Supplemental Document

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Optical tomography in a single camera frame using fringe-encoded deep-learning full-field OCT: supplement

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OPTICAL TOMOGRAPHY IN A SINGLE CAMERA FRAME USING FRINGE-ENCODED DEEP-LEARNING FULL-FIELD OCT: SUPPLEMENTAL DOCUMENT

U-net architecture:

DynamicUnet

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Layer (type)	Output Shape	Param #	Trainable
Conv2d	[64, 128, 128]	9,408	False
BatchNorm2d	[64, 128, 128]	128	True
ReLU	[64, 128, 128]	0	False
MaxPool2d	[64, 64, 64]	0	False
Conv2d	[64, 64, 64]	36,864	False
BatchNorm2d	[64, 64, 64]	128	True
ReLU	[64, 64, 64]	0	False
Conv2d	[64, 64, 64]	36,864	False
BatchNorm2d	[64, 64, 64]	128	True
Conv2d	[64, 64, 64]	36,864	False
BatchNorm2d	[64, 64, 64]	128	True
ReLU	[64, 64, 64]	0	False

Conv2d	[64, 64, 64]	36,864	False
BatchNorm2d	[64, 64, 64]	128	True
Conv2d	[64, 64, 64]	36,864	False
BatchNorm2d	[64, 64, 64]	128	True
ReLU	[64, 64, 64]	0	False
Conv2d	[64, 64, 64]	36,864	False
BatchNorm2d	[64, 64, 64]	128	True
Conv2d	[128, 32, 32]	73,728	False
BatchNorm2d	[128, 32, 32]	256	True
ReLU	[128, 32, 32]	0	False
Conv2d	[128, 32, 32]	147,456	False
BatchNorm2d	[128, 32, 32]	256	True
Conv2d	[128, 32, 32]	8,192	False
BatchNorm2d	[128, 32, 32]	256	True
Conv2d	[128, 32, 32]	147,456	False
BatchNorm2d	[128, 32, 32]	256	True
ReLU	[128, 32, 32]	0	False

Conv2d	[128, 32, 32]	147,456	False
BatchNorm2d	[128, 32, 32]	256	True
Conv2d	[128, 32, 32]	147,456	False
BatchNorm2d	[128, 32, 32]	256	True
ReLU	[128, 32, 32]	0	False
Conv2d	[128, 32, 32]	147,456	False
BatchNorm2d	[128, 32, 32]	256	True
Conv2d	[128, 32, 32]	147,456	False
BatchNorm2d	[128, 32, 32]	256	True
ReLU	[128, 32, 32]	0	False
Conv2d	[128, 32, 32]	147,456	False
BatchNorm2d	[128, 32, 32]	256	True
Conv2d	[256, 16, 16]	294,912	False
BatchNorm2d	[256, 16, 16]	512	True
ReLU	[256, 16, 16]	0	False
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True

Conv2d	[256, 16, 16]	32,768	False
BatchNorm2d	[256, 16, 16]	512	True
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
ReLU	[256, 16, 16]	0	False
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
ReLU	[256, 16, 16]	0	False
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
ReLU	[256, 16, 16]	0	False
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True

Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
ReLU	[256, 16, 16]	0	False
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
ReLU	[256, 16, 16]	0	False
Conv2d	[256, 16, 16]	589,824	False
BatchNorm2d	[256, 16, 16]	512	True
Conv2d	[512, 8, 8]	1,179,648	False
BatchNorm2d	[512, 8, 8]	1,024	True
ReLU	[512, 8, 8]	0	False
Conv2d	[512, 8, 8]	2,359,296	False
BatchNorm2d	[512, 8, 8]	1,024	True
Conv2d	[512, 8, 8]	131,072	False
BatchNorm2d	[512, 8, 8]	1,024	True

Conv2d	[512, 8, 8]	2,359,296	False
BatchNorm2d	[512, 8, 8]	1,024	True
ReLU	[512, 8, 8]	0	False
Conv2d	[512, 8, 8]	2,359,296	False
BatchNorm2d	[512, 8, 8]	1,024	True
Conv2d	[512, 8, 8]	2,359,296	False
BatchNorm2d	[512, 8, 8]	1,024	True
ReLU	[512, 8, 8]	0	False
Conv2d	[512, 8, 8]	2,359,296	False
BatchNorm2d	[512, 8, 8]	1,024	True
BatchNorm2d	[512, 8, 8]	1,024	True
ReLU	[512, 8, 8]	0	False
Conv2d	[1024, 8, 8]	4,719,616	True
ReLU	[1024, 8, 8]	0	False
Conv2d	[512, 8, 8]	4,719,104	True
ReLU	[512, 8, 8]	0	False
Conv2d	[1024, 8, 8]	525,312	True

PixelShuffle	[256, 16, 16]	0	False
ReplicationPad2d	[256, 17, 17]	0	False
AvgPool2d	[256, 16, 16]	0	False
ReLU	[1024, 8, 8]	0	False
BatchNorm2d	[256, 16, 16]	512	True
Conv2d	[512, 16, 16]	2,359,808	True
ReLU	[512, 16, 16]	0	False
Conv2d	[512, 16, 16]	2,359,808	True
ReLU	[512, 16, 16]	0	False
ReLU	[512, 16, 16]	0	False
Conv2d	[1024, 16, 16]	525,312	True
PixelShuffle	[256, 32, 32]	0	False
ReplicationPad2d	[256, 33, 33]	0	False
AvgPool2d	[256, 32, 32]	0	False
ReLU	[1024, 16, 16]	0	False
BatchNorm2d	[128, 32, 32]	256	True
Conv2d	[384, 32, 32]	1,327,488	True

ReLU	[384, 32, 32]	0	False
Conv2d	[384, 32, 32]	1,327,488	True
ReLU	[384, 32, 32]	0	False
Conv1d	[48, 1024]	18,432	True
Conv1d	[48, 1024]	18,432	True
Conv1d	[384, 1024]	147,456	True
ReLU	[384, 32, 32]	0	False
Conv2d	[768, 32, 32]	295,680	True
PixelShuffle	[192, 64, 64]	0	False
ReplicationPad2d	[192, 65, 65]	0	False
AvgPool2d	[192, 64, 64]	0	False
ReLU	[768, 32, 32]	0	False
BatchNorm2d	[64, 64, 64]	128	True
Conv2d	[256, 64, 64]	590,080	True
ReLU	[256, 64, 64]	0	False
Conv2d	[256, 64, 64]	590,080	True
ReLU	[256, 64, 64]	0	False

ReLU	[256, 64, 64]	0	False
Conv2d	[512, 64, 64]	131,584	True
PixelShuffle	[128, 128, 128]	0	False
ReplicationPad2d	[128, 129, 129]	0	False
AvgPool2d	[128, 128, 128]	0	False
ReLU	[512, 64, 64]	0	False
BatchNorm2d	[64, 128, 128]	128	True
Conv2d	[96, 128, 128]	165,984	True
ReLU	[96, 128, 128]	0	False
Conv2d	[96, 128, 128]	83,040	True
ReLU	[96, 128, 128]	0	False
ReLU	[192, 128, 128]	0	False
Conv2d	[384, 128, 128]	37,248	True
PixelShuffle	[96, 256, 256]	0	False
ReLU	[384, 128, 128]	0	False
MergeLayer	[99, 256, 256]	0	False
Conv2d	[99, 256, 256]	88,308	True

ReLU	[99, 256, 256]	0	False
Conv2d	[99, 256, 256]	88,308	True
ReLU	[99, 256, 256]	0	False
MergeLayer	[99, 256, 256]	0	False
Conv2d	[3, 256, 256]	300	True
SigmoidRange	[3, 256, 256]	0	False

Total params: 41,405,588

Total trainable params: 20,137,940

Total non-trainable params: 21,267,648

Optimized with 'torch.optim.adam.Adam', betas=(0.9, 0.99)

Using true weight decay as discussed in https://www.fast.ai/2018/07/02/adam-weight-decay/

Loss function : FlattenedLoss

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Pix2pix architecture:

Pix2pix generator:

Model: "model"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 256, 256, 3)	0	
sequential_2 (Sequential)	(None, 128, 128, 64)	3072	input_1[0][0]
sequential_3 (Sequential)	(None, 64, 64, 128)	131584	sequential_2[0][0]
sequential_4 (Sequential)	(None, 32, 32, 256)	525312	sequential_3[0][0]
sequential_5 (Sequential)	(None, 16, 16, 512)	2099200	sequential_4[0][0]
sequential_6 (Sequential)	(None, 8, 8, 512)	4196352	sequential_5[0][0]
sequential_7 (Sequential)	(None, 4, 4, 512)	4196352	sequential_6[0][0]
sequential_8 (Sequential)	(None, 2, 2, 512)	4196352	sequential_7[0][0]
sequential_9 (Sequential)	(None, 1, 1, 512)	4196352	sequential_8[0][0]
sequential_10 (Sequential)	(None, 2, 2, 512)	4196352	sequential_9[0][0]

concatenate (Concatenate) (None, 2, 2, 1024) 0 sequential_10[0][0]
sequential_8[0][0]

---

sequential_11 (Sequential) (None, 4, 4, 512) 8390656 concatenate[0][0]

---

concatenate_1 (Concatenate) (None, 4, 4, 1024) 0 sequential_11[0][0]
sequential_7[0][0]

---

sequential_12 (Sequential) (None, 8, 8, 512) 8390656 concatenate_1[0][0]

---

concatenate_2 (Concatenate) (None, 8, 8, 1024) 0 sequential_12[0][0]
sequential_6[0][0]

---

sequential_13 (Sequential) (None, 16, 16, 512) 8390656 concatenate_2[0][0]

---

concatenate_3 (Concatenate) (None, 16, 16, 1024) 0 sequential_13[0][0]
sequential_5[0][0]

---

sequential_14 (Sequential) (None, 32, 32, 256) 4195328 concatenate_3[0][0]

---

concatenate_4 (Concatenate) (None, 32, 32, 512) 0 sequential_14[0][0]
sequential_4[0][0]

---

sequential_15 (Sequential) (None, 64, 64, 128) 1049088 concatenate_4[0][0]

---

concatenate_5 (Concatenate) (None, 64, 64, 256) 0 sequential_15[0][0]
sequential_3[0][0]

```
__________________________________________________________________________________________________
sequential_16 (Sequential)      (None, 128, 128, 64) 262400      concatenate_5[0][0]
__________________________________________________________________________________________________
concatenate_6 (Concatenate)     (None, 128, 128, 128 0           sequential_16[0][0]
                                                                 sequential_2[0][0]
__________________________________________________________________________________________________
conv2d_transpose_8 (Conv2DTrans (None, 256, 256, 3)  6147        concatenate_6[0][0]
==================================================================================================
Total params: 54,425,859
Trainable params: 54,414,979
Non-trainable params: 10,880
```

Pix2pix discriminator:

```
Model: "model_1"
__________________________________________________________________________________________________
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================================
input_image (InputLayer)        [(None, 256, 256, 3) 0
__________________________________________________________________________________________________
target_image (InputLayer)       [(None, 256, 256, 3) 0
__________________________________________________________________________________________________
concatenate_7 (Concatenate)     (None, 256, 256, 6)  0           input_image[0][0]
                                                                 target_image[0][0]
__________________________________________________________________________________________________
sequential_17 (Sequential)      (None, 128, 128, 64) 6144        concatenate_7[0][0]
__________________________________________________________________________________________________
sequential_18 (Sequential)      (None, 64, 64, 128)  131584      sequential_17[0][0]
```

```
__________________________________________________________________________________________________
sequential_19 (Sequential)      (None, 32, 32, 256)  525312      sequential_18[0][0]
__________________________________________________________________________________________________
zero_padding2d (ZeroPadding2D)  (None, 34, 34, 256)  0           sequential_19[0][0]
__________________________________________________________________________________________________
conv2d_12 (Conv2D)              (None, 31, 31, 512)  2097152     zero_padding2d[0][0]
__________________________________________________________________________________________________
batch_normalization_18 (BatchNo (None, 31, 31, 512)  2048        conv2d_12[0][0]
__________________________________________________________________________________________________
leaky_re_lu_12 (LeakyReLU)      (None, 31, 31, 512)  0           batch_normalization_18[0][0]
__________________________________________________________________________________________________
zero_padding2d_1 (ZeroPadding2D (None, 33, 33, 512)  0           leaky_re_lu_12[0][0]
__________________________________________________________________________________________________
conv2d_13 (Conv2D)              (None, 30, 30, 1)    8193        zero_padding2d_1[0][0]
==================================================================================================
Total params: 2,770,433
Trainable params: 2,768,641
Non-trainable params: 1,792
```