data, wavelength_data=None, original_dir=None):
    if original_dir is not None:
        copy(original_dir, filename)
        hf = h5py.File(filename, 'r+')
        del hf['Cube']['Images']
        hf['Cube'].create_dataset('Images', data=data.astype(np.float32))
        hf.close()
    else:
        hf = h5py.File(filename, 'w')
        g1 = hf.create_group('Cube')
        g1.create_dataset('Images', data=data.astype(np.float16))
        if wavelength_data is not None:
            g1.create_dataset('Wavelength', data=wavelength_data)
        hf.close()
    return None

output_img = ReadH5.revert_normalization(np.swapaxes(np.swapaxes(output_img
[0,:,:,:], 0, 1),-1,0), img_max, img_min)
output_name = 'Results/'+ file + '_denoised.h5'
write_H5(output_name,output_img,original_dir=file_dir)
print("Save successful at {}.".format(Path(output_name)))
```

```
Save successful at Results\CsPbBr3_denoised.h5.
```

4. Analyze the result

Load the data

Time cost: 1 min

In [15]:
```
img_raw = ReadH5.load_H5(r'Data/CsPbBr3.h5')/2**16*30000
img_denoised = ReadH5.load_H5(r'Results/CsPbBr3_denoised.h5')/2**16*30000
wav = list(range(420, 552, 2))
```

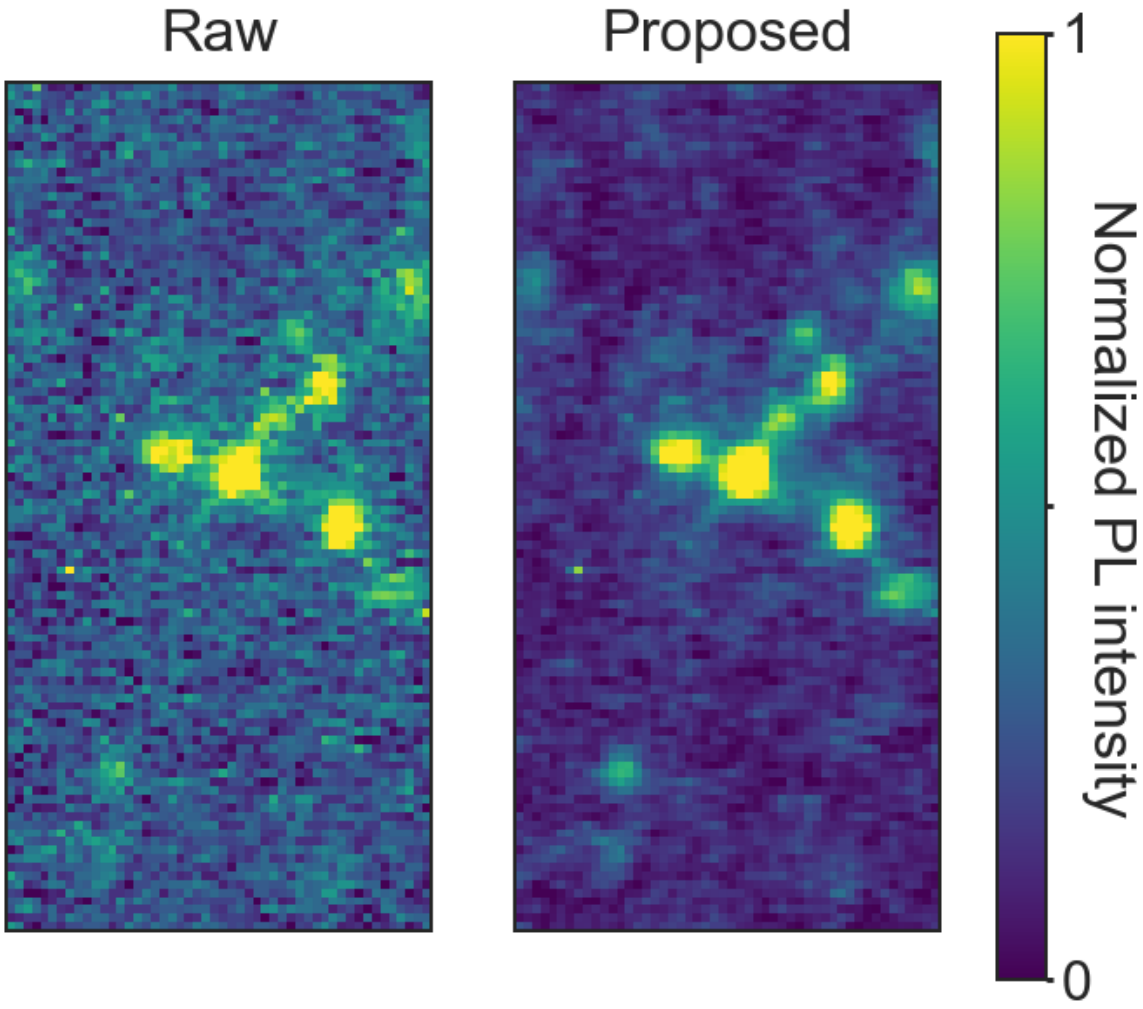
Reproducing Figure 2a

Expected output: Figure 2a (left), 2b (right), 470 nm

Time cost: 1 min

In [16]:

```
plt.style.use('seaborn-white')
matplotlib.rcParams['axes.linewidth'] = 2
font = {'size': 34}
matplotlib.rc('font', **font)
matplotlib.rcParams['xtick.major.pad']='8'
matplotlib.rcParams['ytick.major.pad']='8'
plt.rcParams["font.weight"] = "normal"
plt.rcParams["axes.labelweight"] = "normal"

fig, (ax0, ax1) = plt.subplots(1, 2, sharey=True, gridspec_kw=dict(width_ra
tios=[1, 1],hspace=0.075),figsize=(12, 10))
mat = ax0.matshow(ReadH5.normalization(img_raw[25,1000:1100,468:518], dynam
ic = 0.99, rang=[0,1])[0], cmap='viridis')
ax0.set(xticklabels=[])
ax0.axes.get_yaxis().set_visible(False)
ax0.set_xlabel('Raw', labelpad=10)
ax0.xaxis.set_label_position('top')
mat = ax1.matshow(ReadH5.normalization(img_denoised[25,1000:1100,468:518],
dynamic = 0.99, rang=[0,1])[0], cmap='viridis')
ax1.set(xticklabels=[])
ax1.axes.get_yaxis().set_visible(False)
ax1.set_xlabel('Proposed', labelpad=10)
ax1.xaxis.set_label_position('top')
cbar = fig.colorbar(mat, ax=[ax0,ax1])
cbar.ax.tick_params(axis='y', direction='out',length=4,width=3,pad=5,labels
ize=32)
cbar.ax.set_ylabel('Normalized PL intensity',labelpad=25, rotation=-90)
cbar.ax.yaxis.set_major_locator(matplotlib.ticker.MaxNLocator(nbins=3, inte
ger=True, steps=[1, 2, 5, 10]))
cbar.ax.yaxis.set_minor_locator(matplotlib.ticker.AutoMinorLocator(2))
cbar.ax.tick_params(axis='y',which='minor',direction='out',length=4,width=
3,pad=5,labelsize=32)
```



Reproducing SI Figure 2c

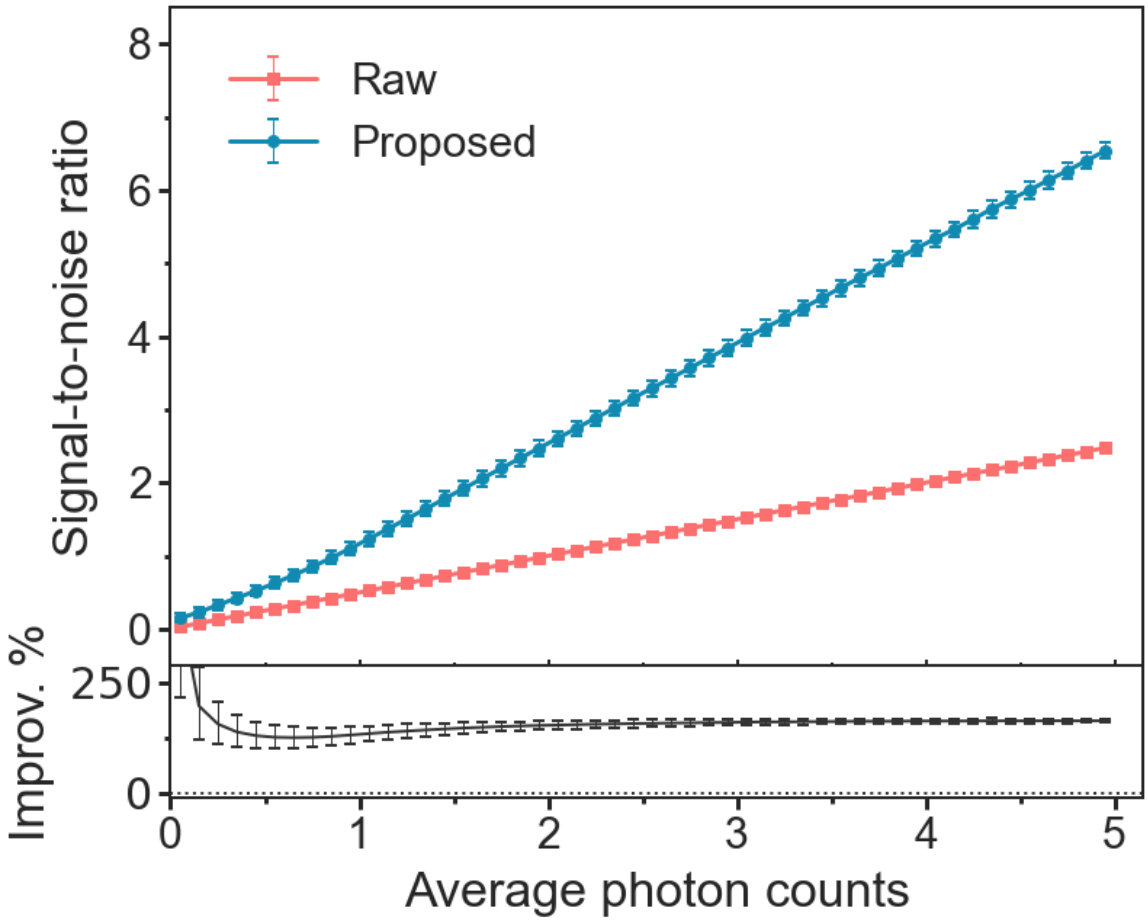
Expect output: SI Figure 2c

Time cost: 3-5 min

In [17]:

```
# SNR mapping statistics
import scipy
from scipy.stats import gaussian_kde, binned_statistic, binned_statistic_2d

def signaltonoise(a, std, axis=0, ddof=0):
    a = np.asanyarray(a)
    m = a.mean(axis)
    return m/std

img_int = np.mean(img_raw,axis=0).flatten()
img_raw_snr = signaltonoise(img_raw,np.std(img_raw[:,101:109,710:718]),axis
=(0)).flatten()
img_denoised_snr = signaltonoise(img_denoised,np.std(img_denoised[:,101:10
9,710:718]),axis=(0)).flatten()

# remove pixels of counts<=0
delete_list = []
for i, value in enumerate(img_raw_snr):
    if value <= 0:
        delete_list.append(i)
img_int = np.delete(img_int, delete_list)
img_raw_snr = np.delete(img_raw_snr, delete_list)
img_denoised_snr = np.delete(img_denoised_snr, delete_list)

int_range = [0,5]
int_bin = (int_range[1]-int_range[0])*10

raw_median, bin_edges, _ = binned_statistic(img_int, img_raw_snr, statistic
='median', bins=int_bin, range=[int_range])
raw_25, _, _ = binned_statistic(img_int, img_raw_snr, statistic=lambda y: n
p.percentile(y, 25), bins=int_bin, range=[int_range])
raw_75, _, _ = binned_statistic(img_int, img_raw_snr, statistic=lambda y: n
p.percentile(y, 75), bins=int_bin, range=[int_range])
raw_count, _, _ = binned_statistic(img_int, img_raw_snr, statistic='count',
bins=int_bin, range=[int_range])
de_median, _, _ = binned_statistic(img_int, img_denoised_snr, statistic='me
dian', bins=int_bin, range=[int_range])
de_25, _, _ = binned_statistic(img_int, img_denoised_snr, statistic=lambda
y: np.percentile(y, 25), bins=int_bin, range=[int_range])
de_75, _, _ = binned_statistic(img_int, img_denoised_snr, statistic=lambda
y: np.percentile(y, 75), bins=int_bin, range=[int_range])

improv = np.array((img_denoised_snr/img_raw_snr-1)*100)

improv_median, _, _ = binned_statistic(img_int, improv, statistic=lambda y:
np.median(y), bins=int_bin, range=[int_range])
improv_25, _, _ = binned_statistic(img_int, improv, statistic=lambda y: np.
percentile(y, 25), bins=int_bin, range=[int_range])
improv_75, _, _ = binned_statistic(img_int, improv, statistic=lambda y: np.
percentile(y, 75), bins=int_bin, range=[int_range])

