**Hybrid T1 ConvNeXt Model Train**

**Development Notes**

**Run # 1 – > Using unbalanced dataset to perform Hybrid T1 model training for 300 epochs!!!**

**Train Report**

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Train code: ConvNeXt\_train\_**1.2**\_WIP.py (adopt **class weights** for imbalance issue of training dataset)

Model saved as: Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_xxE.pth / Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_200'E.pth

Train data: D:/Hybrid\_model\_train/dataset\_v1.0/T1/train/ (NG: **8070**; OK: **12833**) –> after manual data cleaning

Val data: D:/TBR\_model\_train/dataset\_v1.0/T1/val/ (NG: **1008**; OK: **1608**) –> after manual data cleaning

Pre-trained model: None

**Class Weights to Balance Train Dataset = tensor([1.2951, 0.8144])**

Training device: cuda:0

Training started at: 2024-08-23 20:43:22

**Epoch 1/300**

Training Loss: 0.2093, Training Accuracy: 0.9325| 327/327 [06:41<00:00, 1.23s/it]

Validation Loss: 0.1329, Validation Accuracy: 0.9534| 41/41 [00:52<00:00, 1.27s/it]

Best model saved with accuracy: 0.9534

**Epoch 2/300**

Training Loss: 0.1397, Training Accuracy: 0.9535| 327/327 [06:46<00:00, 1.24s/it]

Validation Loss: 0.1150, Validation Accuracy: 0.9568| 41/41 [00:41<00:00, 1.01s/it]

Best model saved with accuracy: 0.9568

**Epoch 3/300**

Training Loss: 0.1252, Training Accuracy: 0.9588| 327/327 [06:43<00:00, 1.24s/it]

Validation Loss: 0.1016, Validation Accuracy: 0.9629| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9629

**Epoch 4/300**

Training Loss: 0.1193, Training Accuracy: 0.9615| 327/327 [06:43<00:00, 1.23s/it]

Validation Loss: 0.0941, Validation Accuracy: 0.9652| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: 0.9652

**Epoch 5/300**

Training Loss: 0.1105, Training Accuracy: 0.9632| 327/327 [06:42<00:00, 1.23s/it]

Validation Loss: 0.0882, Validation Accuracy: 0.9667| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: 0.9667

**Epoch 6/300**

Training Loss: 0.1088, Training Accuracy: 0.9631| 327/327 [06:41<00:00, 1.23s/it]

Validation Loss: 0.0833, Validation Accuracy: 0.9706| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9706

**Epoch 8/300**

Training Loss: 0.1037, Training Accuracy: 0.9659| 327/327 [06:40<00:00, 1.23s/it]

Validation Loss: 0.0791, Validation Accuracy: 0.9713| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9713

**Epoch 10/300**

Training Loss: 0.0981, Training Accuracy: 0.9671| 327/327 [06:40<00:00, 1.22s/it]

Validation Loss: 0.0809, Validation Accuracy: 0.9729| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9729

**Epoch 12/300**

Training Loss: 0.0965, Training Accuracy: 0.9680| 327/327 [06:40<00:00, 1.23s/it]

Validation Loss: 0.0710, Validation Accuracy: 0.9752| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9752

**Epoch 13/300**

Training Loss: 0.0952, Training Accuracy: 0.9681| 327/327 [06:42<00:00, 1.23s/it]

Validation Loss: 0.0712, Validation Accuracy: 0.9771| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: 0.9771

**Epoch 16/300**

Training Loss: 0.0934, Training Accuracy: 0.9689| 327/327 [07:30<00:00, 1.38s/it]

Validation Loss: 0.0662, Validation Accuracy: 0.9782| 41/41 [00:50<00:00, 1.23s/it]

Best model saved with accuracy: 0.9782

**Epoch 18/300**

Training Loss: 0.0937, Training Accuracy: 0.9687| 327/327 [06:42<00:00, 1.23s/it]

Validation Loss: 0.0647, Validation Accuracy: 0.9794| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9794

**Epoch 24/300**

Training Loss: 0.0872, Training Accuracy: 0.9709| 327/327 [06:40<00:00, 1.23s/it]

Validation Loss: 0.0630, Validation Accuracy: 0.9809| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9809

**Epoch 35/300**

Training Loss: 0.0826, Training Accuracy: 0.9725| 327/327 [06:38<00:00, 1.22s/it]

Validation Loss: 0.0588, Validation Accuracy: 0.9820| 41/41 [00:40<00:00, 1.02it/s]

Best model saved with accuracy: 0.9820

**Epoch 45/300**

Training Loss: 0.0804, Training Accuracy: 0.9731| 327/327 [06:39<00:00, 1.22s/it]

Validation Loss: 0.0572, Validation Accuracy: 0.9828| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: 0.9828

**Epoch 55/300**

Training Loss: 0.0804, Training Accuracy: 0.9726| 327/327 [06:40<00:00, 1.23s/it]

Validation Loss: 0.0545, Validation Accuracy: 0.9839| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: 0.9839

**Epoch 58/300**

Training Loss: 0.0796, Training Accuracy: 0.9730| 327/327 [06:40<00:00, 1.23s/it]

Validation Loss: 0.0562, Validation Accuracy: 0.9843| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: 0.9843

**Epoch 80/300**

Training Loss: 0.0785, Training Accuracy: 0.9754| 327/327 [06:43<00:00, 1.23s/it]

Validation Loss: 0.0521, Validation Accuracy: 0.9851| 41/41 [00:41<00:00, 1.00s/it]

Best model saved with accuracy: 0.9851

**Epoch 91/300**

Training Loss: 0.0755, Training Accuracy: 0.9744| 327/327 [06:50<00:00, 1.26s/it]

Validation Loss: 0.0527, Validation Accuracy: 0.9855| 41/41 [00:42<00:00, 1.04s/it]

Best model saved with accuracy: 0.9855

**Epoch 105/300**

Training Loss: 0.0734, Training Accuracy: 0.9760| 327/327 [06:40<00:00, 1.23s/it]

Validation Loss: 0.0606, Validation Accuracy: 0.9805| 41/41 [00:40<00:00, 1.02it/s]

**Epoch 106/300**

Training Loss: 0.0751, Training Accuracy: 0.9758| 327/327 [06:40<00:00, 1.22s/it]

Validation Loss: 0.0510, Validation Accuracy: 0.9859| 41/41 [00:40<00:00, 1.00it/s]

Best model saved with accuracy: 0.9859

**Epoch 111/300**

Training Loss: 0.0699, Training Accuracy: 0.9761| 327/327 [06:38<00:00, 1.22s/it]

Validation Loss: 0.0515, Validation Accuracy: 0.9862| 41/41 [00:40<00:00, 1.02it/s]

Best model saved with accuracy: 0.9862

**Epoch 135/300**

Training Loss: 0.0749, Training Accuracy: 0.9754| 327/327 [06:44<00:00, 1.24s/it]

Validation Loss: 0.0504, Validation Accuracy: 0.9866| 41/41 [00:41<00:00, 1.00s/it]

Best model saved with accuracy: 0.9866

**Epoch 144/300**

Training Loss: 0.0736, Training Accuracy: 0.9758| 327/327 [06:42<00:00, 1.23s/it]

Validation Loss: 0.0486, Validation Accuracy: 0.9870| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: 0.9870

**Epoch 225/300**

Training Loss: 0.0729, Training Accuracy: 0.9757| 327/327 [06:35<00:00, 1.21s/it]

Validation Loss: 0.0478, Validation Accuracy: 0.9874| 41/41 [00:40<00:00, 1.01it/s]

Best model saved with accuracy: **0.9874**

**Epoch 300/300**

Training Loss: 0.0703, Training Accuracy: 0.9766| 327/327 [06:33<00:00, 1.20s/it]

Validation Loss: 0.0473, Validation Accuracy: 0.9855| 41/41 [00:40<00:00, 1.02it/s]

Training complete. Best/final model and optimizer saved successfully!

