Model Training

Importing

In [1]:
```
import tensorflow as tf
from tensorflow.keras.optimizers.schedules import InverseTimeDecay
from model.models import Model_1
from testing import test_model, pred_patches
from dataloader import DataLoader
from model.losses import FocalLoss, WBCE
from model.callbacks import UpdateAccuracy
from ops import reconstruct_image
import os
import json
import shutil
import matplotlib.pyplot as plt
import numpy as np
from tqdm import tqdm
from PIL import Image
from tensorflow.keras.utils import to_categorical
from sklearn.metrics import average_precision_score
```

Parameters

In [2]:
```
# load the params-patches.json options
with open(os.path.join('v1', 'params-patches.json')) as param_file:
    params_patches = json.load(param_file)

# load the params-patches.json options
with open(os.path.join('v1', 'params-training.json')) as param_file:
    params_training = json.load(param_file)

#load the params-model.json options
with open(os.path.join('v1', 'params-model.json')) as param_file:
    params_model = json.load(param_file)

#load the shapes.json options
with open('shapes.json') as param_file:
    shapes_json = json.load(param_file)
```

In [3]:
```
patches_path = params_patches['patches_path']

train_path = os.path.join(patches_path, params_patches['train_sub'])
val_path = os.path.join(patches_path, params_patches['val_sub'])
test_path = os.path.join(patches_path, params_patches['test_sub'])
```

Setting Dataloaders

In [4]:
```
dl_train = DataLoader(
    batch_size = params_training['batch_size'],
    data_path=os.path.join(train_path, params_patches['data_sub']),
    label_path=os.path.join(train_path, params_patches['label_sub']),
    patch_size=128,
    opt_bands=8,
```

```
    sar_bands=4,
    num_classes=3,
    shuffle=True#,
    #limit=params_training['patch_limit']
)

dl_val = DataLoader(
    batch_size=params_training['batch_size'],
    data_path=os.path.join(val_path, params_patches['data_sub']),
    label_path=os.path.join(val_path, params_patches['label_sub']),
    patch_size=128,
    opt_bands=8,
    sar_bands=4,
    num_classes=3#,
    #limit=params_training['patch_limit']
)

dl_test = DataLoader(
    batch_size=params_training['batch_size'],
    data_path=os.path.join(test_path, params_patches['data_sub']),
    label_path=os.path.join(test_path, params_patches['label_sub']),
    patch_size=128,
    opt_bands=8,
    sar_bands=4,
    num_classes=3)
```

Model definition

In [5]:

```
model = Model_1(name='modelo_1')

metrics = {
}

weights = [0.2, 0.8, 0.0]

learning_rate = InverseTimeDecay(
    initial_learning_rate=1e-4,
    decay_steps=params_training['learning_reduction']*len(dl_train),
    decay_rate = 0.01,
    staircase=True
    )

optimizers = {
    'opt': tf.keras.optimizers.Adam(learning_rate = learning_rate),
    'sar': tf.keras.optimizers.Adam(learning_rate = learning_rate),
    'fusion': tf.keras.optimizers.Adam(learning_rate = learning_rate),
}

class_indexes = [0, 1]

model.compile(
    optimizers = optimizers,
    loss_fn = WBCE,
    metrics_dict = metrics,
    class_weights = weights,
    class_indexes = class_indexes,
    run_eagerly=params_training['run_eagerly']
)
```

In [6]:

```
callbacks = [
    tf.keras.callbacks.EarlyStopping(
```

```
        monitor='val_combined_f1score',
        patience = params_training['patience'],
        mode = 'max',
        restore_best_weights=True),
    UpdateAccuracy()
]


history = model.fit(
    x=dl_train,
    validation_data=dl_val,
    epochs=params_training['epochs_train'],
    callbacks=callbacks,
    verbose = 1
    )
```

```
Epoch 1/200
330/330 [==============================] - 221s 666ms/step - opt_loss: 0.2509 - sar_
loss: 0.3288 - fusion_loss: 0.2666 - loss: 0.8464 - opt_accuracy: 0.8699 - sar_accur
acy: 0.8223 - fusion_accuracy: 0.8599 - combined_accuracy: 0.8742 - opt_f1score: 0.7
653 - sar_f1score: 0.6455 - fusion_f1score: 0.7508 - combined_f1score: 0.7751 - val_
opt_loss: 0.3202 - val_sar_loss: 1.7063 - val_fusion_loss: 1.4579 - val_loss: 3.4845
- val_opt_accuracy: 0.7214 - val_sar_accuracy: 0.6016 - val_fusion_accuracy: 0.6016
- val_combined_accuracy: 0.6016 - val_opt_f1score: 0.3512 - val_sar_f1score: 1.3213e
-04 - val_fusion_f1score: 9.4773e-05 - val_combined_f1score: 1.1943e-04
Epoch 2/200
330/330 [==============================] - 105s 318ms/step - opt_loss: 0.1947 - sar_
loss: 0.2629 - fusion_loss: 0.1989 - loss: 0.6564 - opt_accuracy: 0.8910 - sar_accur
acy: 0.8535 - fusion_accuracy: 0.8873 - combined_accuracy: 0.8928 - opt_f1score: 0.8
134 - sar_f1score: 0.7237 - fusion_f1score: 0.8088 - combined_f1score: 0.8152 - val_
opt_loss: 0.1872 - val_sar_loss: 0.4165 - val_fusion_loss: 0.2317 - val_loss: 0.8353
- val_opt_accuracy: 0.8806 - val_sar_accuracy: 0.6583 - val_fusion_accuracy: 0.7843
- val_combined_accuracy: 0.7904 - val_opt_f1score: 0.7505 - val_sar_f1score: 0.1409
- val_fusion_f1score: 0.4690 - val_combined_f1score: 0.4644
Epoch 3/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1804 - sar_
loss: 0.2510 - fusion_loss: 0.1834 - loss: 0.6148 - opt_accuracy: 0.8967 - sar_accur
acy: 0.8591 - fusion_accuracy: 0.8941 - combined_accuracy: 0.8982 - opt_f1score: 0.8
237 - sar_f1score: 0.7354 - fusion_f1score: 0.8207 - combined_f1score: 0.8254 - val_
opt_loss: 0.1581 - val_sar_loss: 0.2407 - val_fusion_loss: 0.1555 - val_loss: 0.5544
- val_opt_accuracy: 0.8984 - val_sar_accuracy: 0.8601 - val_fusion_accuracy: 0.8993
- val_combined_accuracy: 0.8924 - val_opt_f1score: 0.7629 - val_sar_f1score: 0.6029
- val_fusion_f1score: 0.7480 - val_combined_f1score: 0.7255
Epoch 4/200
330/330 [==============================] - 104s 315ms/step - opt_loss: 0.1700 - sar_
loss: 0.2350 - fusion_loss: 0.1695 - loss: 0.5745 - opt_accuracy: 0.9015 - sar_accur
acy: 0.8662 - fusion_accuracy: 0.8997 - combined_accuracy: 0.9030 - opt_f1score: 0.8
315 - sar_f1score: 0.7534 - fusion_f1score: 0.8317 - combined_f1score: 0.8354 - val_
opt_loss: 0.1516 - val_sar_loss: 0.4259 - val_fusion_loss: 0.2590 - val_loss: 0.8365
- val_opt_accuracy: 0.9008 - val_sar_accuracy: 0.8230 - val_fusion_accuracy: 0.8748
- val_combined_accuracy: 0.8700 - val_opt_f1score: 0.7554 - val_sar_f1score: 0.5133
- val_fusion_f1score: 0.6556 - val_combined_f1score: 0.6361
Epoch 5/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1620 - sar_
loss: 0.2228 - fusion_loss: 0.1574 - loss: 0.5422 - opt_accuracy: 0.9042 - sar_accur
acy: 0.8705 - fusion_accuracy: 0.9040 - combined_accuracy: 0.9067 - opt_f1score: 0.8
364 - sar_f1score: 0.7662 - fusion_f1score: 0.8416 - combined_f1score: 0.8441 - val_
opt_loss: 0.1715 - val_sar_loss: 0.3015 - val_fusion_loss: 0.1774 - val_loss: 0.6505
- val_opt_accuracy: 0.9015 - val_sar_accuracy: 0.8329 - val_fusion_accuracy: 0.8935
- val_combined_accuracy: 0.8896 - val_opt_f1score: 0.7779 - val_sar_f1score: 0.4902
- val_fusion_f1score: 0.7057 - val_combined_f1score: 0.7060
Epoch 6/200
330/330 [==============================] - 104s 315ms/step - opt_loss: 0.1549 - sar_
loss: 0.2111 - fusion_loss: 0.1458 - loss: 0.5118 - opt_accuracy: 0.9067 - sar_accur
acy: 0.8752 - fusion_accuracy: 0.9081 - combined_accuracy: 0.9101 - opt_f1score: 0.8
```

```
419 - sar_f1score: 0.7799 - fusion_f1score: 0.8526 - combined_f1score: 0.8541 - val_
opt_loss: 0.1430 - val_sar_loss: 0.2106 - val_fusion_loss: 0.1456 - val_loss: 0.4992
- val_opt_accuracy: 0.9021 - val_sar_accuracy: 0.8625 - val_fusion_accuracy: 0.9005
- val_combined_accuracy: 0.8960 - val_opt_f1score: 0.7819 - val_sar_f1score: 0.6537
- val_fusion_f1score: 0.7583 - val_combined_f1score: 0.7476
Epoch 7/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1454 - sar_
loss: 0.1972 - fusion_loss: 0.1340 - loss: 0.4766 - opt_accuracy: 0.9096 - sar_accur
acy: 0.8790 - fusion_accuracy: 0.9119 - combined_accuracy: 0.9137 - opt_f1score: 0.8
486 - sar_f1score: 0.7945 - fusion_f1score: 0.8628 - combined_f1score: 0.8639 - val_
opt_loss: 0.1493 - val_sar_loss: 0.1981 - val_fusion_loss: 0.1437 - val_loss: 0.4911
- val_opt_accuracy: 0.8955 - val_sar_accuracy: 0.8669 - val_fusion_accuracy: 0.8942
- val_combined_accuracy: 0.8987 - val_opt_f1score: 0.7706 - val_sar_f1score: 0.6577
- val_fusion_f1score: 0.7758 - val_combined_f1score: 0.7738
Epoch 8/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1446 - sar_
loss: 0.1893 - fusion_loss: 0.1295 - loss: 0.4634 - opt_accuracy: 0.9108 - sar_accur
acy: 0.8811 - fusion_accuracy: 0.9141 - combined_accuracy: 0.9154 - opt_f1score: 0.8
498 - sar_f1score: 0.8012 - fusion_f1score: 0.8673 - combined_f1score: 0.8678 - val_
opt_loss: 0.1369 - val_sar_loss: 0.1976 - val_fusion_loss: 0.1296 - val_loss: 0.4640
- val_opt_accuracy: 0.9066 - val_sar_accuracy: 0.8667 - val_fusion_accuracy: 0.9059
- val_combined_accuracy: 0.9003 - val_opt_f1score: 0.7966 - val_sar_f1score: 0.6947
- val_fusion_f1score: 0.7961 - val_combined_f1score: 0.7836
Epoch 9/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1368 - sar_
loss: 0.1806 - fusion_loss: 0.1203 - loss: 0.4377 - opt_accuracy: 0.9142 - sar_accur
acy: 0.8848 - fusion_accuracy: 0.9182 - combined_accuracy: 0.9193 - opt_f1score: 0.8
573 - sar_f1score: 0.8107 - fusion_f1score: 0.8761 - combined_f1score: 0.8763 - val_
opt_loss: 0.1351 - val_sar_loss: 0.2002 - val_fusion_loss: 0.1321 - val_loss: 0.4673
- val_opt_accuracy: 0.9089 - val_sar_accuracy: 0.8733 - val_fusion_accuracy: 0.9100
- val_combined_accuracy: 0.9088 - val_opt_f1score: 0.7995 - val_sar_f1score: 0.7019
- val_fusion_f1score: 0.8035 - val_combined_f1score: 0.8043
Epoch 10/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1319 - sar_
loss: 0.1704 - fusion_loss: 0.1136 - loss: 0.4159 - opt_accuracy: 0.9159 - sar_accur
acy: 0.8885 - fusion_accuracy: 0.9208 - combined_accuracy: 0.9217 - opt_f1score: 0.8
616 - sar_f1score: 0.8215 - fusion_f1score: 0.8822 - combined_f1score: 0.8821 - val_
opt_loss: 0.1233 - val_sar_loss: 0.2049 - val_fusion_loss: 0.1267 - val_loss: 0.4550
- val_opt_accuracy: 0.9134 - val_sar_accuracy: 0.8784 - val_fusion_accuracy: 0.9114
- val_combined_accuracy: 0.9090 - val_opt_f1score: 0.8059 - val_sar_f1score: 0.6465
- val_fusion_f1score: 0.7929 - val_combined_f1score: 0.7865
Epoch 11/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1266 - sar_
loss: 0.1620 - fusion_loss: 0.1076 - loss: 0.3962 - opt_accuracy: 0.9175 - sar_accur
acy: 0.8906 - fusion_accuracy: 0.9226 - combined_accuracy: 0.9233 - opt_f1score: 0.8
671 - sar_f1score: 0.8296 - fusion_f1score: 0.8878 - combined_f1score: 0.8877 - val_
opt_loss: 0.1609 - val_sar_loss: 0.1951 - val_fusion_loss: 0.1683 - val_loss: 0.5244
- val_opt_accuracy: 0.8804 - val_sar_accuracy: 0.8466 - val_fusion_accuracy: 0.8475
- val_combined_accuracy: 0.8751 - val_opt_f1score: 0.7500 - val_sar_f1score: 0.6633
- val_fusion_f1score: 0.7220 - val_combined_f1score: 0.7451
Epoch 12/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1231 - sar_
loss: 0.1560 - fusion_loss: 0.1036 - loss: 0.3828 - opt_accuracy: 0.9193 - sar_accur
acy: 0.8935 - fusion_accuracy: 0.9249 - combined_accuracy: 0.9254 - opt_f1score: 0.8
706 - sar_f1score: 0.8364 - fusion_f1score: 0.8920 - combined_f1score: 0.8918 - val_
opt_loss: 0.1296 - val_sar_loss: 0.2047 - val_fusion_loss: 0.1248 - val_loss: 0.4591
- val_opt_accuracy: 0.9092 - val_sar_accuracy: 0.8699 - val_fusion_accuracy: 0.9110
- val_combined_accuracy: 0.9081 - val_opt_f1score: 0.8048 - val_sar_f1score: 0.7184
- val_fusion_f1score: 0.8247 - val_combined_f1score: 0.8178
Epoch 13/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1154 - sar_
loss: 0.1470 - fusion_loss: 0.0968 - loss: 0.3592 - opt_accuracy: 0.9224 - sar_accur
acy: 0.8975 - fusion_accuracy: 0.9281 - combined_accuracy: 0.9284 - opt_f1score: 0.8
779 - sar_f1score: 0.8450 - fusion_f1score: 0.8981 - combined_f1score: 0.8976 - val_
opt_loss: 0.1264 - val_sar_loss: 0.2350 - val_fusion_loss: 0.1351 - val_loss: 0.4965
```

```
- val_opt_accuracy: 0.9116 - val_sar_accuracy: 0.8546 - val_fusion_accuracy: 0.8986
- val_combined_accuracy: 0.9052 - val_opt_f1score: 0.8118 - val_sar_f1score: 0.6683
- val_fusion_f1score: 0.8063 - val_combined_f1score: 0.8119
Epoch 14/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.1144 - sar_
loss: 0.1418 - fusion_loss: 0.0943 - loss: 0.3506 - opt_accuracy: 0.9226 - sar_accur
acy: 0.8990 - fusion_accuracy: 0.9288 - combined_accuracy: 0.9292 - opt_f1score: 0.8
787 - sar_f1score: 0.8498 - fusion_f1score: 0.9003 - combined_f1score: 0.8998 - val_
opt_loss: 0.1473 - val_sar_loss: 0.1849 - val_fusion_loss: 0.1404 - val_loss: 0.4726
- val_opt_accuracy: 0.8866 - val_sar_accuracy: 0.8850 - val_fusion_accuracy: 0.8964
- val_combined_accuracy: 0.9045 - val_opt_f1score: 0.7685 - val_sar_f1score: 0.7405
- val_fusion_f1score: 0.7919 - val_combined_f1score: 0.7951
Epoch 15/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1082 - sar_
loss: 0.1373 - fusion_loss: 0.0896 - loss: 0.3351 - opt_accuracy: 0.9254 - sar_accur
acy: 0.9009 - fusion_accuracy: 0.9311 - combined_accuracy: 0.9311 - opt_f1score: 0.8
852 - sar_f1score: 0.8550 - fusion_f1score: 0.9048 - combined_f1score: 0.9040 - val_
opt_loss: 0.1224 - val_sar_loss: 0.1916 - val_fusion_loss: 0.1177 - val_loss: 0.4317
- val_opt_accuracy: 0.9142 - val_sar_accuracy: 0.8796 - val_fusion_accuracy: 0.9188
- val_combined_accuracy: 0.9182 - val_opt_f1score: 0.8221 - val_sar_f1score: 0.7114
- val_fusion_f1score: 0.8284 - val_combined_f1score: 0.8256
Epoch 16/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.1050 - sar_
loss: 0.1347 - fusion_loss: 0.0864 - loss: 0.3261 - opt_accuracy: 0.9268 - sar_accur
acy: 0.9024 - fusion_accuracy: 0.9330 - combined_accuracy: 0.9331 - opt_f1score: 0.8
887 - sar_f1score: 0.8577 - fusion_f1score: 0.9083 - combined_f1score: 0.9075 - val_
opt_loss: 0.1224 - val_sar_loss: 0.2187 - val_fusion_loss: 0.1435 - val_loss: 0.4846
- val_opt_accuracy: 0.9172 - val_sar_accuracy: 0.8824 - val_fusion_accuracy: 0.9140
- val_combined_accuracy: 0.9140 - val_opt_f1score: 0.8171 - val_sar_f1score: 0.6938
- val_fusion_f1score: 0.7940 - val_combined_f1score: 0.7944
Epoch 17/200
330/330 [==============================] - 105s 320ms/step - opt_loss: 0.1000 - sar_
loss: 0.1278 - fusion_loss: 0.0824 - loss: 0.3101 - opt_accuracy: 0.9291 - sar_accur
acy: 0.9063 - fusion_accuracy: 0.9352 - combined_accuracy: 0.9351 - opt_f1score: 0.8
935 - sar_f1score: 0.8647 - fusion_f1score: 0.9122 - combined_f1score: 0.9114 - val_
opt_loss: 0.1254 - val_sar_loss: 0.1706 - val_fusion_loss: 0.1221 - val_loss: 0.4182
- val_opt_accuracy: 0.9109 - val_sar_accuracy: 0.8920 - val_fusion_accuracy: 0.9109
- val_combined_accuracy: 0.9160 - val_opt_f1score: 0.8045 - val_sar_f1score: 0.7624
- val_fusion_f1score: 0.8189 - val_combined_f1score: 0.8241
Epoch 18/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0986 - sar_
loss: 0.1255 - fusion_loss: 0.0810 - loss: 0.3051 - opt_accuracy: 0.9294 - sar_accur
acy: 0.9072 - fusion_accuracy: 0.9359 - combined_accuracy: 0.9358 - opt_f1score: 0.8
953 - sar_f1score: 0.8670 - fusion_f1score: 0.9138 - combined_f1score: 0.9130 - val_
opt_loss: 0.1276 - val_sar_loss: 0.1963 - val_fusion_loss: 0.1218 - val_loss: 0.4457
- val_opt_accuracy: 0.9051 - val_sar_accuracy: 0.8899 - val_fusion_accuracy: 0.9161
- val_combined_accuracy: 0.9165 - val_opt_f1score: 0.8046 - val_sar_f1score: 0.7515
- val_fusion_f1score: 0.8308 - val_combined_f1score: 0.8269
Epoch 19/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0958 - sar_
loss: 0.1220 - fusion_loss: 0.0783 - loss: 0.2960 - opt_accuracy: 0.9311 - sar_accur
acy: 0.9086 - fusion_accuracy: 0.9375 - combined_accuracy: 0.9374 - opt_f1score: 0.8
978 - sar_f1score: 0.8702 - fusion_f1score: 0.9163 - combined_f1score: 0.9155 - val_
opt_loss: 0.1148 - val_sar_loss: 0.1707 - val_fusion_loss: 0.1120 - val_loss: 0.3975
- val_opt_accuracy: 0.9210 - val_sar_accuracy: 0.8872 - val_fusion_accuracy: 0.9216
- val_combined_accuracy: 0.9233 - val_opt_f1score: 0.8345 - val_sar_f1score: 0.7596
- val_fusion_f1score: 0.8408 - val_combined_f1score: 0.8404
Epoch 20/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0899 - sar_
loss: 0.1162 - fusion_loss: 0.0739 - loss: 0.2801 - opt_accuracy: 0.9334 - sar_accur
acy: 0.9119 - fusion_accuracy: 0.9397 - combined_accuracy: 0.9395 - opt_f1score: 0.9
038 - sar_f1score: 0.8765 - fusion_f1score: 0.9208 - combined_f1score: 0.9199 - val_
opt_loss: 0.1178 - val_sar_loss: 0.3453 - val_fusion_loss: 0.1746 - val_loss: 0.6377
- val_opt_accuracy: 0.9185 - val_sar_accuracy: 0.8490 - val_fusion_accuracy: 0.9059
- val_combined_accuracy: 0.9006 - val_opt_f1score: 0.8251 - val_sar_f1score: 0.7104
```

```
- val_fusion_f1score: 0.8088 - val_combined_f1score: 0.8009
Epoch 21/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0887 - sar_
loss: 0.1126 - fusion_loss: 0.0725 - loss: 0.2739 - opt_accuracy: 0.9343 - sar_accur
acy: 0.9141 - fusion_accuracy: 0.9409 - combined_accuracy: 0.9406 - opt_f1score: 0.9
053 - sar_f1score: 0.8802 - fusion_f1score: 0.9222 - combined_f1score: 0.9214 - val_
opt_loss: 0.1163 - val_sar_loss: 0.2483 - val_fusion_loss: 0.1406 - val_loss: 0.5052
- val_opt_accuracy: 0.9207 - val_sar_accuracy: 0.8788 - val_fusion_accuracy: 0.9152
- val_combined_accuracy: 0.9135 - val_opt_f1score: 0.8232 - val_sar_f1score: 0.7580
- val_fusion_f1score: 0.8289 - val_combined_f1score: 0.8254
Epoch 22/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0878 - sar_
loss: 0.1122 - fusion_loss: 0.0712 - loss: 0.2712 - opt_accuracy: 0.9348 - sar_accur
acy: 0.9144 - fusion_accuracy: 0.9417 - combined_accuracy: 0.9413 - opt_f1score: 0.9
061 - sar_f1score: 0.8804 - fusion_f1score: 0.9236 - combined_f1score: 0.9227 - val_
opt_loss: 0.1205 - val_sar_loss: 0.2170 - val_fusion_loss: 0.1271 - val_loss: 0.4646
- val_opt_accuracy: 0.9178 - val_sar_accuracy: 0.8141 - val_fusion_accuracy: 0.9031
- val_combined_accuracy: 0.9125 - val_opt_f1score: 0.8243 - val_sar_f1score: 0.6819
- val_fusion_f1score: 0.8173 - val_combined_f1score: 0.8258
Epoch 23/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0843 - sar_
loss: 0.1073 - fusion_loss: 0.0685 - loss: 0.2600 - opt_accuracy: 0.9367 - sar_accur
acy: 0.9172 - fusion_accuracy: 0.9437 - combined_accuracy: 0.9433 - opt_f1score: 0.9
100 - sar_f1score: 0.8856 - fusion_f1score: 0.9266 - combined_f1score: 0.9258 - val_
opt_loss: 0.1217 - val_sar_loss: 0.2496 - val_fusion_loss: 0.1497 - val_loss: 0.5211
- val_opt_accuracy: 0.9198 - val_sar_accuracy: 0.8726 - val_fusion_accuracy: 0.9141
- val_combined_accuracy: 0.9127 - val_opt_f1score: 0.8294 - val_sar_f1score: 0.7732
- val_fusion_f1score: 0.8299 - val_combined_f1score: 0.8279
Epoch 24/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0825 - sar_
loss: 0.1064 - fusion_loss: 0.0671 - loss: 0.2560 - opt_accuracy: 0.9371 - sar_accur
acy: 0.9182 - fusion_accuracy: 0.9443 - combined_accuracy: 0.9438 - opt_f1score: 0.9
118 - sar_f1score: 0.8870 - fusion_f1score: 0.9281 - combined_f1score: 0.9272 - val_
opt_loss: 0.1353 - val_sar_loss: 0.1752 - val_fusion_loss: 0.1413 - val_loss: 0.4518
- val_opt_accuracy: 0.8982 - val_sar_accuracy: 0.8600 - val_fusion_accuracy: 0.8728
- val_combined_accuracy: 0.8931 - val_opt_f1score: 0.7984 - val_sar_f1score: 0.7450
- val_fusion_f1score: 0.7910 - val_combined_f1score: 0.8067
Epoch 25/200
330/330 [==============================] - 104s 317ms/step - opt_loss: 0.0836 - sar_
loss: 0.1051 - fusion_loss: 0.0671 - loss: 0.2557 - opt_accuracy: 0.9370 - sar_accur
acy: 0.9190 - fusion_accuracy: 0.9445 - combined_accuracy: 0.9441 - opt_f1score: 0.9
109 - sar_f1score: 0.8880 - fusion_f1score: 0.9281 - combined_f1score: 0.9272 - val_
opt_loss: 0.1123 - val_sar_loss: 0.2773 - val_fusion_loss: 0.1425 - val_loss: 0.5321
- val_opt_accuracy: 0.9191 - val_sar_accuracy: 0.8675 - val_fusion_accuracy: 0.9134
- val_combined_accuracy: 0.9110 - val_opt_f1score: 0.8463 - val_sar_f1score: 0.7517
- val_fusion_f1score: 0.8352 - val_combined_f1score: 0.8362
Epoch 26/200
330/330 [==============================] - 105s 318ms/step - opt_loss: 0.0788 - sar_
loss: 0.1000 - fusion_loss: 0.0634 - loss: 0.2421 - opt_accuracy: 0.9391 - sar_accur
acy: 0.9216 - fusion_accuracy: 0.9466 - combined_accuracy: 0.9460 - opt_f1score: 0.9
155 - sar_f1score: 0.8935 - fusion_f1score: 0.9318 - combined_f1score: 0.9309 - val_
opt_loss: 0.1159 - val_sar_loss: 0.4314 - val_fusion_loss: 0.2184 - val_loss: 0.7658
- val_opt_accuracy: 0.9207 - val_sar_accuracy: 0.8448 - val_fusion_accuracy: 0.9003
- val_combined_accuracy: 0.8958 - val_opt_f1score: 0.8458 - val_sar_f1score: 0.7286
- val_fusion_f1score: 0.8225 - val_combined_f1score: 0.8192
Epoch 27/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0758 - sar_
loss: 0.0966 - fusion_loss: 0.0613 - loss: 0.2337 - opt_accuracy: 0.9405 - sar_accur
acy: 0.9239 - fusion_accuracy: 0.9479 - combined_accuracy: 0.9474 - opt_f1score: 0.9
185 - sar_f1score: 0.8970 - fusion_f1score: 0.9338 - combined_f1score: 0.9331 - val_
opt_loss: 0.1137 - val_sar_loss: 0.2079 - val_fusion_loss: 0.1101 - val_loss: 0.4317
- val_opt_accuracy: 0.9233 - val_sar_accuracy: 0.8999 - val_fusion_accuracy: 0.9281
- val_combined_accuracy: 0.9282 - val_opt_f1score: 0.8488 - val_sar_f1score: 0.7933
- val_fusion_f1score: 0.8556 - val_combined_f1score: 0.8585
Epoch 28/200
```

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330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0749 - sar_
loss: 0.0949 - fusion_loss: 0.0602 - loss: 0.2300 - opt_accuracy: 0.9412 - sar_accur
acy: 0.9249 - fusion_accuracy: 0.9489 - combined_accuracy: 0.9483 - opt_f1score: 0.9
194 - sar_f1score: 0.8989 - fusion_f1score: 0.9351 - combined_f1score: 0.9343 - val_
opt_loss: 0.1188 - val_sar_loss: 0.1897 - val_fusion_loss: 0.1240 - val_loss: 0.4326
- val_opt_accuracy: 0.9206 - val_sar_accuracy: 0.8863 - val_fusion_accuracy: 0.9155
- val_combined_accuracy: 0.9207 - val_opt_f1score: 0.8353 - val_sar_f1score: 0.7736
- val_fusion_f1score: 0.8307 - val_combined_f1score: 0.8338
Epoch 29/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0759 - sar_
loss: 0.0937 - fusion_loss: 0.0600 - loss: 0.2297 - opt_accuracy: 0.9410 - sar_accur
acy: 0.9255 - fusion_accuracy: 0.9492 - combined_accuracy: 0.9485 - opt_f1score: 0.9
189 - sar_f1score: 0.9003 - fusion_f1score: 0.9355 - combined_f1score: 0.9347 - val_
opt_loss: 0.1130 - val_sar_loss: 0.2317 - val_fusion_loss: 0.1235 - val_loss: 0.4681
- val_opt_accuracy: 0.9253 - val_sar_accuracy: 0.8955 - val_fusion_accuracy: 0.9269
- val_combined_accuracy: 0.9246 - val_opt_f1score: 0.8481 - val_sar_f1score: 0.7926
- val_fusion_f1score: 0.8569 - val_combined_f1score: 0.8553
Epoch 30/200
330/330 [==============================] - 105s 318ms/step - opt_loss: 0.0716 - sar_
loss: 0.0907 - fusion_loss: 0.0571 - loss: 0.2194 - opt_accuracy: 0.9435 - sar_accur
acy: 0.9276 - fusion_accuracy: 0.9514 - combined_accuracy: 0.9506 - opt_f1score: 0.9
233 - sar_f1score: 0.9035 - fusion_f1score: 0.9385 - combined_f1score: 0.9378 - val_
opt_loss: 0.1362 - val_sar_loss: 0.2288 - val_fusion_loss: 0.1475 - val_loss: 0.5126
- val_opt_accuracy: 0.9023 - val_sar_accuracy: 0.8974 - val_fusion_accuracy: 0.9189
- val_combined_accuracy: 0.9210 - val_opt_f1score: 0.8086 - val_sar_f1score: 0.7580
- val_fusion_f1score: 0.8176 - val_combined_f1score: 0.8185
Epoch 31/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0702 - sar_
loss: 0.0876 - fusion_loss: 0.0556 - loss: 0.2134 - opt_accuracy: 0.9443 - sar_accur
acy: 0.9299 - fusion_accuracy: 0.9526 - combined_accuracy: 0.9518 - opt_f1score: 0.9
249 - sar_f1score: 0.9070 - fusion_f1score: 0.9402 - combined_f1score: 0.9394 - val_
opt_loss: 0.1376 - val_sar_loss: 0.3034 - val_fusion_loss: 0.1700 - val_loss: 0.6110
- val_opt_accuracy: 0.9164 - val_sar_accuracy: 0.8783 - val_fusion_accuracy: 0.9173
- val_combined_accuracy: 0.9149 - val_opt_f1score: 0.8172 - val_sar_f1score: 0.7692
- val_fusion_f1score: 0.8250 - val_combined_f1score: 0.8264
Epoch 32/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0685 - sar_
loss: 0.0875 - fusion_loss: 0.0546 - loss: 0.2107 - opt_accuracy: 0.9451 - sar_accur
acy: 0.9299 - fusion_accuracy: 0.9531 - combined_accuracy: 0.9524 - opt_f1score: 0.9
266 - sar_f1score: 0.9071 - fusion_f1score: 0.9411 - combined_f1score: 0.9405 - val_
opt_loss: 0.1243 - val_sar_loss: 0.2005 - val_fusion_loss: 0.1181 - val_loss: 0.4428
- val_opt_accuracy: 0.9209 - val_sar_accuracy: 0.9047 - val_fusion_accuracy: 0.9261
- val_combined_accuracy: 0.9268 - val_opt_f1score: 0.8426 - val_sar_f1score: 0.7795
- val_fusion_f1score: 0.8489 - val_combined_f1score: 0.8508
Epoch 33/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0683 - sar_
loss: 0.0860 - fusion_loss: 0.0542 - loss: 0.2085 - opt_accuracy: 0.9454 - sar_accur
acy: 0.9307 - fusion_accuracy: 0.9535 - combined_accuracy: 0.9528 - opt_f1score: 0.9
269 - sar_f1score: 0.9085 - fusion_f1score: 0.9415 - combined_f1score: 0.9409 - val_
opt_loss: 0.1330 - val_sar_loss: 0.2621 - val_fusion_loss: 0.1588 - val_loss: 0.5540
- val_opt_accuracy: 0.9186 - val_sar_accuracy: 0.8902 - val_fusion_accuracy: 0.9232
- val_combined_accuracy: 0.9224 - val_opt_f1score: 0.8222 - val_sar_f1score: 0.7744
- val_fusion_f1score: 0.8279 - val_combined_f1score: 0.8271
Epoch 34/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0675 - sar_
loss: 0.0859 - fusion_loss: 0.0533 - loss: 0.2067 - opt_accuracy: 0.9460 - sar_accur
acy: 0.9318 - fusion_accuracy: 0.9543 - combined_accuracy: 0.9537 - opt_f1score: 0.9
276 - sar_f1score: 0.9091 - fusion_f1score: 0.9425 - combined_f1score: 0.9419 - val_
opt_loss: 0.1304 - val_sar_loss: 0.4261 - val_fusion_loss: 0.1995 - val_loss: 0.7560
- val_opt_accuracy: 0.9154 - val_sar_accuracy: 0.6747 - val_fusion_accuracy: 0.8364
- val_combined_accuracy: 0.8432 - val_opt_f1score: 0.8261 - val_sar_f1score: 0.3834
- val_fusion_f1score: 0.7291 - val_combined_f1score: 0.7322
Epoch 35/200
330/330 [==============================] - 105s 318ms/step - opt_loss: 0.0655 - sar_
loss: 0.0811 - fusion_loss: 0.0514 - loss: 0.1980 - opt_accuracy: 0.9472 - sar_accur
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acy: 0.9341 - fusion_accuracy: 0.9557 - combined_accuracy: 0.9550 - opt_f1score: 0.9
299 - sar_f1score: 0.9141 - fusion_f1score: 0.9447 - combined_f1score: 0.9441 - val_
opt_loss: 0.1172 - val_sar_loss: 0.2585 - val_fusion_loss: 0.1395 - val_loss: 0.5152
- val_opt_accuracy: 0.9259 - val_sar_accuracy: 0.8884 - val_fusion_accuracy: 0.9237
- val_combined_accuracy: 0.9269 - val_opt_f1score: 0.8595 - val_sar_f1score: 0.7339
- val_fusion_f1score: 0.8407 - val_combined_f1score: 0.8448
Epoch 36/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0632 - sar_
loss: 0.0796 - fusion_loss: 0.0499 - loss: 0.1927 - opt_accuracy: 0.9482 - sar_accur
acy: 0.9348 - fusion_accuracy: 0.9565 - combined_accuracy: 0.9558 - opt_f1score: 0.9
322 - sar_f1score: 0.9153 - fusion_f1score: 0.9460 - combined_f1score: 0.9455 - val_
opt_loss: 0.1252 - val_sar_loss: 0.3930 - val_fusion_loss: 0.2232 - val_loss: 0.7415
- val_opt_accuracy: 0.9268 - val_sar_accuracy: 0.8657 - val_fusion_accuracy: 0.9156
- val_combined_accuracy: 0.9119 - val_opt_f1score: 0.8413 - val_sar_f1score: 0.7519
- val_fusion_f1score: 0.8212 - val_combined_f1score: 0.8209
Epoch 37/200
330/330 [==============================] - 105s 318ms/step - opt_loss: 0.0632 - sar_
loss: 0.0793 - fusion_loss: 0.0496 - loss: 0.1921 - opt_accuracy: 0.9486 - sar_accur
acy: 0.9356 - fusion_accuracy: 0.9573 - combined_accuracy: 0.9566 - opt_f1score: 0.9
322 - sar_f1score: 0.9160 - fusion_f1score: 0.9466 - combined_f1score: 0.9461 - val_
opt_loss: 0.1185 - val_sar_loss: 0.2028 - val_fusion_loss: 0.1232 - val_loss: 0.4446
- val_opt_accuracy: 0.9289 - val_sar_accuracy: 0.9034 - val_fusion_accuracy: 0.9290
- val_combined_accuracy: 0.9304 - val_opt_f1score: 0.8531 - val_sar_f1score: 0.7849
- val_fusion_f1score: 0.8506 - val_combined_f1score: 0.8531
Epoch 38/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0627 - sar_
loss: 0.0782 - fusion_loss: 0.0491 - loss: 0.1900 - opt_accuracy: 0.9488 - sar_accur
acy: 0.9365 - fusion_accuracy: 0.9575 - combined_accuracy: 0.9569 - opt_f1score: 0.9
327 - sar_f1score: 0.9171 - fusion_f1score: 0.9470 - combined_f1score: 0.9465 - val_
opt_loss: 0.1263 - val_sar_loss: 0.2452 - val_fusion_loss: 0.1450 - val_loss: 0.5165
- val_opt_accuracy: 0.9260 - val_sar_accuracy: 0.9034 - val_fusion_accuracy: 0.9279
- val_combined_accuracy: 0.9279 - val_opt_f1score: 0.8434 - val_sar_f1score: 0.7851
- val_fusion_f1score: 0.8356 - val_combined_f1score: 0.8381
Epoch 39/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0625 - sar_
loss: 0.0788 - fusion_loss: 0.0489 - loss: 0.1902 - opt_accuracy: 0.9492 - sar_accur
acy: 0.9361 - fusion_accuracy: 0.9577 - combined_accuracy: 0.9571 - opt_f1score: 0.9
333 - sar_f1score: 0.9165 - fusion_f1score: 0.9473 - combined_f1score: 0.9468 - val_
opt_loss: 0.1230 - val_sar_loss: 0.1904 - val_fusion_loss: 0.1193 - val_loss: 0.4328
- val_opt_accuracy: 0.9272 - val_sar_accuracy: 0.9079 - val_fusion_accuracy: 0.9321
- val_combined_accuracy: 0.9323 - val_opt_f1score: 0.8559 - val_sar_f1score: 0.8098
- val_fusion_f1score: 0.8633 - val_combined_f1score: 0.8651
Epoch 40/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0618 - sar_
loss: 0.0763 - fusion_loss: 0.0480 - loss: 0.1861 - opt_accuracy: 0.9498 - sar_accur
acy: 0.9375 - fusion_accuracy: 0.9584 - combined_accuracy: 0.9577 - opt_f1score: 0.9
340 - sar_f1score: 0.9190 - fusion_f1score: 0.9482 - combined_f1score: 0.9477 - val_
opt_loss: 0.1211 - val_sar_loss: 0.2042 - val_fusion_loss: 0.1250 - val_loss: 0.4503
- val_opt_accuracy: 0.9302 - val_sar_accuracy: 0.8956 - val_fusion_accuracy: 0.9222
- val_combined_accuracy: 0.9274 - val_opt_f1score: 0.8613 - val_sar_f1score: 0.7780
- val_fusion_f1score: 0.8478 - val_combined_f1score: 0.8543
Epoch 41/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0585 - sar_
loss: 0.0732 - fusion_loss: 0.0455 - loss: 0.1773 - opt_accuracy: 0.9516 - sar_accur
acy: 0.9395 - fusion_accuracy: 0.9601 - combined_accuracy: 0.9595 - opt_f1score: 0.9
372 - sar_f1score: 0.9224 - fusion_f1score: 0.9508 - combined_f1score: 0.9503 - val_
opt_loss: 0.1363 - val_sar_loss: 0.2305 - val_fusion_loss: 0.1452 - val_loss: 0.5120
- val_opt_accuracy: 0.9148 - val_sar_accuracy: 0.9054 - val_fusion_accuracy: 0.9285
- val_combined_accuracy: 0.9301 - val_opt_f1score: 0.8368 - val_sar_f1score: 0.7977
- val_fusion_f1score: 0.8492 - val_combined_f1score: 0.8523
Epoch 42/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0579 - sar_
loss: 0.0719 - fusion_loss: 0.0451 - loss: 0.1749 - opt_accuracy: 0.9520 - sar_accur
acy: 0.9403 - fusion_accuracy: 0.9606 - combined_accuracy: 0.9600 - opt_f1score: 0.9
379 - sar_f1score: 0.9236 - fusion_f1score: 0.9513 - combined_f1score: 0.9509 - val_
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opt_loss: 0.1256 - val_sar_loss: 0.2646 - val_fusion_loss: 0.1400 - val_loss: 0.5302
- val_opt_accuracy: 0.9254 - val_sar_accuracy: 0.8978 - val_fusion_accuracy: 0.9304
- val_combined_accuracy: 0.9281 - val_opt_f1score: 0.8588 - val_sar_f1score: 0.7738
- val_fusion_f1score: 0.8591 - val_combined_f1score: 0.8594
Epoch 43/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0574 - sar_
loss: 0.0717 - fusion_loss: 0.0446 - loss: 0.1738 - opt_accuracy: 0.9523 - sar_accur
acy: 0.9404 - fusion_accuracy: 0.9609 - combined_accuracy: 0.9604 - opt_f1score: 0.9
384 - sar_f1score: 0.9238 - fusion_f1score: 0.9517 - combined_f1score: 0.9514 - val_
opt_loss: 0.1209 - val_sar_loss: 0.2535 - val_fusion_loss: 0.1367 - val_loss: 0.5111
- val_opt_accuracy: 0.9304 - val_sar_accuracy: 0.9028 - val_fusion_accuracy: 0.9314
- val_combined_accuracy: 0.9317 - val_opt_f1score: 0.8642 - val_sar_f1score: 0.7726
- val_fusion_f1score: 0.8506 - val_combined_f1score: 0.8560
Epoch 44/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0563 - sar_
loss: 0.0699 - fusion_loss: 0.0435 - loss: 0.1698 - opt_accuracy: 0.9534 - sar_accur
acy: 0.9420 - fusion_accuracy: 0.9619 - combined_accuracy: 0.9614 - opt_f1score: 0.9
397 - sar_f1score: 0.9259 - fusion_f1score: 0.9529 - combined_f1score: 0.9526 - val_
opt_loss: 0.1238 - val_sar_loss: 0.1836 - val_fusion_loss: 0.1187 - val_loss: 0.4261
- val_opt_accuracy: 0.9271 - val_sar_accuracy: 0.9025 - val_fusion_accuracy: 0.9265
- val_combined_accuracy: 0.9313 - val_opt_f1score: 0.8621 - val_sar_f1score: 0.8099
- val_fusion_f1score: 0.8621 - val_combined_f1score: 0.8687
Epoch 45/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0580 - sar_
loss: 0.0722 - fusion_loss: 0.0448 - loss: 0.1750 - opt_accuracy: 0.9525 - sar_accur
acy: 0.9407 - fusion_accuracy: 0.9612 - combined_accuracy: 0.9607 - opt_f1score: 0.9
381 - sar_f1score: 0.9236 - fusion_f1score: 0.9517 - combined_f1score: 0.9513 - val_
opt_loss: 0.1407 - val_sar_loss: 0.2371 - val_fusion_loss: 0.1646 - val_loss: 0.5424
- val_opt_accuracy: 0.9172 - val_sar_accuracy: 0.9021 - val_fusion_accuracy: 0.9265
- val_combined_accuracy: 0.9268 - val_opt_f1score: 0.8328 - val_sar_f1score: 0.7737
- val_fusion_f1score: 0.8255 - val_combined_f1score: 0.8255
Epoch 46/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0547 - sar_
loss: 0.0675 - fusion_loss: 0.0422 - loss: 0.1644 - opt_accuracy: 0.9545 - sar_accur
acy: 0.9433 - fusion_accuracy: 0.9630 - combined_accuracy: 0.9624 - opt_f1score: 0.9
413 - sar_f1score: 0.9281 - fusion_f1score: 0.9543 - combined_f1score: 0.9539 - val_
opt_loss: 0.1232 - val_sar_loss: 0.1986 - val_fusion_loss: 0.1175 - val_loss: 0.4392
- val_opt_accuracy: 0.9272 - val_sar_accuracy: 0.9032 - val_fusion_accuracy: 0.9303
- val_combined_accuracy: 0.9322 - val_opt_f1score: 0.8623 - val_sar_f1score: 0.8027
- val_fusion_f1score: 0.8672 - val_combined_f1score: 0.8707
Epoch 47/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0652 - sar_
loss: 0.0763 - fusion_loss: 0.0483 - loss: 0.1898 - opt_accuracy: 0.9495 - sar_accur
acy: 0.9391 - fusion_accuracy: 0.9595 - combined_accuracy: 0.9590 - opt_f1score: 0.9
320 - sar_f1score: 0.9199 - fusion_f1score: 0.9488 - combined_f1score: 0.9484 - val_
opt_loss: 0.1264 - val_sar_loss: 0.2811 - val_fusion_loss: 0.1578 - val_loss: 0.5653
- val_opt_accuracy: 0.9271 - val_sar_accuracy: 0.8398 - val_fusion_accuracy: 0.9076
- val_combined_accuracy: 0.9154 - val_opt_f1score: 0.8419 - val_sar_f1score: 0.6863
- val_fusion_f1score: 0.8114 - val_combined_f1score: 0.8166
Epoch 48/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0528 - sar_
loss: 0.0647 - fusion_loss: 0.0405 - loss: 0.1580 - opt_accuracy: 0.9559 - sar_accur
acy: 0.9452 - fusion_accuracy: 0.9643 - combined_accuracy: 0.9638 - opt_f1score: 0.9
434 - sar_f1score: 0.9311 - fusion_f1score: 0.9562 - combined_f1score: 0.9559 - val_
opt_loss: 0.1194 - val_sar_loss: 0.2164 - val_fusion_loss: 0.1322 - val_loss: 0.4680
- val_opt_accuracy: 0.9292 - val_sar_accuracy: 0.9091 - val_fusion_accuracy: 0.9338
- val_combined_accuracy: 0.9340 - val_opt_f1score: 0.8574 - val_sar_f1score: 0.8075
- val_fusion_f1score: 0.8575 - val_combined_f1score: 0.8604
Epoch 49/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0533 - sar_
loss: 0.0651 - fusion_loss: 0.0408 - loss: 0.1593 - opt_accuracy: 0.9556 - sar_accur
acy: 0.9452 - fusion_accuracy: 0.9643 - combined_accuracy: 0.9638 - opt_f1score: 0.9
430 - sar_f1score: 0.9310 - fusion_f1score: 0.9560 - combined_f1score: 0.9557 - val_
opt_loss: 0.1276 - val_sar_loss: 0.1856 - val_fusion_loss: 0.1188 - val_loss: 0.4320
- val_opt_accuracy: 0.9245 - val_sar_accuracy: 0.9111 - val_fusion_accuracy: 0.9340
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- val_combined_accuracy: 0.9360 - val_opt_f1score: 0.8556 - val_sar_f1score: 0.8146
- val_fusion_f1score: 0.8673 - val_combined_f1score: 0.8696
Epoch 50/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0514 - sar_
loss: 0.0628 - fusion_loss: 0.0393 - loss: 0.1535 - opt_accuracy: 0.9569 - sar_accur
acy: 0.9470 - fusion_accuracy: 0.9653 - combined_accuracy: 0.9649 - opt_f1score: 0.9
449 - sar_f1score: 0.9334 - fusion_f1score: 0.9574 - combined_f1score: 0.9572 - val_
opt_loss: 0.1289 - val_sar_loss: 0.1945 - val_fusion_loss: 0.1334 - val_loss: 0.4568
- val_opt_accuracy: 0.9157 - val_sar_accuracy: 0.9043 - val_fusion_accuracy: 0.9186
- val_combined_accuracy: 0.9259 - val_opt_f1score: 0.8439 - val_sar_f1score: 0.8077
- val_fusion_f1score: 0.8470 - val_combined_f1score: 0.8537
Epoch 51/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0504 - sar_
loss: 0.0612 - fusion_loss: 0.0384 - loss: 0.1499 - opt_accuracy: 0.9573 - sar_accur
acy: 0.9475 - fusion_accuracy: 0.9659 - combined_accuracy: 0.9655 - opt_f1score: 0.9
459 - sar_f1score: 0.9349 - fusion_f1score: 0.9584 - combined_f1score: 0.9582 - val_
opt_loss: 0.1279 - val_sar_loss: 0.3722 - val_fusion_loss: 0.1865 - val_loss: 0.6866
- val_opt_accuracy: 0.9255 - val_sar_accuracy: 0.8713 - val_fusion_accuracy: 0.9221
- val_combined_accuracy: 0.9191 - val_opt_f1score: 0.8594 - val_sar_f1score: 0.7533
- val_fusion_f1score: 0.8461 - val_combined_f1score: 0.8467
Epoch 52/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0506 - sar_
loss: 0.0623 - fusion_loss: 0.0387 - loss: 0.1516 - opt_accuracy: 0.9576 - sar_accur
acy: 0.9469 - fusion_accuracy: 0.9658 - combined_accuracy: 0.9654 - opt_f1score: 0.9
458 - sar_f1score: 0.9337 - fusion_f1score: 0.9581 - combined_f1score: 0.9578 - val_
opt_loss: 0.1308 - val_sar_loss: 0.2538 - val_fusion_loss: 0.1497 - val_loss: 0.5343
- val_opt_accuracy: 0.9264 - val_sar_accuracy: 0.9097 - val_fusion_accuracy: 0.9301
- val_combined_accuracy: 0.9325 - val_opt_f1score: 0.8534 - val_sar_f1score: 0.7731
- val_fusion_f1score: 0.8418 - val_combined_f1score: 0.8423
Epoch 53/200
330/330 [==============================] - 105s 318ms/step - opt_loss: 0.0505 - sar_
loss: 0.0622 - fusion_loss: 0.0385 - loss: 0.1512 - opt_accuracy: 0.9579 - sar_accur
acy: 0.9476 - fusion_accuracy: 0.9662 - combined_accuracy: 0.9658 - opt_f1score: 0.9
460 - sar_f1score: 0.9339 - fusion_f1score: 0.9583 - combined_f1score: 0.9581 - val_
opt_loss: 0.1348 - val_sar_loss: 0.2104 - val_fusion_loss: 0.1373 - val_loss: 0.4826
- val_opt_accuracy: 0.9215 - val_sar_accuracy: 0.9136 - val_fusion_accuracy: 0.9313
- val_combined_accuracy: 0.9321 - val_opt_f1score: 0.8485 - val_sar_f1score: 0.8069
- val_fusion_f1score: 0.8542 - val_combined_f1score: 0.8545
Epoch 54/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0502 - sar_
loss: 0.0617 - fusion_loss: 0.0383 - loss: 0.1502 - opt_accuracy: 0.9581 - sar_accur
acy: 0.9479 - fusion_accuracy: 0.9664 - combined_accuracy: 0.9661 - opt_f1score: 0.9
464 - sar_f1score: 0.9346 - fusion_f1score: 0.9586 - combined_f1score: 0.9584 - val_
opt_loss: 0.1238 - val_sar_loss: 0.2179 - val_fusion_loss: 0.1318 - val_loss: 0.4735
- val_opt_accuracy: 0.9262 - val_sar_accuracy: 0.9094 - val_fusion_accuracy: 0.9319
- val_combined_accuracy: 0.9350 - val_opt_f1score: 0.8599 - val_sar_f1score: 0.8003
- val_fusion_f1score: 0.8585 - val_combined_f1score: 0.8617
Epoch 55/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0493 - sar_
loss: 0.0605 - fusion_loss: 0.0375 - loss: 0.1473 - opt_accuracy: 0.9585 - sar_accur
acy: 0.9484 - fusion_accuracy: 0.9669 - combined_accuracy: 0.9666 - opt_f1score: 0.9
472 - sar_f1score: 0.9355 - fusion_f1score: 0.9594 - combined_f1score: 0.9592 - val_
opt_loss: 0.1307 - val_sar_loss: 0.2561 - val_fusion_loss: 0.1466 - val_loss: 0.5334
- val_opt_accuracy: 0.9281 - val_sar_accuracy: 0.8652 - val_fusion_accuracy: 0.9199
- val_combined_accuracy: 0.9240 - val_opt_f1score: 0.8574 - val_sar_f1score: 0.7509
- val_fusion_f1score: 0.8468 - val_combined_f1score: 0.8479
Epoch 56/200
330/330 [==============================] - 105s 317ms/step - opt_loss: 0.0488 - sar_
loss: 0.0591 - fusion_loss: 0.0369 - loss: 0.1447 - opt_accuracy: 0.9589 - sar_accur
acy: 0.9498 - fusion_accuracy: 0.9675 - combined_accuracy: 0.9671 - opt_f1score: 0.9
478 - sar_f1score: 0.9371 - fusion_f1score: 0.9601 - combined_f1score: 0.9598 - val_
opt_loss: 0.1316 - val_sar_loss: 0.2349 - val_fusion_loss: 0.1298 - val_loss: 0.4962
- val_opt_accuracy: 0.9293 - val_sar_accuracy: 0.9061 - val_fusion_accuracy: 0.9349
- val_combined_accuracy: 0.9364 - val_opt_f1score: 0.8647 - val_sar_f1score: 0.7870
- val_fusion_f1score: 0.8663 - val_combined_f1score: 0.8678
```