# plot the analysis
plt.style.use('seaborn-white')
matplotlib.rcParams['axes.linewidth'] = 2
font = {'size': 34}
matplotlib.rc('font', **font)
matplotlib.rcParams['xtick.major.pad'] = '8'
matplotlib.rcParams['ytick.major.pad'] = '8'
plt.rcParams["font.weight"] = "normal"
plt.rcParams["axes.labelweight"] = "normal"
```

```
labelsize=30

fig, (ax0, ax1) = plt.subplots(2,1, sharex=True, gridspec_kw=dict(height_ra
tios=[5, 1]),figsize=(12, 10))

ax0.errorbar(bin_edges[:-1]+0.05, raw_median, yerr=np.array([raw_median-raw
_25,raw_75-raw_median]),
             linestyle='-', label='Raw', marker='s', elinewidth=1, capsize=
4, capthick=2, color=matplotlib.colors.to_rgba('#fb6f6f')[:-1]+(1,), linewi
dth=3, markersize=8, zorder=1)
ax0.errorbar(bin_edges[:-1]+0.05, de_median, yerr=np.array([de_median-de_2
5,de_75-de_median]),
             linestyle='-', label='Proposed', marker='o', elinewidth=1, cap
size=4, capthick=2, color=matplotlib.colors.to_rgba('#118ab2')[:-1]+(1,), l
inewidth=3, markersize=8, zorder=2)
handles, labels = ax0.get_legend_handles_labels()
ax0.legend(fontsize=30, loc='lower left', bbox_to_anchor=(0.02, 0.70))
ax0.set_xlim(int_range)
ax0.set_ylim([-0.5, 8.5])
ax0.xaxis.set_minor_locator(matplotlib.ticker.AutoMinorLocator(2))
ax0.set_ylabel('Signal-to-noise ratio', labelpad=20)
ax0.tick_params(axis='y', direction='out', length=8, width=3, pad=5, labels
ize=labelsize)
ax0.tick_params(axis='x', direction='inout', length=8, width=2, pad=5, labe
lsize=labelsize)
ax0.xaxis.set_major_locator(matplotlib.ticker.MaxNLocator(nbins=6, integer=
True, steps=[1, 2, 5, 10]))
ax0.xaxis.set_minor_locator(matplotlib.ticker.AutoMinorLocator(2))
ax0.yaxis.set_major_locator(matplotlib.ticker.MaxNLocator(nbins=5, integer=
False, steps=[2, 5]))
ax0.yaxis.set_minor_locator(matplotlib.ticker.AutoMinorLocator(2))
ax0.tick_params(axis='y', which='minor', direction='out', length=4, width=
3, pad=5)
ax0.tick_params(axis='x', which='minor', direction='inout', length=4, width
=2, pad=5)

ax1.errorbar(bin_edges[:-1]+0.05, improv_median, yerr=np.array([improv_medi
an-improv_25,improv_75-improv_median]),
         elinewidth=1, capsize=4, capthick=2, color=matplotlib.colors.to_rg
ba('#333333'), linewidth=2)
ax1.hlines(y=0, xmin=0, xmax=10, linestyles='dotted', linewidth=2, color=ma
tplotlib.colors.to_rgba('#333333'))
ax1.yaxis.set_ticklabels([])
ax0.set_xlim([0,5.15])
ax1.set_ylim([-10, 290])
ax1.set_xlabel('Average photon counts', labelpad=10)
ax1.set_ylabel('Improv. %', labelpad=9)
ax1.tick_params(axis='both', direction='out', length=8, width=3, pad=5, lab
elsize=labelsize)
ax1.tick_params(axis='both', which='minor', direction='out', length=4, widt
h=3, pad=5)
f = matplotlib.ticker.ScalarFormatter(useOffset=False, useMathText=True)
g = lambda x,pos : "${}$".format(f._formatSciNotation('%d' % x))
ax1.yaxis.set_major_formatter(matplotlib.ticker.FuncFormatter(g))
ax1.xaxis.set_major_locator(matplotlib.ticker.MaxNLocator(nbins=6, integer=
True, steps=[1, 2, 5, 10]))
ax1.yaxis.set_minor_locator(matplotlib.ticker.AutoMinorLocator(2))
plt.subplots_adjust(hspace=.0)
```


Raw
Proposed
Signal-to-noise ratio
8
6
4
2
0
Improv. %
250
0
0
1
2
3
4
5
Average photon counts

In [ ]: