
Tools

```
%%capture
!pip install pyDOE tensorflow_addons
import pickle
import numpy as np
np.random.seed(42)
import pandas as pd
from scipy import integrate
from pyDOE import lhs
import matplotlib.pyplot as plt
import seaborn as sb
import warnings
warnings.filterwarnings('ignore')
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
import tensorflow as tf
import tensorflow_addons as tfa
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.initializers import GlorotUniform
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from tensorflow.keras.layers import BatchNormalization
from tensorflow.keras.layers import Activation
from tensorflow.keras import regularizers
from tensorflow.keras.models import Sequential, save_model, load_model
from google.colab import drive

```

Step 1: Data Generation with the Heston Model

ANN Parameters	Range	Method
Input		
Moneyness, m = S0/K	(0.6, 1.4)	LHS
Time to maturity, τ	(0.1, 1.4)(year)	LHS
Risk free rate, r	(0.0%, 10%)	LHS
Correlation, ρ	(−0.95, 0.0)	LHS
Reversion speed, κ	(0.0, 2.0)	LHS
Long average variance, θ	(0.0, 0.5)	LHS
Volatility of volatility, σ	(0.0, 0.5)	LHS
Initial variance, v0	(0.05, 0.5)	LHS
Output		
European call price, V	(0, 0.67)	

The LHS method, also known as Latin Hypercube Sampling, is a statistical sampling technique used in various fields, including engineering, computer experiments, and simulation studies. It is designed to create a representative sample of parameter values from a multivariate distribution.

In Latin Hypercube Sampling, the parameter space is divided into equal intervals along each dimension, and then one random sample is selected from each interval. This ensures that the resulting sample covers the entire parameter space uniformly and efficiently. The Latin Hypercube structure helps to reduce sampling variability and ensures a more representative sample compared to simple random sampling.

 image.png

```
def heston_price(m, v0, kappa, theta, sigma, rho, tau, r, a, b, N_cos):

    sum=0
    sum1=0

    moneyness = m - r* tau
    for k in range(0, N_cos):
      args = (m, v0, kappa, theta, sigma, rho, tau, r, a, b)
      res= heston_charfunc(k* np.pi/(b-a), *args)* U_k(k, a, b)* np.exp(-1j* k* np.pi* ((moneyness+ a)/(b-a)))
      if k==0 :
        sum1=res
      else:
        sum+=res

    result= np.exp(-r* tau)* np.real(0.5* sum1+ sum)

    return result

def heston_price(m, v0, kappa, theta, sigma, rho, tau, r, a, b, N_cos):
```

```
20
21     sum=0
22     sum1=0
23
24     moneyness = m - r* tau
25     for k in range(0, N_cos):
26       args = (m, v0, kappa, theta, sigma, rho, tau, r, a, b)
27       res= heston_charfunc(k* np.pi/(b-a), *args)* U_k_calc(k, a, b)* np.exp(-1j* k* np.pi* ((moneyness+ a)/(b-a)))
28       if k==0 :
29         sum1=res
30       else:
31         sum+=res
32
33
34     result= np.exp(-r* tau)* np.real(0.5* sum1+ sum)
35
36
37     return result
38
39 def heston_charfunc(w, m, v0, kappa, theta, sigma, rho, tau, r, a, b):
40
41     args = (w, m, v0, kappa, theta, sigma, rho, tau, r, a, b)
42     D= D_calc(*args)
43     G= G_calc(*args)
44     result= np.exp(1j* w* r* tau+ (v0/(sigma**2))* ((1- np.exp(-1* D* tau))/(1-G* np.exp(-1* D* tau)))
45     * (kappa- (1j* rho* sigma* w)- D))* np.exp((kappa* theta/ (sigma**2))* (tau* (kappa- 1j* rho* sigma* w- D)-
46                                                                                 2* np.log((1- G* np.exp(-1* D* tau))/(1-G))))
47
48     return result
49
50 def D_calc(w, m, v0, kappa, theta, sigma, rho, tau, r, a, b):
51
52     result= np.sqrt((kappa- 1j* rho* sigma* w)**2 + (w**2+ 1j* w)* (sigma**2))
53
54     return result
55
56 def G_calc(w, m, v0, kappa, theta, sigma, rho, tau, r, a, b):
57
58     args = (w, m, v0, kappa, theta, sigma, rho, tau, r, a, b)
59     D= D_calc(*args)
60     result= (kappa- 1j* rho* sigma* w- D )/ (kappa- 1j* rho* sigma* w+ D)
61
62     return result
63
64 def U_k_calc(k, a, b):
65
66     result= (2/(b-a))* (Chi_k(k, 0, b, a, b)- Psi_k(k, 0, b, a, b))
67
68     return result
```

```
def Chi_k(k, c, d, a, b):

    result= (1/((1+ (k* np.pi/ (b-a))**2) ))* ((np.cos(k* np.pi * ((d-a)/(b-a)))* np.exp(d))- (np.cos(k* np.pi* ((c-a)/(b-a)))* np.exp(c))
    + ((k* np.pi/(b-a)) *np.sin(k* np.pi* ((d-a)/(b-a)))* np.exp(d))- ((k* np.pi/(b-a)) *np.sin(k* np.pi* ((c-a)/(b-a)))* np.exp(c) ))

    return result

def Psi_k(k, c, d, a, b):

    if k==0:
      result= d-c
    else:
      result=(np.sin(k* np.pi* ((d-a)/(b-a)))- np.sin(k* np.pi* ((c-a)/(b-a))))* (b-a)/ (k* np.pi)

    # print('say_x', result)
    return result

def calc_a_b(m, v0, kappa, theta, sigma, rho, tau, r, L_cos):

    c1= r* tau+ (1- np.exp(-1* kappa* tau))* ((theta- v0)/ (2* kappa))- 0.5* theta* tau

    c2= (1/(8* (kappa**3)))* (sigma* tau* kappa* np.exp(-1* kappa* tau)*(v0-theta)* (8* kappa* rho- 4* sigma)+
                              kappa* rho* sigma* (1- np.exp(-1* kappa* tau))* (16* theta- 8* v0)+
                              2* theta* kappa* tau* (-4* kappa* rho* sigma+ sigma**2+ 4* (kappa**2))+
                              sigma**2 * ((theta- 2*v0)* np.exp(-2* kappa* tau)+ theta* (6* np.exp(-1* kappa* tau)-7)+ 2* v0)+
                              8* (kappa**2) * (v0- theta)* (1-np.exp(-1* kappa * tau)))

    a= c1- L_cos* (np.sqrt(np.abs(c2)))
    b= c1+ L_cos* (np.sqrt(np.abs(c2)))

    return a, b

# Define the LHS method with lhs function in Python library pyDOE

def lhs_sample(range_values):
    lower_bound, upper_bound = range_values
    samples = lhs(1, samples=1)  # Generating a single sample
    scaled_sample = samples * (upper_bound - lower_bound) + lower_bound
    return scaled_sample.item()

# Create an empty data frame to store the values
df = pd.DataFrame(columns=['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'sigma', 'v0', 'option_price'])


num_samples = 1000000

# Define the ranges for input parameters
dataset = []
```

```
for i in range(num_samples):
    if i % 3000 == 0:
        print(i)
    m = lhs_sample([0.6, 1.4])
    tau = lhs_sample([0.1, 1.4])
    r = lhs_sample([0.0, 0.1])
    rho = lhs_sample([-0.95, 0.0])
    kappa = lhs_sample([0.0, 2.0])
    theta = lhs_sample([0.0, 0.5])
    sigma = lhs_sample([0.0, 0.5])
    v0 = lhs_sample([0.05, 0.5])

    a, b = calc_a_b(np.log(m), v0, kappa, theta, sigma, rho, tau, r, L_cos=50)
        #print(a, b)
    option_price = heston_price(np.log(m), v0, kappa, theta, sigma, rho, tau, r, a, b, N_cos=1500)
        # dataset.append([m, tau, r, rho, kappa, theta, sigma, v0, ])
        # Append the values to the data frame
    df = df.append({
        'm': m,
        'tau': tau,
        'r': r,
        'rho': rho,
        'kappa': kappa,
        'theta': theta,
        'sigma': sigma,
        'v0': v0,
        'option_price': option_price
    }, ignore_index=True)

with open('df_{}.pickle'.format(len(df)), 'wb') as f:
  pickle.dump(df, f)
```

```
# load df by pickle
with open('df_1000000.pickle', 'rb') as f:
    df = pickle.load(f)

```

```
df.dropna(inplace=True)

df.reset_index(drop=True, inplace=True)

df_filtered = df[df['option_price'] < 1]
df_filtered = df_filtered[df_filtered['option_price'] >= 0]

df_filtered.head(10)

```

	m	tau	r	rho	kappa	theta	sigma	v0	o
1	1.080892	1.020494	0.002058	-0.028586	1.664885	0.106170	0.090912	0.132532	
2	0.843394	0.782183	0.043195	-0.673332	1.223706	0.069747	0.146072	0.214863	
3	0.964856	1.120729	0.019967	-0.461477	1.184829	0.023225	0.303772	0.126736	
4	0.652041	1.333551	0.096563	-0.182023	0.609228	0.048836	0.342117	0.248069	
5	0.697631	0.743730	0.003439	-0.086146	0.517560	0.331261	0.155856	0.284031	
6	1.037368	0.340311	0.096958	-0.213624	1.878998	0.447414	0.298950	0.464843	
7	0.670794	0.354778	0.004523	-0.640936	0.777355	0.135675	0.414369	0.210539	
8	0.824748	0.805505	0.014092	-0.187913	0.149101	0.493443	0.386122	0.139422	
9	0.604418	1.160100	0.070686	-0.257443	1.542541	0.037022	0.179233	0.102141	
10	1.290483	0.910288	0.033090	-0.889620	0.621965	0.162592	0.364803	0.336901	

```
# Split the dataset into train and test sets

train_df, test_df = train_test_split(df_filtered, test_size=0.1, random_state=55)
train_df, eval_df = train_test_split(train_df, test_size=1/9, random_state=55)

```

```
# Check if GPU is available

if tf.test.gpu_device_name():
    print('GPU found')
else:
    print("No GPU found")

# Create a TensorFlow session and set it to use the GPU
config = tf.compat.v1.ConfigProto()
config.gpu_options.allow_growth = True
session = tf.compat.v1.Session(config=config)
```

```
GPU found
```

```
def calc_metrics(y_true, y_pred):

    mse = mean_squared_error(y_true, y_pred)
    mae = mean_absolute_error(y_true, y_pred)
    r2 = r2_score(y_true, y_pred)
    return {'mse': mse, 'mae': mae, 'r2': r2}
```

Step 2: Heston Option Pricing ANN

Parameters of the ANN

Parameters	Options
Hidden layers	4
Neurons(each layer)	400
Activation	ReLU
Dropout rate	0.0
Batch-normalization	No
Initialization	Glorot_uniform
Optimizer	Adam
Batch size	1024

```
model = Sequential()
model.add(Dense(400, activation='relu', kernel_initializer=GlorotUniform(), input_shape=(8,)))
model.add(Dense(400, activation='relu', kernel_initializer=GlorotUniform()))
model.add(Dense(400, activation='relu', kernel_initializer=GlorotUniform()))
model.add(Dense(400, activation='relu', kernel_initializer=GlorotUniform()))
model.add(Dense(1))
model.compile(optimizer=Adam(), loss='mean_squared_error')

# Train the model on the GPU

batch_size = 1024
epochs = 100
with tf.device('/GPU:0'):
    history = model.fit(
        x = train_df[['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'sigma', 'v0']],
        y = train_df['option_price'],
        batch_size=batch_size,
        epochs=epochs,
        verbose=1
    )
```

```
Epoch 1/100
719/719 [==============================] - 10s 4ms/step - loss: 0.0033
Epoch 2/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0015
Epoch 3/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0014
Epoch 4/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0013
Epoch 5/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0012
Epoch 6/100
```

```
719/719 [==============================] - 3s 4ms/step - loss: 0.0012
Epoch 7/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0011
Epoch 8/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0011
Epoch 9/100
719/719 [==============================] - 3s 5ms/step - loss: 0.0011
Epoch 10/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0011
Epoch 11/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0011
Epoch 12/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0011
Epoch 13/100
719/719 [==============================] - 4s 5ms/step - loss: 0.0010
Epoch 14/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0010
Epoch 15/100
719/719 [==============================] - 3s 5ms/step - loss: 0.0010
Epoch 16/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0010
Epoch 17/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0010
Epoch 18/100
719/719 [==============================] - 3s 4ms/step - loss: 0.0010
Epoch 19/100
719/719 [==============================] - 3s 4ms/step - loss: 9.8761e-04
Epoch 20/100
719/719 [==============================] - 3s 4ms/step - loss: 9.8143e-04
Epoch 21/100
719/719 [==============================] - 3s 4ms/step - loss: 9.9153e-04
Epoch 22/100
719/719 [==============================] - 5s 7ms/step - loss: 9.8722e-04
Epoch 23/100
719/719 [==============================] - 3s 4ms/step - loss: 9.8305e-04
Epoch 24/100
719/719 [==============================] - 3s 4ms/step - loss: 9.6651e-04
Epoch 25/100
719/719 [==============================] - 3s 4ms/step - loss: 9.5987e-04
Epoch 26/100
719/719 [==============================] - 3s 4ms/step - loss: 9.6322e-04
Epoch 27/100
719/719 [==============================] - 3s 4ms/step - loss: 9.5242e-04
Epoch 28/100
719/719 [==============================] - 3s 4ms/step - loss: 9.4937e-04
Epoch 29/100
719/719 [==============================] - 3s 4ms/step - loss: 9.3702e-04
```

```
1 # Evaluate the trained model on the test sets on the GPU
2
3 with tf.device('/GPU:0'):
4     wide_test_loss = model.evaluate(
5         test_df[['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'sigma', 'v0']],
```

```
        test_df['option_price'],
        verbose=0
    )

wide_test_predictions = model.predict(test_df[['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'sigma', 'v0']])


# Reshape wide_test_predictions to match the shape of test_df['option_price']
wide_test_predictions = wide_test_predictions.flatten()

# Calculate performance metrics for wide test set
res = calc_metrics(test_df['option_price'], wide_test_predictions)
print(res)
```

```
2874/2874 [==============================] - 5s 2ms/step
{'mse': 0.001004394715258821, 'mae': 0.009025426892304482, 'r2': 0.9800865105589234}
```

Step 3: Heston Implicit Volatility ANN

```
model = Sequential()
model.add(Dense(600, ))
model.add(BatchNormalization())
model.add(Activation('relu'))
model.add(Dropout(0.1))
model.add(Dense(600, ))
model.add(BatchNormalization())
model.add(Activation('relu'))
model.add(Dropout(0.1))
model.add(Dense(600, ))
model.add(BatchNormalization())
model.add(Activation('relu'))
model.add(Dropout(0.1))
model.add(Dense(600, ))
model.add(BatchNormalization())
model.add(Activation('relu'))
model.add(Dropout(0.3))
model.add(Dense(1, ))
epochs = 200
batch_size = 1024

initial_learning_rate = 0.01
lr_schedule = tf.keras.optimizers.schedules.ExponentialDecay(
    initial_learning_rate,
    decay_steps=100000,
    decay_rate=0.99,
    staircase=True)
```

```
28
29 steps_per_epoch = batch_size
30 INIT_LR = 1e-5
31 MAX_LR = 1e-1
32
33 clr = tfa.optimizers.CyclicalLearningRate(initial_learning_rate=INIT_LR,
34     maximal_learning_rate=MAX_LR,
35     scale_fn=lambda x: 1/(2.**(x-1)),
36     step_size=2 * steps_per_epoch
37 )
38
39 filepath = 'best_model'
40 checkpoint = tf.keras.callbacks.ModelCheckpoint(filepath=filepath, mode='min', monitor='val_loss', verbose=1, save_best_only=True)
41 callbacks_list = [checkpoint]
42 callbacks=callbacks_list
43 model.compile(optimizer=tf.keras.optimizers.Adam(learning_rate=clr), loss='mean_squared_error', )
44
45 # Train the model on the GPU
46
47 with tf.device('/GPU:0'):
48     history = model.fit(
49         x = train_df[['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'v0','option_price' ]],
50         y = train_df['sigma'],
51         validation_data = (eval_df[['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'v0','option_price' ]], eval_df['sigma']),
52         batch_size=batch_size,
53         epochs=epochs,
54         verbose=1,
55         callbacks=callbacks_list
56     )
57
58 # plot lines
59 plt.plot([i for i in range(1, len(history.history['loss'])+1)], history.history['loss'], label = "training loss")
60 plt.plot([i for i in range(1, len(history.history['val_loss'])+1)], history.history['val_loss'], label = "validation loss")
61 plt.legend()
62 plt.show()
63
```

```
Epoch 1/333
659/662 [============================>.] - ETA: 0s - loss: 0.3219
Epoch 1: val_loss improved from inf to 0.02358, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 13s 11ms/step - loss: 0.3211 - val_loss: 0.0236
Epoch 2/333
661/662 [============================>.] - ETA: 0s - loss: 0.0841
Epoch 2: val_loss improved from 0.02358 to 0.02115, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 41s 63ms/step - loss: 0.0841 - val_loss: 0.0211
Epoch 3/333
662/662 [==============================] - ETA: 0s - loss: 0.0406
Epoch 3: val_loss improved from 0.02115 to 0.02100, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0406 - val_loss: 0.0210
Epoch 4/333
657/662 [============================>.] - ETA: 0s - loss: 0.0280
Epoch 4: val_loss improved from 0.02100 to 0.02091, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 13ms/step - loss: 0.0280 - val_loss: 0.0209
Epoch 5/333
659/662 [============================>.] - ETA: 0s - loss: 0.0234
Epoch 5: val_loss did not improve from 0.02091
662/662 [==============================] - 5s 7ms/step - loss: 0.0234 - val_loss: 0.0210
Epoch 6/333
661/662 [============================>.] - ETA: 0s - loss: 0.0216
Epoch 6: val_loss improved from 0.02091 to 0.02091, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 10s 15ms/step - loss: 0.0216 - val_loss: 0.0209
Epoch 7/333
659/662 [============================>.] - ETA: 0s - loss: 0.0210
Epoch 7: val_loss improved from 0.02091 to 0.02074, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 7s 11ms/step - loss: 0.0210 - val_loss: 0.0207
Epoch 8/333
660/662 [============================>.] - ETA: 0s - loss: 0.0208
Epoch 8: val_loss did not improve from 0.02074
662/662 [==============================] - 6s 9ms/step - loss: 0.0208 - val_loss: 0.0208
Epoch 9/333
656/662 [============================>.] - ETA: 0s - loss: 0.0208
Epoch 9: val_loss improved from 0.02074 to 0.02072, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 7s 11ms/step - loss: 0.0208 - val_loss: 0.0207
Epoch 10/333
657/662 [============================>.] - ETA: 0s - loss: 0.0207
Epoch 10: val_loss improved from 0.02072 to 0.02070, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0207 - val_loss: 0.0207
Epoch 11/333
656/662 [============================>.] - ETA: 0s - loss: 0.0207
Epoch 11: val_loss did not improve from 0.02070
662/662 [==============================] - 5s 7ms/step - loss: 0.0207 - val_loss: 0.0207
Epoch 12/333
660/662 [============================>.] - ETA: 0s - loss: 0.0207
```

```
Epoch 12: val_loss did not improve from 0.02070
662/662 [==============================] - 5s 8ms/step - loss: 0.0207 - val_loss: 0.0208
Epoch 13/333
659/662 [============================>.] - ETA: 0s - loss: 0.0207
Epoch 13: val_loss did not improve from 0.02070
662/662 [==============================] - 6s 9ms/step - loss: 0.0207 - val_loss: 0.0207
Epoch 14/333
658/662 [============================>.] - ETA: 0s - loss: 0.0207
Epoch 14: val_loss improved from 0.02070 to 0.02070, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 7s 11ms/step - loss: 0.0207 - val_loss: 0.0207
Epoch 15/333
660/662 [============================>.] - ETA: 0s - loss: 0.0207
Epoch 15: val_loss improved from 0.02070 to 0.02068, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0207 - val_loss: 0.0207
Epoch 16/333
657/662 [============================>.] - ETA: 0s - loss: 0.0207
Epoch 16: val_loss did not improve from 0.02068
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 17/333
660/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 17: val_loss improved from 0.02068 to 0.02065, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 18/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 18: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 19/333
658/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 19: val_loss did not improve from 0.02065
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 20/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 20: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0208
Epoch 21/333
660/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 21: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 22/333
662/662 [==============================] - ETA: 0s - loss: 0.0206
Epoch 22: val_loss did not improve from 0.02065
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 23/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 23: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 24/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 24: val_loss improved from 0.02065 to 0.02065, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0206 - val_loss: 0.0206
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Epoch 25/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 25: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 26/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 26: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 27/333
658/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 27: val_loss did not improve from 0.02065
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 28/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 28: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 29/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 29: val_loss did not improve from 0.02065
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 30/333
662/662 [==============================] - ETA: 0s - loss: 0.0206
Epoch 30: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 31/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 31: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 32/333
658/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 32: val_loss did not improve from 0.02065
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 33/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 33: val_loss did not improve from 0.02065
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 34/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 34: val_loss did not improve from 0.02065
662/662 [==============================] - 7s 10ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 35/333
662/662 [==============================] - ETA: 0s - loss: 0.0206
Epoch 35: val_loss improved from 0.02065 to 0.02064, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 36/333
660/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 36: val_loss did not improve from 0.02064
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 37/333
660/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 37: val_loss improved from 0.02064 to 0.02064, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0206 - val_loss: 0.0206
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Epoch 38/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 38: val_loss did not improve from 0.02064
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 39/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 39: val_loss did not improve from 0.02064
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 40/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 40: val_loss did not improve from 0.02064
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 41/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 41: val_loss did not improve from 0.02064
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 42/333
662/662 [==============================] - ETA: 0s - loss: 0.0206
Epoch 42: val_loss did not improve from 0.02064
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 43/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 43: val_loss did not improve from 0.02064
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 44/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 44: val_loss did not improve from 0.02064
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 45/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 45: val_loss improved from 0.02064 to 0.02063, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 7s 11ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 46/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 46: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 47/333
658/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 47: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 48/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 48: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 49/333
660/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 49: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 50/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 50: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 51/333
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658/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 51: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 52/333
656/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 52: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 53/333
660/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 53: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 54/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 54: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 55/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 55: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 56/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 56: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0207
Epoch 57/333
656/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 57: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 58/333
662/662 [==============================] - ETA: 0s - loss: 0.0206
Epoch 58: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 59/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 59: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 60/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 60: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 61/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 61: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0208
Epoch 62/333
657/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 62: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 63/333
662/662 [==============================] - ETA: 0s - loss: 0.0206
Epoch 63: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0206 - val_loss: 0.0206
Epoch 64/333
659/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 64: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0206 - val_loss: 0.0206
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Epoch 65/333
661/662 [============================>.] - ETA: 0s - loss: 0.0206
Epoch 65: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 66/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 66: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 67/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 67: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 68/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 68: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 69/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 69: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 70/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 70: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 71/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 71: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 72/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 72: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 73/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 73: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 74/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 74: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 75/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 75: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 76/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 76: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 77/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 77: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 78/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
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Epoch 78: val_loss improved from 0.02063 to 0.02063, saving model to best_model
WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not
662/662 [==============================] - 8s 12ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 79/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 79: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 80/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 80: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 81/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 81: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 82/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 82: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 83/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 83: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 84/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 84: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 85/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 85: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 86/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 86: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 87/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 87: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 88/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 88: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 89/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 89: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 90/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 90: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 91/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 91: val_loss did not improve from 0.02063
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662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 92/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 92: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 93/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 93: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 10ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 94/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 94: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 95/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 95: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 96/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 96: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 97/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 97: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 98/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 98: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 99/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 99: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 100/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 100: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 101/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 101: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 102/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 102: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 103/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 103: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 104/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 104: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 105/333
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662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 105: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 106/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 106: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 107/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 107: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 108/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 108: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 109/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 109: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 110/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 110: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 111/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 111: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 112/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 112: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 113/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 113: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 114/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 114: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 115/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 115: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 116/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 116: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 117/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 117: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 118/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 118: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
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662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 119/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 119: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 120/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 120: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 121/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 121: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 122/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 122: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 123/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 123: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 124/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 124: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 125/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 125: val_loss did not improve from 0.02063
662/662 [==============================] - 7s 10ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 126/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 126: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 127/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 127: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 128/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 128: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 129/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 129: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 130/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 130: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 131/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 131: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 132/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
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Epoch 132: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 133/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 133: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 134/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 134: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 135/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 135: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 136/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 136: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 137/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 137: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 138/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 138: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 139/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 139: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 140/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 140: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 141/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 141: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 142/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 142: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 143/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 143: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 144/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 144: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 145/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 145: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
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Epoch 146/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 146: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 147/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 147: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 148/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 148: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 149/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 149: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 150/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 150: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0206
Epoch 151/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 151: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 152/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 152: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 153/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 153: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 154/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 154: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 155/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 155: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 156/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 156: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 157/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 157: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 158/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 158: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 159/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
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Epoch 159: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 160/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 160: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 161/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 161: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 162/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 162: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 163/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 163: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 164/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 164: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 165/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 165: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 166/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 166: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 167/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 167: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 168/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 168: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 169/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 169: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 170/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 170: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 171/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 171: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 172/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 172: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
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Epoch 173/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 173: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 174/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 174: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 175/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 175: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 176/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 176: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 177/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 177: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 178/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 178: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 179/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 179: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 180/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 180: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 181/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 181: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 182/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 182: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 183/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 183: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 184/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 184: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 185/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 185: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 186/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 186: val_loss did not improve from 0.02063
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Epoch 186: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 187/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 187: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 188/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 188: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 189/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 189: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 190/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 190: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 191/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 191: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 192/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 192: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 193/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 193: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 194/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 194: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 195/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 195: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 196/333
655/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 196: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 197/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 197: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 198/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 198: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 199/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 199: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 200/333
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661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 200: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 201/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 201: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 202/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 202: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 203/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 203: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 204/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 204: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 205/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 205: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 206/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 206: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 207/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 207: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 208/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 208: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 209/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 209: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 210/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 210: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 211/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 211: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 212/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 212: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 213/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 213: val_loss did not improve from 0.02063
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662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 214/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 214: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 215/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 215: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 216/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 216: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 217/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 217: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 218/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 218: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 219/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 219: val_loss did not improve from 0.02063
662/662 [==============================] - 7s 10ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 220/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 220: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 221/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 221: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 222/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 222: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 223/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 223: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 224/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 224: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 225/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 225: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 226/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 226: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 227/333
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661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 227: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 228/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 228: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 229/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 229: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 230/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 230: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 231/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 231: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 232/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 232: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 233/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 233: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 234/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 234: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 235/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 235: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 236/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 236: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 237/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 237: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 238/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 238: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 239/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 239: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 240/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 240: val_loss did not improve from 0.02063
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662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 241/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 241: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 242/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 242: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 243/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 243: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 244/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 244: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 245/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 245: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 246/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 246: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 247/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 247: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 248/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 248: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 249/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 249: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 10ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 250/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 250: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 251/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 251: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 252/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 252: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 253/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 253: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 254/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
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661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 254: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 255/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 255: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 256/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 256: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 257/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 257: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 258/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 258: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 259/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 259: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 260/333
657/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 260: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 261/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 261: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 262/333
656/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 262: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 263/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 263: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 264/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 264: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 265/333
661/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 265: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 266/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 266: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 267/333
660/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 267: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
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Epoch 268/333
662/662 [==============================] - ETA: 0s - loss: 0.0205
Epoch 268: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0205 - val_loss: 0.0207
Epoch 269/333
658/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 269: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 270/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 270: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 271/333
659/662 [============================>.] - ETA: 0s - loss: 0.0205
Epoch 271: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 272/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 272: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 273/333
660/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 273: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 274/333
660/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 274: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 275/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 275: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 276/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 276: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 277/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 277: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 278/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 278: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 279/333
660/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 279: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 280/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 280: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 281/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
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Epoch 281: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 282/333
661/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 282: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 283/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 283: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 284/333
658/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 284: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 285/333
658/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 285: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 286/333
660/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 286: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 287/333
658/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 287: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 288/333
660/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 288: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 289/333
658/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 289: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 290/333
660/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 290: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 291/333
658/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 291: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 292/333
656/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 292: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 293/333
661/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 293: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 294/333
660/662 [==============================>.] - ETA: 0s - loss: 0.0204
Epoch 294: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
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Epoch 295/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 295: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 296/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 296: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 297/333
656/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 297: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 298/333
657/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 298: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 299/333
658/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 299: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 300/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 300: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 301/333
658/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 301: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 302/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 302: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 303/333
656/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 303: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 304/333
657/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 304: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 305/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 305: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 306/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 306: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 307/333
658/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 307: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 308/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
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Epoch 308: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 309/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 309: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 310/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 310: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 311/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 311: val_loss did not improve from 0.02063
662/662 [==============================] - 7s 11ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 312/333
660/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 312: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 313/333
657/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 313: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 314/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 314: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 315/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 315: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 316/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 316: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 317/333
657/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 317: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 318/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 318: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 319/333
657/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 319: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 320/333
660/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 320: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 321/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 321: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 322/333
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659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 322: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 323/333
660/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 323: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 324/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 324: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 325/333
658/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 325: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 326/333
659/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 326: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 327/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 327: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 328/333
662/662 [==============================] - ETA: 0s - loss: 0.0204
Epoch 328: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 329/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 329: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 9ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 330/333
661/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 330: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 7ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 331/333
658/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 331: val_loss did not improve from 0.02063
662/662 [==============================] - 6s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 332/333
656/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 332: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0207
Epoch 333/333
657/662 [============================>.] - ETA: 0s - loss: 0.0204
Epoch 333: val_loss did not improve from 0.02063
662/662 [==============================] - 5s 8ms/step - loss: 0.0204 - val_loss: 0.0208
```


```
# Evaluate the trained model on the test sets on the GPU
# model = tf.keras.models.load_model('best_model')

with tf.device('/GPU:0'):
    wide_test_loss = model.evaluate(
        test_df[['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'v0','option_price']],
        test_df['sigma'],
        verbose=0
    )

wide_test_predictions = model.predict(test_df[['m', 'tau', 'r', 'rho', 'kappa', 'theta', 'v0','option_price']])

# Calculate performance metrics for wide test set

res = calc_metrics(test_df['sigma'], wide_test_predictions)
print(res)
```

```
2874/2874 [==============================] - 6s 2ms/step
{'mse': 0.0064118987324165225, 'mae': 0.053238941802368274, 'r2': 0.6892325231064504}
```