```
Epoch 57/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0486 - sar_
loss: 0.0590 - fusion_loss: 0.0367 - loss: 0.1444 - opt_accuracy: 0.9592 - sar_accur
acy: 0.9498 - fusion_accuracy: 0.9677 - combined_accuracy: 0.9674 - opt_f1score: 0.9
481 - sar_f1score: 0.9372 - fusion_f1score: 0.9603 - combined_f1score: 0.9602 - val_
opt_loss: 0.1229 - val_sar_loss: 0.2229 - val_fusion_loss: 0.1304 - val_loss: 0.4762
- val_opt_accuracy: 0.9324 - val_sar_accuracy: 0.8531 - val_fusion_accuracy: 0.9223
- val_combined_accuracy: 0.9258 - val_opt_f1score: 0.8657 - val_sar_f1score: 0.7511
- val_fusion_f1score: 0.8529 - val_combined_f1score: 0.8547
Epoch 58/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0483 - sar_
loss: 0.0602 - fusion_loss: 0.0369 - loss: 0.1453 - opt_accuracy: 0.9594 - sar_accur
acy: 0.9486 - fusion_accuracy: 0.9675 - combined_accuracy: 0.9672 - opt_f1score: 0.9
483 - sar_f1score: 0.9361 - fusion_f1score: 0.9601 - combined_f1score: 0.9599 - val_
opt_loss: 0.1319 - val_sar_loss: 0.3077 - val_fusion_loss: 0.1621 - val_loss: 0.6017
- val_opt_accuracy: 0.9278 - val_sar_accuracy: 0.8917 - val_fusion_accuracy: 0.9295
- val_combined_accuracy: 0.9327 - val_opt_f1score: 0.8605 - val_sar_f1score: 0.6960
- val_fusion_f1score: 0.8422 - val_combined_f1score: 0.8451
Epoch 59/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0492 - sar_
loss: 0.0578 - fusion_loss: 0.0366 - loss: 0.1436 - opt_accuracy: 0.9591 - sar_accur
acy: 0.9505 - fusion_accuracy: 0.9679 - combined_accuracy: 0.9676 - opt_f1score: 0.9
476 - sar_f1score: 0.9385 - fusion_f1score: 0.9605 - combined_f1score: 0.9604 - val_
opt_loss: 0.1188 - val_sar_loss: 0.2615 - val_fusion_loss: 0.1480 - val_loss: 0.5282
- val_opt_accuracy: 0.9308 - val_sar_accuracy: 0.8943 - val_fusion_accuracy: 0.9289
- val_combined_accuracy: 0.9314 - val_opt_f1score: 0.8670 - val_sar_f1score: 0.7241
- val_fusion_f1score: 0.8328 - val_combined_f1score: 0.8372
Epoch 60/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0461 - sar_
loss: 0.0559 - fusion_loss: 0.0348 - loss: 0.1369 - opt_accuracy: 0.9612 - sar_accur
acy: 0.9521 - fusion_accuracy: 0.9693 - combined_accuracy: 0.9690 - opt_f1score: 0.9
507 - sar_f1score: 0.9405 - fusion_f1score: 0.9624 - combined_f1score: 0.9622 - val_
opt_loss: 0.1341 - val_sar_loss: 0.2302 - val_fusion_loss: 0.1420 - val_loss: 0.5063
- val_opt_accuracy: 0.9314 - val_sar_accuracy: 0.8924 - val_fusion_accuracy: 0.9196
- val_combined_accuracy: 0.9266 - val_opt_f1score: 0.8668 - val_sar_f1score: 0.7894
- val_fusion_f1score: 0.8545 - val_combined_f1score: 0.8614
Epoch 61/200
330/330 [==============================] - 104s 316ms/step - opt_loss: 0.0456 - sar_
loss: 0.0565 - fusion_loss: 0.0345 - loss: 0.1366 - opt_accuracy: 0.9616 - sar_accur
acy: 0.9516 - fusion_accuracy: 0.9696 - combined_accuracy: 0.9693 - opt_f1score: 0.9
513 - sar_f1score: 0.9399 - fusion_f1score: 0.9627 - combined_f1score: 0.9625 - val_
opt_loss: 0.1358 - val_sar_loss: 0.2560 - val_fusion_loss: 0.1659 - val_loss: 0.5577
- val_opt_accuracy: 0.9232 - val_sar_accuracy: 0.9035 - val_fusion_accuracy: 0.9316
- val_combined_accuracy: 0.9304 - val_opt_f1score: 0.8427 - val_sar_f1score: 0.8070
- val_fusion_f1score: 0.8494 - val_combined_f1score: 0.8504
```

Show training history

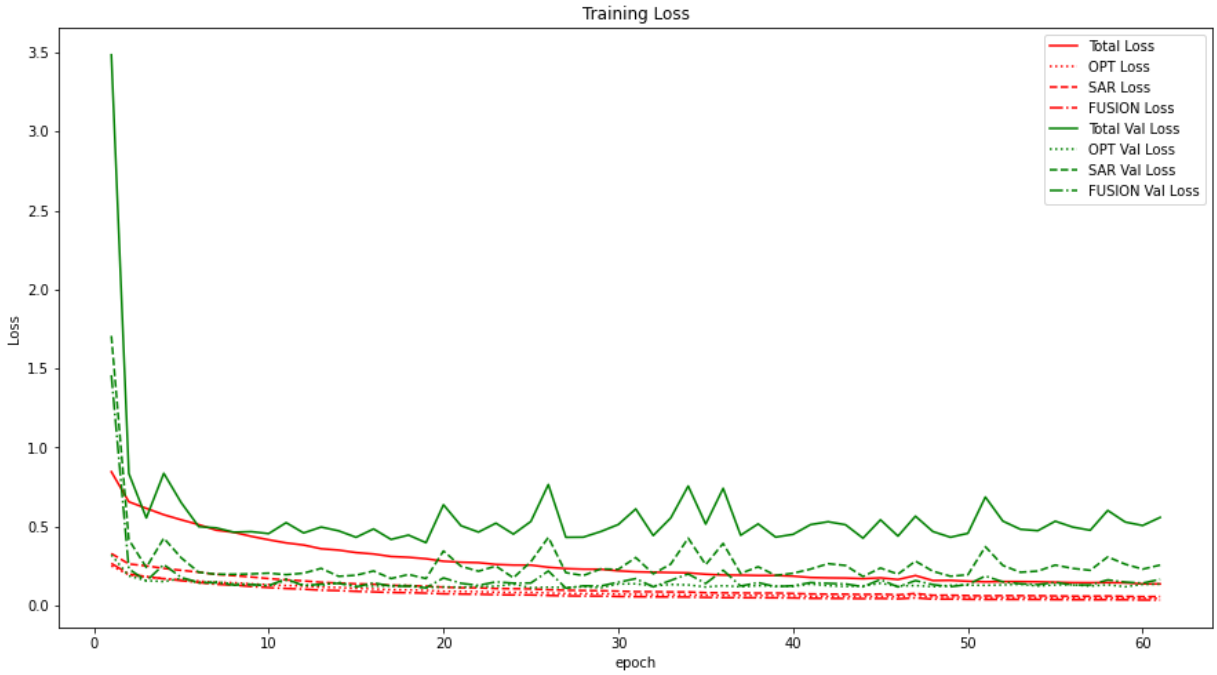
In [7]:

```
plt.figure(figsize=(15, 8))
x = np.arange(len(history.history['loss']))+1
plt.plot(x, history.history['loss'], 'r-',label='Total Loss')
plt.plot(x, history.history['opt_loss'], 'r:',label='OPT Loss')
plt.plot(x, history.history['sar_loss'], 'r--',label='SAR Loss')
plt.plot(x, history.history['fusion_loss'], 'r-.',label='FUSION Loss')

plt.plot(x, history.history['val_loss'], 'g-',label='Total Val Loss')
plt.plot(x, history.history['val_opt_loss'], 'g:',label='OPT Val Loss')
plt.plot(x, history.history['val_sar_loss'], 'g--',label='SAR Val Loss')
plt.plot(x, history.history['val_fusion_loss'], 'g-.',label='FUSION Val Loss')

plt.title('Training Loss')
plt.ylabel('Loss')
plt.xlabel('epoch')
```

```
plt.legend(loc='upper right')
plt.savefig('graphics/Loss.png')
plt.show()
```

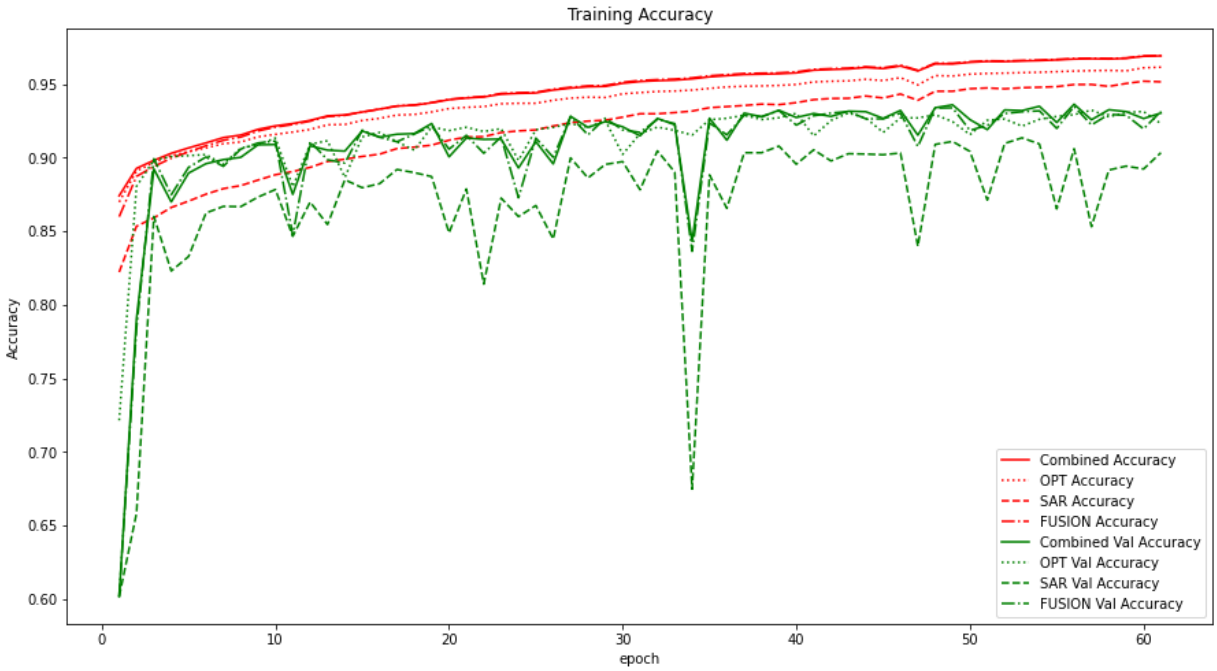


In [8]:

```
plt.figure(figsize=(15, 8))
x = np.arange(len(history.history['loss']))+1
plt.plot(x, history.history['combined_accuracy'], 'r-',label='Combined Accuracy')
plt.plot(x, history.history['opt_accuracy'], 'r:',label='OPT Accuracy')
plt.plot(x, history.history['sar_accuracy'], 'r--',label='SAR Accuracy')
plt.plot(x, history.history['fusion_accuracy'], 'r-.',label='FUSION Accuracy')

plt.plot(x, history.history['val_combined_accuracy'], 'g-',label='Combined Val Accur
plt.plot(x, history.history['val_opt_accuracy'], 'g:',label='OPT Val Accuracy')
plt.plot(x, history.history['val_sar_accuracy'], 'g--',label='SAR Val Accuracy')
plt.plot(x, history.history['val_fusion_accuracy'], 'g-.',label='FUSION Val Accuracy

plt.title('Training Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('epoch')
plt.legend(loc='lower right')
plt.savefig('graphics/Accuracy.png')
plt.show()
```

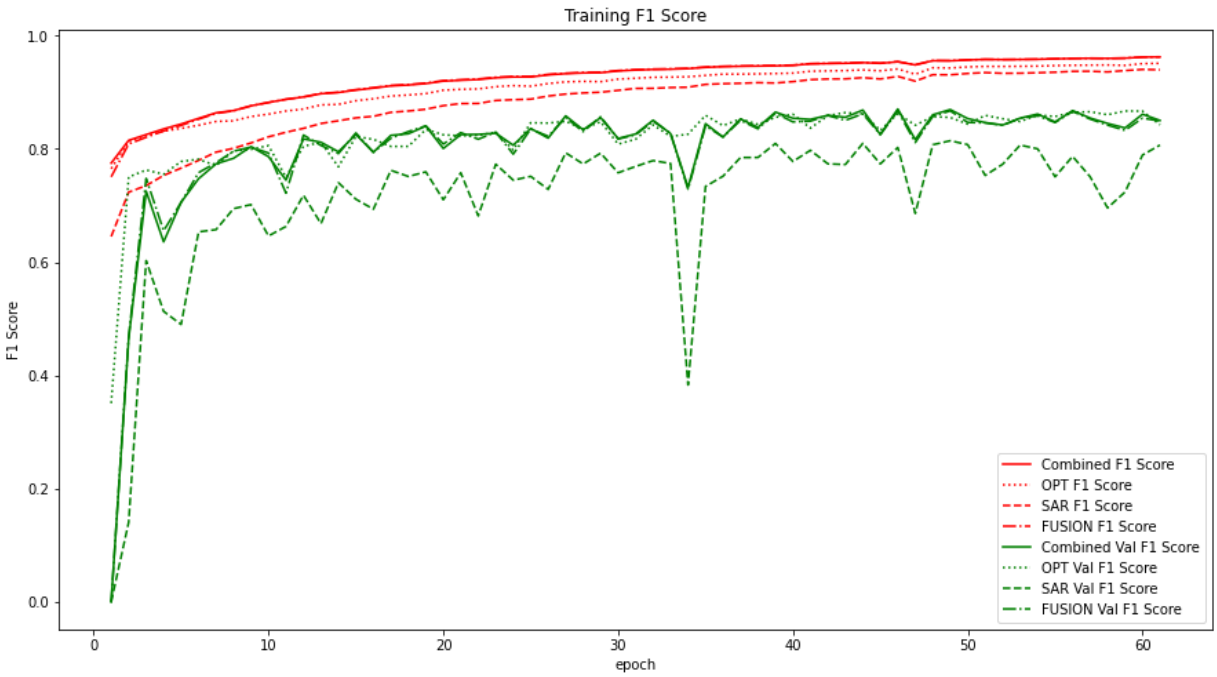


In [9]:

```
plt.figure(figsize=(15, 8))
x = np.arange(len(history.history['loss']))+1
plt.plot(x, history.history['combined_f1score'], 'r-',label='Combined F1 Score')
plt.plot(x, history.history['opt_f1score'], 'r:',label='OPT F1 Score')
plt.plot(x, history.history['sar_f1score'], 'r--',label='SAR F1 Score')
plt.plot(x, history.history['fusion_f1score'], 'r-.',label='FUSION F1 Score')

plt.plot(x, history.history['val_combined_f1score'], 'g-',label='Combined Val F1 Sco
plt.plot(x, history.history['val_opt_f1score'], 'g:',label='OPT Val F1 Score')
plt.plot(x, history.history['val_sar_f1score'], 'g--',label='SAR Val F1 Score')
plt.plot(x, history.history['val_fusion_f1score'], 'g-.',label='FUSION Val F1 Score'

plt.title('Training F1 Score')
plt.ylabel('F1 Score')
plt.xlabel('epoch')
plt.legend(loc='lower right')
plt.savefig('graphics/F1score.png')
plt.show()
```



Evaluation

In [15]:

