# Prediction of Atomic Stress Fields using Cycle-Consistent Adversarial Neural Networks based on Unpaired and Unmatched Sparse Datasets

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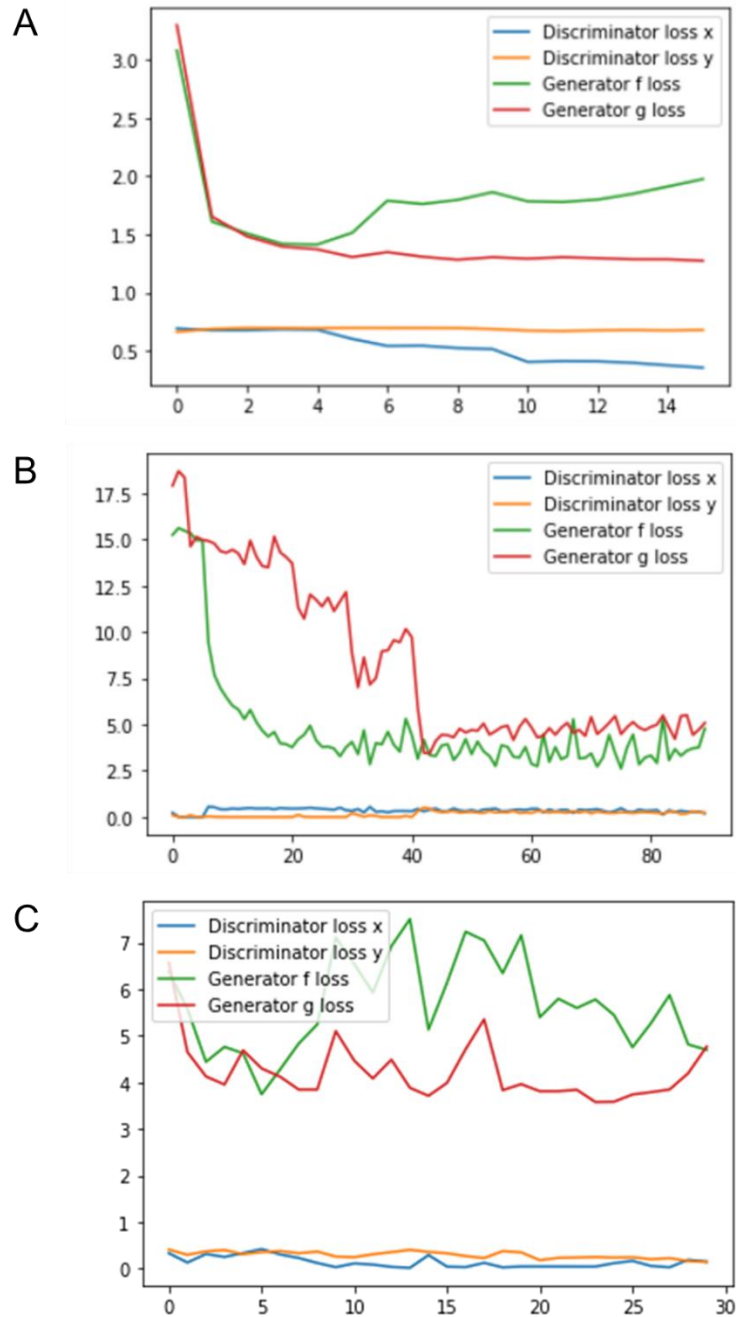
# SUPPLEMENTARY INFORMATION

**Figure S1**: Training progression of the U-Net (A), ResNet (B), and U-Net-ResNet (C) neural networks. Note, the results shown in (C) are for the most challenging problem, training for deformation of the lattice while at the same time solving for the stress field. As can be seen, while training performance for A-B is generally good, performance for the third problem is more challenging.
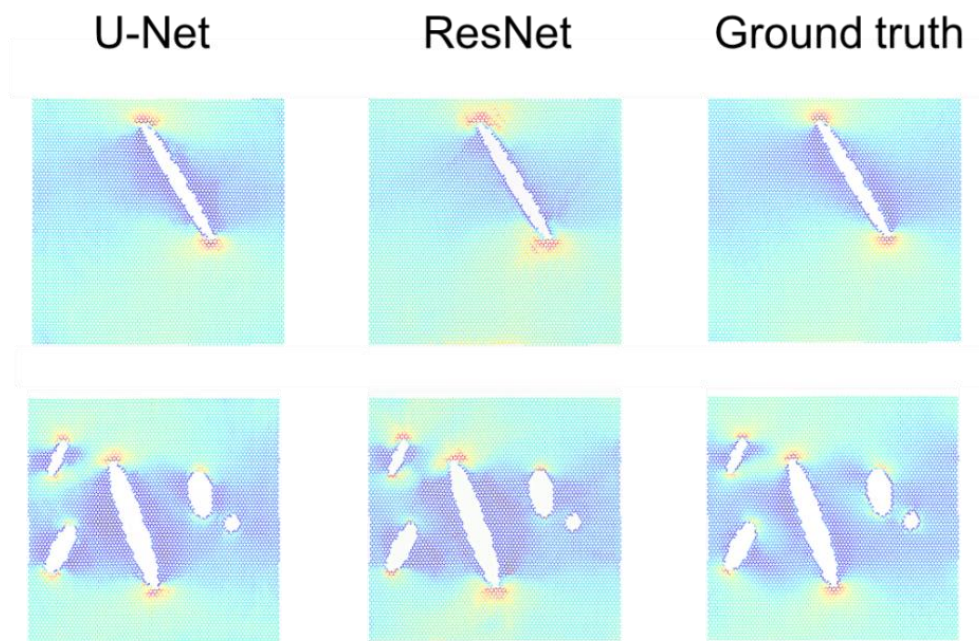
**Figure S2**: Direct comparison between predictions from the U-Net and ResNet generators, and comparison to ground truth data.

```
U-Net generator model:
_____
Layer (type)                  Output Shape            Param #     Connected to
=========================================================================================
input_1 (InputLayer)          [(None, None, None,     0
_____
sequential (Sequential)       (None, None, None, 6    3072        input_1[0][0]
_____
sequential_1 (Sequential)     (None, None, None, 1    131328      sequential[0][0]
_____
sequential_2 (Sequential)     (None, None, None, 2    524800      sequential_1[0][0]
_____
sequential_3 (Sequential)     (None, None, None, 5    2098176     sequential_2[0][0]
_____
sequential_4 (Sequential)     (None, None, None, 5    4195328     sequential_3[0][0]
_____
sequential_5 (Sequential)     (None, None, None, 1    8390656     sequential_4[0][0]
_____
sequential_6 (Sequential)     (None, None, None, 1    16779264    sequential_5[0][0]
_____
sequential_7 (Sequential)     (None, None, None, 1    16779264    sequential_6[0][0]
_____
sequential_8 (Sequential)     (None, None, None, 1    16779264    sequential_7[0][0]
_____
sequential_9 (Sequential)     (None, None, None, 1    16779264    sequential_8[0][0]
_____
sequential_10 (Sequential)    (None, None, None, 1    16779264    sequential_9[0][0]
_____
concatenate (Concatenate)     multiple                0           sequential_10[0][0]
                                                                  sequential_8[0][0]
                                                                  sequential_11[0][0]
                                                                  sequential_7[0][0]
                                                                  sequential_12[0][0]
                                                                  sequential_6[0][0]
                                                                  sequential_13[0][0]
                                                                  sequential_5[0][0]
                                                                  sequential_14[0][0]
                                                                  sequential_4[0][0]
                                                                  sequential_15[0][0]
                                                                  sequential_3[0][0]
                                                                  sequential_16[0][0]
                                                                  sequential_2[0][0]
                                                                  sequential_17[0][0]
                                                                  sequential_1[0][0]
                                                                  sequential_18[0][0]
                                                                  sequential[0][0]
_____
sequential_11 (Sequential)    (None, None, None, 1    33556480    concatenate[0][0]
_____
sequential_12 (Sequential)    (None, None, None, 1    33556480    concatenate[1][0]
_____
sequential_13 (Sequential)    (None, None, None, 1    33556480    concatenate[2][0]
_____
sequential_14 (Sequential)    (None, None, None, 1    33556480    concatenate[3][0]
_____
sequential_15 (Sequential)    (None, None, None, 5    12583936    concatenate[4][0]
_____
sequential_16 (Sequential)    (None, None, None, 5    8389632     concatenate[5][0]
_____
sequential_17 (Sequential)    (None, None, None, 2    3146240     concatenate[6][0]
_____
sequential_18 (Sequential)    (None, None, None, 1    786688      concatenate[7][0]
_____
conv2d_transpose_10 (Conv2DTran (None, None, None, 3   9219        concatenate[8][0]
=========================================================================================
Total params: 258,381,315
Trainable params: 258,381,315
Non-trainable params: 0
=========================================================================================
```

**Figure S3**: U-Net generator architecture, featuring skip connections.

ResNet generator model:

```
_____
Layer (type)                   Output Shape         Param #      Connected to
=================================================================================================
input_1 (InputLayer)           [(None, 1024, 1024,  0
_____
conv2d (Conv2D)                (None, 1024, 1024, 6 9472         input_1[0][0]
_____
instance_normalization (Instanc (None, 1024, 1024, 6 128         conv2d[0][0]
_____
activation (Activation)        (None, 1024, 1024, 6 0            instance_normalization[0][0]
_____
conv2d_1 (Conv2D)              (None, 512, 512, 128 73856        activation[0][0]
_____
instance_normalization_1 (Insta (None, 512, 512, 128 256         conv2d_1[0][0]
_____
activation_1 (Activation)      (None, 512, 512, 128 0            instance_normalization_1[0][0]
_____
conv2d_2 (Conv2D)              (None, 256, 256, 256 295168       activation_1[0][0]
_____
instance_normalization_2 (Insta (None, 256, 256, 256 512         conv2d_2[0][0]
_____
activation_2 (Activation)      (None, 256, 256, 256 0            instance_normalization_2[0][0]
_____
conv2d_3 (Conv2D)              (None, 256, 256, 256 590080       activation_2[0][0]
_____
instance_normalization_3 (Insta (None, 256, 256, 256 512         conv2d_3[0][0]
_____
activation_3 (Activation)      (None, 256, 256, 256 0            instance_normalization_3[0][0]
_____
conv2d_4 (Conv2D)              (None, 256, 256, 256 590080       activation_3[0][0]
_____
instance_normalization_4 (Insta (None, 256, 256, 256 512         conv2d_4[0][0]
_____
concatenate (Concatenate)      (None, 256, 256, 512 0            instance_normalization_4[0][0]
                                                                 activation_2[0][0]
_____
conv2d_5 (Conv2D)              (None, 256, 256, 256 1179904      concatenate[0][0]
_____
instance_normalization_5 (Insta (None, 256, 256, 256 512         conv2d_5[0][0]
_____
activation_4 (Activation)      (None, 256, 256, 256 0            instance_normalization_5[0][0]
_____
conv2d_6 (Conv2D)              (None, 256, 256, 256 590080       activation_4[0][0]
_____
instance_normalization_6 (Insta (None, 256, 256, 256 512         conv2d_6[0][0]
_____
concatenate_1 (Concatenate)    (None, 256, 256, 768 0            instance_normalization_6[0][0]
                                                                 concatenate[0][0]
_____
conv2d_7 (Conv2D)              (None, 256, 256, 256 1769728      concatenate_1[0][0]
_____
instance_normalization_7 (Insta (None, 256, 256, 256 512         conv2d_7[0][0]
_____
activation_5 (Activation)      (None, 256, 256, 256 0            instance_normalization_7[0][0]
_____
conv2d_8 (Conv2D)              (None, 256, 256, 256 590080       activation_5[0][0]
_____
instance_normalization_8 (Insta (None, 256, 256, 256 512         conv2d_8[0][0]
_____
concatenate_2 (Concatenate)    (None, 256, 256, 102 0            instance_normalization_8[0][0]
                                                                 concatenate_1[0][0]
_____
conv2d_9 (Conv2D)              (None, 256, 256, 256 2359552      concatenate_2[0][0]
_____
instance_normalization_9 (Insta (None, 256, 256, 256 512         conv2d_9[0][0]
_____
activation_6 (Activation)      (None, 256, 256, 256 0            instance_normalization_9[0][0]
_____
conv2d_10 (Conv2D)             (None, 256, 256, 256 590080       activation_6[0][0]
_____
instance_normalization_10 (Inst (None, 256, 256, 256 512         conv2d_10[0][0]
_____
concatenate_3 (Concatenate)    (None, 256, 256, 128 0            instance_normalization_10[0][0]
                                                                 concatenate_2[0][0]
_____
conv2d_11 (Conv2D)             (None, 256, 256, 256 2949376      concatenate_3[0][0]
_____
instance_normalization_11 (Inst (None, 256, 256, 256 512         conv2d_11[0][0]
_____
activation_7 (Activation)      (None, 256, 256, 256 0            instance_normalization_11[0][0]
_____
conv2d_12 (Conv2D)             (None, 256, 256, 256 590080       activation_7[0][0]
_____
instance_normalization_12 (Inst (None, 256, 256, 256 512         conv2d_12[0][0]
_____
concatenate_4 (Concatenate)    (None, 256, 256, 153 0            instance_normalization_12[0][0]
                                                                 concatenate_3[0][0]
_____
conv2d_13 (Conv2D)             (None, 256, 256, 256 3539200      concatenate_4[0][0]
_____
instance_normalization_13 (Inst (None, 256, 256, 256 512         conv2d_13[0][0]
_____
activation_8 (Activation)      (None, 256, 256, 256 0            instance_normalization_13[0][0]
_____
conv2d_14 (Conv2D)             (None, 256, 256, 256 590080       activation_8[0][0]
_____
instance_normalization_14 (Inst (None, 256, 256, 256 512         conv2d_14[0][0]
_____
concatenate_5 (Concatenate)    (None, 256, 256, 179 0            instance_normalization_14[0][0]
                                                                 concatenate_4[0][0]
_____
conv2d_15 (Conv2D)             (None, 256, 256, 256 4129024      concatenate_5[0][0]
_____
instance_normalization_15 (Inst (None, 256, 256, 256 512         conv2d_15[0][0]
_____
activation_9 (Activation)      (None, 256, 256, 256 0            instance_normalization_15[0][0]
_____
conv2d_16 (Conv2D)             (None, 256, 256, 256 590080       activation_9[0][0]
_____
instance_normalization_16 (Inst (None, 256, 256, 256 512         conv2d_16[0][0]
_____
concatenate_6 (Concatenate)    (None, 256, 256, 204 0            instance_normalization_16[0][0]
                                                                 concatenate_5[0][0]
_____
conv2d_17 (Conv2D)             (None, 256, 256, 256 4718848      concatenate_6[0][0]
_____
```

```
instance_normalization_17 (Inst (None, 256, 256, 256 512          conv2d_17[0][0]
_____
activation_10 (Activation)      (None, 256, 256, 256 0           instance_normalization_17[0][0]
_____
conv2d_18 (Conv2D)              (None, 256, 256, 256 590080      activation_10[0][0]
_____
instance_normalization_18 (Inst (None, 256, 256, 256 512          conv2d_18[0][0]
_____
concatenate_7 (Concatenate)     (None, 256, 256, 230 0           instance_normalization_18[0][0]
                                                                  concatenate_6[0][0]
_____
conv2d_19 (Conv2D)              (None, 256, 256, 256 5308672     concatenate_7[0][0]
_____
instance_normalization_19 (Inst (None, 256, 256, 256 512          conv2d_19[0][0]
_____
activation_11 (Activation)      (None, 256, 256, 256 0           instance_normalization_19[0][0]
_____
conv2d_20 (Conv2D)              (None, 256, 256, 256 590080      activation_11[0][0]
_____
instance_normalization_20 (Inst (None, 256, 256, 256 512          conv2d_20[0][0]
_____
concatenate_8 (Concatenate)     (None, 256, 256, 256 0           instance_normalization_20[0][0]
                                                                  concatenate_7[0][0]
_____
conv2d_transpose (Conv2DTranspo (None, 512, 512, 128 2949248     concatenate_8[0][0]
_____
instance_normalization_21 (Inst (None, 512, 512, 128 256          conv2d_transpose[0][0]
_____
activation_12 (Activation)      (None, 512, 512, 128 0           instance_normalization_21[0][0]
_____
conv2d_transpose_1 (Conv2DTrans (None, 1024, 1024, 6 73792       activation_12[0][0]
_____
instance_normalization_22 (Inst (None, 1024, 1024, 6 128          conv2d_transpose_1[0][0]
_____
activation_13 (Activation)      (None, 1024, 1024, 6 0           instance_normalization_22[0][0]
_____
conv2d_21 (Conv2D)              (None, 1024, 1024, 3 9411        activation_13[0][0]
_____
instance_normalization_23 (Inst (None, 1024, 1024, 3 6            conv2d_21[0][0]
_____
activation_14 (Activation)      (None, 1024, 1024, 3 0           instance_normalization_23[0][0]
========================================================================================
Total params: 35,276,553
Trainable params: 35,276,553
Non-trainable params: 0
========================================================================================
```

**Figure S4**: ResNet generator architecture (9 ResNet blocks)

```
U-Net-ResNet generator model:
_____
 Layer (type)                   Output Shape         Param #    Connected to
=========================================================================================
 input_1 (InputLayer)           [(None, None, None,  0          []
                                 3)]

 ResNetConv0_1 (Conv2D)         (None, None, None,   1792       ['input_1[0][0]']
                                 64)

 instance_normalization_19 (Ins (None, None, None,   128        ['ResNetConv0_1[0][0]']
 tanceNormalization)            64)

 activation (Activation)        (None, None, None,   0          ['instance_normalization_19[0][0]
                                 64)                             ']

 ResNetConv0_2 (Conv2D)         (None, None, None,   36928      ['activation[0][0]']
                                 64)

 instance_normalization_20 (Ins (None, None, None,   128        ['ResNetConv0_2[0][0]']
 tanceNormalization)            64)

 concatenate_1 (Concatenate)    (None, None, None,   0          ['instance_normalization_20[0][0]
                                 67)                             ',
                                                                 'input_1[0][0]']

 sequential (Sequential)        (None, None, None,   68608      ['concatenate_1[0][0]']
                                 64)

 sequential_1 (Sequential)      (None, None, None,   131328     ['sequential[0][0]']
                                 128)

 ResNetConv1_1 (Conv2D)         (None, None, None,   295168     ['sequential_1[0][0]']
                                 256)

 instance_normalization_21 (Ins (None, None, None,   512        ['ResNetConv1_1[0][0]']
 tanceNormalization)            256)

 activation_1 (Activation)      (None, None, None,   0          ['instance_normalization_21[0][0]
                                 256)                            ']

 ResNetConv1_2 (Conv2D)         (None, None, None,   590080     ['activation_1[0][0]']
                                 256)

 instance_normalization_22 (Ins (None, None, None,   512        ['ResNetConv1_2[0][0]']
 tanceNormalization)            256)

 concatenate_2 (Concatenate)    (None, None, None,   0          ['instance_normalization_22[0][0]
                                 384)                            ',
                                                                 'sequential_1[0][0]']

 sequential_2 (Sequential)      (None, None, None,   1573376    ['concatenate_2[0][0]']
                                 256)

 sequential_3 (Sequential)      (None, None, None,   2098176    ['sequential_2[0][0]']
                                 512)

 ResNetConv2_1 (Conv2D)         (None, None, None,   2359808    ['sequential_3[0][0]']
                                 512)

 instance_normalization_23 (Ins (None, None, None,   1024       ['ResNetConv2_1[0][0]']
 tanceNormalization)            512)

 activation_2 (Activation)      (None, None, None,   0          ['instance_normalization_23[0][0]
                                 512)                            ']

 ResNetConv2_2 (Conv2D)         (None, None, None,   2359808    ['activation_2[0][0]']
                                 512)

 instance_normalization_24 (Ins (None, None, None,   1024       ['ResNetConv2_2[0][0]']
 tanceNormalization)            512)

 concatenate_3 (Concatenate)    (None, None, None,   0          ['instance_normalization_24[0][0]
                                 1024)                           ',
                                                                 'sequential_3[0][0]']

 sequential_4 (Sequential)      (None, None, None,   8389632    ['concatenate_3[0][0]']
                                 512)

 sequential_5 (Sequential)      (None, None, None,   8390656    ['sequential_4[0][0]']
                                 1024)

 ResNetConv3_1 (Conv2D)         (None, None, None,   9438208    ['sequential_5[0][0]']
                                 1024)

 instance_normalization_25 (Ins (None, None, None,   2048       ['ResNetConv3_1[0][0]']
 tanceNormalization)            1024)

 activation_3 (Activation)      (None, None, None,   0          ['instance_normalization_25[0][0]
                                 1024)                           ']

 ResNetConv3_2 (Conv2D)         (None, None, None,   9438208    ['activation_3[0][0]']
                                 1024)

 instance_normalization_26 (Ins (None, None, None,   2048       ['ResNetConv3_2[0][0]']
 tanceNormalization)            1024)

 concatenate_4 (Concatenate)    (None, None, None,   0          ['instance_normalization_26[0][0]
                                 2048)                           ',
                                                                 'sequential_5[0][0]']

 sequential_6 (Sequential)      (None, None, None,   33556480   ['concatenate_4[0][0]']
                                 1024)

 sequential_7 (Sequential)      (None, None, None,   16779264   ['sequential_6[0][0]']
                                 1024)

 ResNetConv4_1 (Conv2D)         (None, None, None,   9438208    ['sequential_7[0][0]']
                                 1024)

 instance_normalization_27 (Ins (None, None, None,   2048       ['ResNetConv4_1[0][0]']
 tanceNormalization)            1024)

 activation_4 (Activation)      (None, None, None,   0          ['instance_normalization_27[0][0]
                                 1024)                           ']

 ResNetConv4_2 (Conv2D)         (None, None, None,   9438208    ['activation_4[0][0]']
_____
```

```
                                                              1024)

instance_normalization_28 (Ins  (None, None, None,   2048       ['ResNetConv4_2[0][0]']
tanceNormalization)             1024)

concatenate_5 (Concatenate)     (None, None, None,   0          ['instance_normalization_28[0][0]
                                2048)                            ',
                                                                 'sequential_7[0][0]']

sequential_8 (Sequential)       (None, None, None,   33556480   ['concatenate_5[0][0]']
                                1024)

sequential_9 (Sequential)       (None, None, None,   16779264   ['sequential_8[0][0]']
                                1024)

ResNetConv5_1 (Conv2D)          (None, None, None,   9438208    ['sequential_9[0][0]']
                                1024)

instance_normalization_29 (Ins  (None, None, None,   2048       ['ResNetConv5_1[0][0]']
tanceNormalization)             1024)

activation_5 (Activation)       (None, None, None,   0          ['instance_normalization_29[0][0]
                                1024)                            ']

ResNetConv5_2 (Conv2D)          (None, None, None,   9438208    ['activation_5[0][0]']
                                1024)

instance_normalization_30 (Ins  (None, None, None,   2048       ['ResNetConv5_2[0][0]']
tanceNormalization)             1024)

concatenate_6 (Concatenate)     (None, None, None,   0          ['instance_normalization_30[0][0]
                                2048)                            ',
                                                                 'sequential1_9[0][0]']

ResNetConv6_1 (Conv2D)          (None, None, None,   18875392   ['concatenate_6[0][0]']
                                1024)

instance_normalization_31 (Ins  (None, None, None,   2048       ['ResNetConv6_1[0][0]']
tanceNormalization)             1024)

activation_6 (Activation)       (None, None, None,   0          ['instance_normalization_31[0][0]
                                1024)                            ']

ResNetConv6_2 (Conv2D)          (None, None, None,   9438208    ['activation_6[0][0]']
                                1024)

instance_normalization_32 (Ins  (None, None, None,   2048       ['ResNetConv6_2[0][0]']
tanceNormalization)             1024)

concatenate_7 (Concatenate)     (None, None, None,   0          ['instance_normalization_32[0][0]
                                3072)                            ',
                                                                 'concatenate_6[0][0]']

ResNetConv7_1 (Conv2D)          (None, None, None,   28312576   ['concatenate_7[0][0]']
                                1024)

instance_normalization_33 (Ins  (None, None, None,   2048       ['ResNetConv7_1[0][0]']
tanceNormalization)             1024)

activation_7 (Activation)       (None, None, None,   0          ['instance_normalization_33[0][0]
                                1024)                            ']

ResNetConv7_2 (Conv2D)          (None, None, None,   9438208    ['activation_7[0][0]']
                                1024)

instance_normalization_34 (Ins  (None, None, None,   2048       ['ResNetConv7_2[0][0]']
tanceNormalization)             1024)

concatenate_8 (Concatenate)     (None, None, None,   0          ['instance_normalization_34[0][0]
                                4096)                            ',
                                                                 'concatenate_7[0][0]']

sequential_10 (Sequential)      (None, None, None,   67110912   ['concatenate_8[0][0]']
                                1024)

concatenate (Concatenate)       multiple             0          ['sequential_10[0][0]',
                                                                 'sequential_8[0][0]',
                                                                 'sequential1_11[0][0]',
                                                                 'sequential1_7[0][0]',
                                                                 'sequential1_12[0][0]',
                                                                 'sequential1_6[0][0]',
                                                                 'sequential1_13[0][0]',
                                                                 'sequential1_5[0][0]',
                                                                 'sequential1_14[0][0]',
                                                                 'sequential1_4[0][0]',
                                                                 'sequential1_15[0][0]',
                                                                 'sequential1_3[0][0]',
                                                                 'sequential1_16[0][0]',
                                                                 'sequential1_2[0][0]',
                                                                 'sequential1_17[0][0]',
                                                                 'sequential1_1[0][0]',
                                                                 'sequential1_18[0][0]',
                                                                 'sequential1[0][0]']

sequential_11 (Sequential)      (None, None, None,   33556480   ['concatenate[0][0]']
                                1024)

ResNetConv8_1 (Conv2D)          (None, None, None,   18875392   ['concatenate[1][0]']
                                1024)

instance_normalization_35 (Ins  (None, None, None,   2048       ['ResNetConv8_1[0][0]']
tanceNormalization)             1024)

activation_8 (Activation)       (None, None, None,   0          ['instance_normalization_35[0][0]
                                1024)                            ']

ResNetConv8_2 (Conv2D)          (None, None, None,   9438208    ['activation_8[0][0]']
                                1024)

instance_normalization_36 (Ins  (None, None, None,   2048       ['ResNetConv8_2[0][0]']
tanceNormalization)             1024)

concatenate_9 (Concatenate)     (None, None, None,   0          ['instance_normalization_36[0][0]
                                3072)                            ',
                                                                 'concatenate[1][0]']

sequential_12 (Sequential)      (None, None, None,   50333696   ['concatenate_9[0][0]']
                                1024)
```

```
                                          1024)

sequential1_13 (Sequential)       (None, None, None,    33556480   ['concatenate[2][0]']
                                   1024)

ResNetConv9_1 (Conv2D)            (None, None, None,    18875392   ['concatenate[3][0]']
                                   1024)

instance_normalization_37 (Ins   (None, None, None,    2048       ['ResNetConv9_1[0][0]']
tanceNormalization)               1024)

activation_9 (Activation)         (None, None, None,    0          ['instance_normalization_37[0][0]
                                   1024)                             ']

ResNetConv9_2 (Conv2D)            (None, None, None,    9438208    ['activation_9[0][0]']
                                   1024)

instance_normalization_38 (Ins   (None, None, None,    2048       ['ResNetConv9_2[0][0]']
tanceNormalization)               1024)

concatenate_10 (Concatenate)      (None, None, None,    0          ['instance_normalization_38[0][0]
                                   3072)                            ',
                                                                    'concatenate[3][0]']

sequential_14 (Sequential)        (None, None, None,    50333696   ['concatenate_10[0][0]']
                                   1024)

sequential_15 (Sequential)        (None, None, None,    12583936   ['concatenate[4][0]']
                                   512)

ResNetConv10_1 (Conv2D)           (None, None, None,    4719104    ['concatenate[5][0]']
                                   512)

instance_normalization_39 (Ins   (None, None, None,    1024       ['ResNetConv10_1[0][0]']
tanceNormalization)               512)

activation_10 (Activation)        (None, None, None,    0          ['instance_normalization_39[0][0]
                                   512)                             ']

ResNetConv10_2 (Conv2D)           (None, None, None,    2359808    ['activation_10[0][0]']
                                   512)

instance_normalization_40 (Ins   (None, None, None,    1024       ['ResNetConv10_2[0][0]']
tanceNormalization)               512)

concatenate_11 (Concatenate)      (None, None, None,    0          ['instance_normalization_40[0][0]
                                   1536)                            ',
                                                                    'concatenate[5][0]']

sequential_16 (Sequential)        (None, None, None,    12583936   ['concatenate_11[0][0]']
                                   512)

sequential_17 (Sequential)        (None, None, None,    3146240    ['concatenate[6][0]']
                                   256)

ResNetConv11_1 (Conv2D)           (None, None, None,    442496     ['concatenate[7][0]']
                                   128)

instance_normalization_41 (Ins   (None, None, None,    256        ['ResNetConv11_1[0][0]']
tanceNormalization)               128)

activation_11 (Activation)        (None, None, None,    0          ['instance_normalization_41[0][0]
                                   128)                             ']

ResNetConv11_2 (Conv2D)           (None, None, None,    147584     ['activation_11[0][0]']
                                   128)

instance_normalization_42 (Ins   (None, None, None,    256        ['ResNetConv11_2[0][0]']
tanceNormalization)               128)

concatenate_12 (Concatenate)      (None, None, None,    0          ['instance_normalization_42[0][0]
                                   512)                             ',
                                                                    'concatenate[7][0]']

sequential_18 (Sequential)        (None, None, None,    1048832    ['concatenate_12[0][0]']
                                   128)

conv2d_transpose_10 (Conv2DTra   (None, None, None,    9219       ['concatenate[8][0]']
nspose)                           3)
==================================================================================================
Total params: 578,254,659
Trainable params: 578,254,659
Non-trainable params: 0
==================================================================================================
```

**Figure S5**: U-Net-ResNet architecture used as a generator.

```
Discriminator model:
_____
Layer (type)                    Output Shape              Param #
=================================================================
input_6 (InputLayer)            [(None, 1024, 1024, 3)]   0

conv2d_46 (Conv2D)              (None, 512, 512, 64)      3136

leaky_re_lu_45 (LeakyReLU)      (None, 512, 512, 64)      0

conv2d_47 (Conv2D)              (None, 256, 256, 128)     131200

instance_normalization_80 (     (None, 256, 256, 128)     256
InstanceNormalization)

leaky_re_lu_46 (LeakyReLU)      (None, 256, 256, 128)     0

conv2d_48 (Conv2D)              (None, 128, 128, 256)     524544

instance_normalization_81 (     (None, 128, 128, 256)     512
InstanceNormalization)

leaky_re_lu_47 (LeakyReLU)      (None, 128, 128, 256)     0

conv2d_49 (Conv2D)              (None, 64, 64, 512)       2097664

instance_normalization_82 (     (None, 64, 64, 512)       1024
InstanceNormalization)

leaky_re_lu_48 (LeakyReLU)      (None, 64, 64, 512)       0

conv2d_50 (Conv2D)              (None, 64, 64, 512)       4194816

instance_normalization_83 (     (None, 64, 64, 512)       1024
InstanceNormalization)

leaky_re_lu_49 (LeakyReLU)      (None, 64, 64, 512)       0

conv2d_51 (Conv2D)              (None, 64, 64, 1)         8193

=================================================================
Total params: 6,962,369
Trainable params: 6,962,369
Non-trainable params: 0
_____
```

**Figure S6**: Discriminator architecture used in the adversarial neural network.

```
_____
Layer (type)                    Output Shape              Param #
=================================================================
input_6 (InputLayer)            [(None, 1024, 1024, 3)]   0

conv2d_46 (Conv2D)              (None, 512, 512, 64)      3136
```