Training finished at: 2024-08-25 10:44:00

Total elapsed training time: **1d 14h 0m 38s**

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自動產生的描述

**Using Hybrid T1 model retest** **the previous T1 test dataset of both PCR and TBR to see any differences???**

**Test Report -- > PCR T1 (Tread)**

**---------------------------------------------------------------------------------------------------------------------------------------------**

Test code: ConvNeXt\_edge\_test\_1.0\_WIP.py

Threshold = **0.1**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| T1\_ConvNeXt\_best\_model\_FZ\_14E.pth | 500 | | 60 | |
| 484 | **16** | 59 | **1** |
| T1\_ConvNeXt\_final\_model\_FZ\_20E.pth | 500 | | 60 | |
| 483 | **17** | 57 | **3** |
| Accuracy (14E): **96.96%**  Accuracy (20E): **96.42%** | | | | |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 500 | | 6060 | |
| 487 | **13** | 56 | **4** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 500 | | 6060 | |
| 488 | **12** | 56 | **4** |
| Accuracy (225E): **96.96%**  Accuracy (300E): **97.14%** | | | | |

Threshold = **0.15**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| T1\_ConvNeXt\_best\_model\_FZ\_14E.pth | 500 | | 60 | |
| 490 | **10** | 57 | **3** |
| T1\_ConvNeXt\_final\_model\_FZ\_20E.pth | 500 | | 60 | |
| 486 | **14** | 57 | **3** |

Accuracy (14E): **97.67%**

Accuracy (20E): **96.96%**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 500 | | 6060 | |
| 492 | **8** | 56 | **4** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 500 | | 6060 | |
| 492 | **8** | 56 | **4** |
| Accuracy (225E): **97.85%**  Accuracy (300E): **97.85%** | | | | |

Threshold = **0.2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| T1\_ConvNeXt\_best\_model\_FZ\_14E.pth | 500 | | 60 | |
| 493 | **7** | 56 | **4** |
| T1\_ConvNeXt\_final\_model\_FZ\_20E.pth | 500 | | 60 | |
| 489 | **11** | 55 | **5** |

Accuracy (14E): **98.03%**

Accuracy (20E): **97.14%**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 500 | | 6060 | |
| 492 | **8** | 56 | **4** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 500 | | 6060 | |
| 492 | **8** | 56 | **4** |
| Accuracy (225E): **97.85%**  Accuracy (300E): **97.85%** | | | | |

**98.03% (PCR\_T1) vs.97.85% (Hybrid T1).**

**Test Report -- > TBR T1 (Tread)**

**---------------------------------------------------------------------------------------------------------------------------------------------**

Test code: ConvNeXt\_edge\_test\_1.0\_WIP.py

Threshold = **0.1** (Total test images: 756)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| TBR\_T1\_ConvNeXt\_best\_model\_UFZ\_120E.pth | 444 | | 312 | |
| 421 | **23** | 311 | **1** |
| TBR\_T1\_ConvNeXt\_final\_model\_UFZ\_200E.pth | 444 | | 312 | |
| 427 | **17** | 311 | **1** |

Accuracy (120E): **96.82%**

Accuracy (200E): **97.61%**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 444 | | 312 | |
| 428 | **16** | 311 | **1** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 444 | | 312 | |
| 427 | **17** | 312 | **0** |
| Accuracy (225E): **97.75%**  Accuracy (300E): **97.75% -- > underkill較低，效果較佳!!!** | | | | |

Threshold = **0.2** (Total test images: 756)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| TBR\_T1\_ConvNeXt\_best\_model\_UFZ\_120E.pth | 444 | | 312 | |
| 432 | **12** | 311 | **1** |
| TBR\_T1\_ConvNeXt\_final\_model\_UFZ\_200E.pth | 444 | | 312 | |
| 429 | **15** | 311 | **1** |

Accuracy (120E): **98.28%**

Accuracy (200E): **97.88%**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 444 | | 312 | |
| 437 | **7** | 310 | **2** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 444 | | 312 | |
| 437 | **7** | 310 | **2** |
| Accuracy (225E): **98.80%**  Accuracy (300E): **98.80%** | | | | |

Threshold = **0.3** (Total test images: 756)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| TBR\_T1\_ConvNeXt\_best\_model\_UFZ\_120E.pth | 444 | | 312 | |
| 435 | **9** | 311 | **1** |
| TBR\_T1\_ConvNeXt\_final\_model\_UFZ\_200E.pth | 444 | | 312 | |
| 433 | **11** | 311 | **1** |

Accuracy (120E): **98.67%**

Accuracy (200E): **98.41%**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 444 | | 312 | |
| 440 | **4** | 309 | **3** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 444 | | 312 | |
| 440 | **4** | 310 | **2** |
| Accuracy (225E): **99.07%**  Accuracy (300E): **99.20%** | | | | |

Threshold = **0.4** (Total test images: 756)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| TBR\_T1\_ConvNeXt\_best\_model\_UFZ\_120E.pth | 444 | | 312 | |
| 436 | **8** | 311 | **1** |
| TBR\_T1\_ConvNeXt\_final\_model\_UFZ\_200E.pth | 444 | | 312 | |
| 435 | **9** | 311 | **1** |

Accuracy (120E): **98.80%**

Accuracy (200E): **98.67%**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 444 | | 312 | |
| 441 | **3** | 309 | **3** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 444 | | 312 | |
| 441 | **3** | 309 | **3** |
| Accuracy (225E): **99.20%**  Accuracy (300E): **99.20% -- > 此為hybrid T1 model的最佳方案 (Threshold=0.4) !!!** | | | | |

Threshold = **0.5** (Total test images: 756)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| TBR\_T1\_ConvNeXt\_best\_model\_UFZ\_120E.pth | 444 | | 312 | |
| 440 | **4** | 309 | **3** |
| TBR\_T1\_ConvNeXt\_final\_model\_UFZ\_200E.pth | 444 | | 312 | |
| 438 | **6** | 311 | **1** |

Accuracy (120E): **99.07%**

Accuracy (200E): **99.07% -- > underkill較低，效果較佳!!!**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 444 | | 312 | |
| 441 | **3** | 308 | **4** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 444 | | 312 | |
| 441 | **3** | 308 | **4** |
| Accuracy (225E): **99.07%**  Accuracy (300E): **99.07%** | | | | |

Threshold = **0.6** (Total test images: 756)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| TBR\_T1\_ConvNeXt\_best\_model\_UFZ\_120E.pth | 444 | | 312 | |
| 440 | **4** | 308 | **4** |
| TBR\_T1\_ConvNeXt\_final\_model\_UFZ\_200E.pth | 444 | | 312 | |
| 439 | **5** | 308 | **4** |

Accuracy (120E): **98.94%**

Accuracy (200E): **98.80%**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 444 | | 312 | |
| 442 | **2** | 308 | **4** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 444 | | 312 | |
| 441 | **3** | 308 | **4** |
| Accuracy (225E): **99.20%**  Accuracy (300E): **99.07%** | | | | |

**99.07% (TBR\_T1) vs.99.20% (Hybrid T1).**

**Using Hybrid T1 model to test against edge test dataset!!!**

Threshold = **0.4** (Total test images: 5221)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 3203 | | 2018 | |
| 3156 | **47** | 1985 | **33** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 3203 | | 2018 | |
| 3155 | **48** | 1987 | **31** |
| Accuracy (225E): **98.46%**  Accuracy (300E): **98.48%** | | | | |

Threshold = **0.35** (Total test images: 5221)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 3203 | | 2018 | |
| 3150 | **53** | 1988 | **30** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 3203 | | 2018 | |
| 3148 | **55** | 1988 | **30** |
| Accuracy (225E): **98.41%**  Accuracy (300E): **98.37%** | | | | |

Threshold = **0.3** (Total test images: 5221)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 3203 | | 2018 | |
| 3135 | **68** | 1994 | **24** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 3203 | | 2018 | |
| 3134 | **69** | 1995 | **23** |
| Accuracy (225E): **98.23%**  Accuracy (300E): **98.23% -- > 此為hybrid T1 model的最佳方案 (Threshold=0.30) !!!** | | | | |

Threshold = **0.25** (Total test images: 5221)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Model** | **OK Test Images** | | **NG Test Images** | |
| **OK** | **NG (Overkill)** | **NG** | **OK (Underkill)** |
| Hybrid\_T1\_ConvNeXt\_best\_model\_UFZ\_225E.pth | 3203 | | 2018 | |
| 3125 | **78** | 1996 | **22** |
| Hybrid\_T1\_ConvNeXt\_final\_model\_UFZ\_300E.pth | 3203 | | 2018 | |
| 3125 | **78** | 1996 | **22** |
| Accuracy (225E): **98.08%**  Accuracy (300E): **98.08%** | | | | |

**Best 98.48% (Hybrid T1)**