```
opt_avg_prec_list = []
sar_avg_prec_list = []
fusion_avg_prec_list = []
combined_avg_prec_list = []


pred_path = params_patches['pred_path']
shutil.rmtree(pred_path, ignore_errors=True)
os.makedirs(pred_path)


for tile_n in params_patches['test_tiles']:
    dl_test.set_tile(int(tile_n))

    shape_tile = shapes_json[str(tile_n)]

    y_true = np.load(os.path.join(params_patches['tiles_path'], params_patches['labe
    y_true = to_categorical(y_true, 3)

    predictions_opt = []
    predictions_sar = []
    predictions_fusion = []
    predictions_combined = []

    for batch in tqdm(range(len(dl_test))):
        pred = model.predict_on_batch(dl_test[batch][0])
        predictions_opt.append(pred[0])
        predictions_sar.append(pred[1])
        predictions_fusion.append(pred[2])
        predictions_combined.append(pred[3])

    predictions_opt = np.concatenate(predictions_opt, axis=0)
    predictions_sar = np.concatenate(predictions_sar, axis=0)
    predictions_fusion = np.concatenate(predictions_fusion, axis=0)
    predictions_combined = np.concatenate(predictions_combined, axis=0)

    predictions_opt_rec = reconstruct_image(predictions_opt, params_patches['patch_s
    predictions_sar_rec = reconstruct_image(predictions_sar, params_patches['patch_s
    predictions_fusion_rec = reconstruct_image(predictions_fusion, params_patches['p
    predictions_combined_rec = reconstruct_image(predictions_combined, params_patche

    np.save(os.path.join(params_patches['pred_path'], f'pred_opt_{tile_n:02d}.npy'),
    np.save(os.path.join(params_patches['pred_path'], f'pred_sar_{tile_n:02d}.npy'),
    np.save(os.path.join(params_patches['pred_path'], f'pred_fusion_{tile_n:02d}.npy
    np.save(os.path.join(params_patches['pred_path'], f'pred_combined_{tile_n:02d}.n

    opt_avg_prec = average_precision_score(y_true[:, :, 1].flatten(), predictions_op
    sar_avg_prec = average_precision_score(y_true[:, :, 1].flatten(), predictions_sa
    fusion_avg_prec = average_precision_score(y_true[:, :, 1].flatten(), predictions
    combined_avg_prec = average_precision_score(y_true[:, :, 1].flatten(), predictio

    opt_avg_prec_list.append(opt_avg_prec)
    sar_avg_prec_list.append(sar_avg_prec)
    fusion_avg_prec_list.append(fusion_avg_prec)
    combined_avg_prec_list.append(combined_avg_prec)

    print(f'Precision Average (Class 1) of OPT prediction of tile {tile_n} is {opt_a
    print(f'Precision Average (Class 1) of SAR prediction of tile {tile_n} is {sar_a
    print(f'Precision Average (Class 1) of FUSION prediction of tile {tile_n} is {fu
    print(f'Precision Average (Class 1) of COMBINED prediction of tile {tile_n} is {

    opt_avg_prec = average_precision_score(y_true[:, :, 0].flatten(), predictions_op
```

```
    sar_avg_prec = average_precision_score(y_true[:, :, 0].flatten(), predictions_sa
    fusion_avg_prec = average_precision_score(y_true[:, :, 0].flatten(), predictions
    combined_avg_prec = average_precision_score(y_true[:, :, 0].flatten(), predictio

    print(f'Precision Average (Class 0) of OPT prediction of tile {tile_n} is {opt_a
    print(f'Precision Average (Class 0) of SAR prediction of tile {tile_n} is {sar_a
    print(f'Precision Average (Class 0) of FUSION prediction of tile {tile_n} is {fu
    print(f'Precision Average (Class 0) of COMBINED prediction of tile {tile_n} is {
```

```
100%|██████████| 558/558 [00:53<00:00, 10.46it/s]
Precision Average (Class 1) of OPT prediction of tile 2 is 0.7599
Precision Average (Class 1) of SAR prediction of tile 2 is 0.5179
Precision Average (Class 1) of FUSION prediction of tile 2 is 0.7785
Precision Average (Class 1) of COMBINED prediction of tile 2 is 0.7468
Precision Average (Class 0) of OPT prediction of tile 2 is 0.9623
Precision Average (Class 0) of SAR prediction of tile 2 is 0.9227
Precision Average (Class 0) of FUSION prediction of tile 2 is 0.9627
Precision Average (Class 0) of COMBINED prediction of tile 2 is 0.9548
100%|██████████| 558/558 [02:04<00:00,  4.49it/s]
Precision Average (Class 1) of OPT prediction of tile 4 is 0.5178
Precision Average (Class 1) of SAR prediction of tile 4 is 0.4537
Precision Average (Class 1) of FUSION prediction of tile 4 is 0.6191
Precision Average (Class 1) of COMBINED prediction of tile 4 is 0.6159
Precision Average (Class 0) of OPT prediction of tile 4 is 0.9627
Precision Average (Class 0) of SAR prediction of tile 4 is 0.9300
Precision Average (Class 0) of FUSION prediction of tile 4 is 0.9614
Precision Average (Class 0) of COMBINED prediction of tile 4 is 0.9624
100%|██████████| 558/558 [02:04<00:00,  4.47it/s]
Precision Average (Class 1) of OPT prediction of tile 5 is 0.7608
Precision Average (Class 1) of SAR prediction of tile 5 is 0.5997
Precision Average (Class 1) of FUSION prediction of tile 5 is 0.7829
Precision Average (Class 1) of COMBINED prediction of tile 5 is 0.7663
Precision Average (Class 0) of OPT prediction of tile 5 is 0.9727
Precision Average (Class 0) of SAR prediction of tile 5 is 0.9364
Precision Average (Class 0) of FUSION prediction of tile 5 is 0.9733
Precision Average (Class 0) of COMBINED prediction of tile 5 is 0.9690
100%|██████████| 558/558 [02:07<00:00,  4.38it/s]
Precision Average (Class 1) of OPT prediction of tile 9 is 0.7553
Precision Average (Class 1) of SAR prediction of tile 9 is 0.5618
Precision Average (Class 1) of FUSION prediction of tile 9 is 0.7844
Precision Average (Class 1) of COMBINED prediction of tile 9 is 0.7568
Precision Average (Class 0) of OPT prediction of tile 9 is 0.9823
Precision Average (Class 0) of SAR prediction of tile 9 is 0.8191
Precision Average (Class 0) of FUSION prediction of tile 9 is 0.9671
Precision Average (Class 0) of COMBINED prediction of tile 9 is 0.9721
100%|██████████| 558/558 [02:08<00:00,  4.35it/s]
Precision Average (Class 1) of OPT prediction of tile 10 is 0.8375
Precision Average (Class 1) of SAR prediction of tile 10 is 0.6415
Precision Average (Class 1) of FUSION prediction of tile 10 is 0.8518
Precision Average (Class 1) of COMBINED prediction of tile 10 is 0.8285
Precision Average (Class 0) of OPT prediction of tile 10 is 0.9817
Precision Average (Class 0) of SAR prediction of tile 10 is 0.9589
Precision Average (Class 0) of FUSION prediction of tile 10 is 0.9808
Precision Average (Class 0) of COMBINED prediction of tile 10 is 0.9800
100%|██████████| 558/558 [02:04<00:00,  4.48it/s]
Precision Average (Class 1) of OPT prediction of tile 11 is 0.4620
Precision Average (Class 1) of SAR prediction of tile 11 is 0.1355
Precision Average (Class 1) of FUSION prediction of tile 11 is 0.4463
Precision Average (Class 1) of COMBINED prediction of tile 11 is 0.3678
Precision Average (Class 0) of OPT prediction of tile 11 is 0.9591
Precision Average (Class 0) of SAR prediction of tile 11 is 0.9244
Precision Average (Class 0) of FUSION prediction of tile 11 is 0.9586
Precision Average (Class 0) of COMBINED prediction of tile 11 is 0.9564
```

```
100%|██████████| 558/558 [02:01<00:00,  4.60it/s]
Precision Average (Class 1) of OPT prediction of tile 13 is 0.5290
Precision Average (Class 1) of SAR prediction of tile 13 is 0.2526
Precision Average (Class 1) of FUSION prediction of tile 13 is 0.5245
Precision Average (Class 1) of COMBINED prediction of tile 13 is 0.4717
Precision Average (Class 0) of OPT prediction of tile 13 is 0.9702
Precision Average (Class 0) of SAR prediction of tile 13 is 0.8946
Precision Average (Class 0) of FUSION prediction of tile 13 is 0.9671
Precision Average (Class 0) of COMBINED prediction of tile 13 is 0.9655
100%|██████████| 558/558 [02:17<00:00,  4.07it/s]
Precision Average (Class 1) of OPT prediction of tile 15 is 0.1129
Precision Average (Class 1) of SAR prediction of tile 15 is 0.0488
Precision Average (Class 1) of FUSION prediction of tile 15 is 0.1758
Precision Average (Class 1) of COMBINED prediction of tile 15 is 0.1539
Precision Average (Class 0) of OPT prediction of tile 15 is 0.9833
Precision Average (Class 0) of SAR prediction of tile 15 is 0.6838
Precision Average (Class 0) of FUSION prediction of tile 15 is 0.9607
Precision Average (Class 0) of COMBINED prediction of tile 15 is 0.9711
100%|██████████| 558/558 [02:17<00:00,  4.06it/s]
Precision Average (Class 1) of OPT prediction of tile 18 is 0.9140
Precision Average (Class 1) of SAR prediction of tile 18 is 0.7471
Precision Average (Class 1) of FUSION prediction of tile 18 is 0.9356
Precision Average (Class 1) of COMBINED prediction of tile 18 is 0.9225
Precision Average (Class 0) of OPT prediction of tile 18 is 0.8790
Precision Average (Class 0) of SAR prediction of tile 18 is 0.3672
Precision Average (Class 0) of FUSION prediction of tile 18 is 0.8325
Precision Average (Class 0) of COMBINED prediction of tile 18 is 0.8420
```

In [ ]: