SMOTETomekOverSample

May 4, 2022

[1]:
```
import warnings
warnings.filterwarnings('ignore')

from glob import glob
import pandas as pd
import numpy as np
from tqdm import tqdm
import cv2

import os
import timm
import random

import torch
from torch.utils.data import Dataset, DataLoader
import torch.nn as nn
import torchvision.transforms as transforms
from sklearn.metrics import f1_score, accuracy_score
import time
import import_ipynb
#from data_undersampling import undersampling1
#from data_oversampling import *
from data_augmentation import *
device = torch.device('cuda')
```

```
importing Jupyter notebook from data_augmentation.ipynb
```

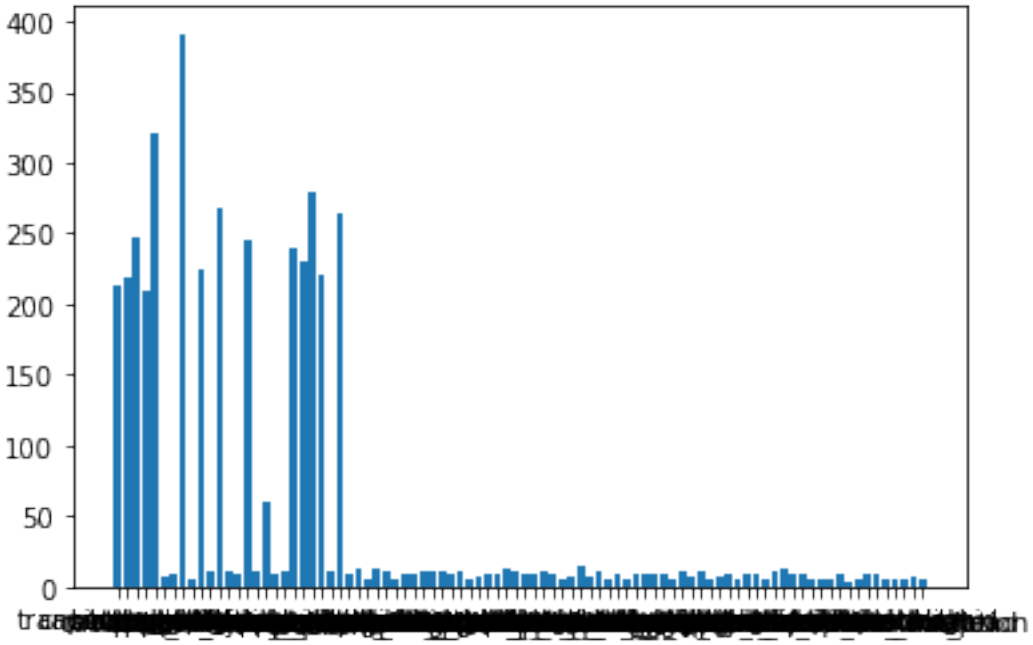
[2]:
```
# SMOTE oversampling
overdata = data_augmentation("./data/train_df.csv")
y = overdata[1]
```

```
Counter({'hazelnut-good': 391, 'screw-good': 320, 'carpet-good': 280, 'pill-
good': 267, 'grid-good': 264, 'wood-good': 247, 'leather-good': 245, 'zipper-
good': 240, 'tile-good': 230, 'cable-good': 224, 'metal_nut-good': 220,
'capsule-good': 219, 'transistor-good': 213, 'bottle-good': 209, 'toothbrush-
good': 60, 'toothbrush-defective': 15, 'pill-crack': 13, 'pill-color': 13,
'screw-scratch_neck': 13, 'metal_nut-bent': 13, 'metal_nut-scratch': 12, 'screw-
thread_side': 12, 'pill-scratch': 12, 'screw-manipulated_front': 12, 'screw-
thread_top': 12, 'capsule-crack': 12, 'metal_nut-flip': 12, 'screw-
```

scratch_head': 12, 'capsule-scratch': 12, 'bottle-contamination': 11, 'capsule-poke': 11, 'metal_nut-color': 11, 'bottle-broken_small': 11, 'pill-contamination': 11, 'wood-scratch': 11, 'capsule-faulty_imprint': 11, 'capsule-squeeze': 10, 'bottle-broken_large': 10, 'leather-cut': 10, 'carpet-thread': 10, 'pill-faulty_imprint': 10, 'leather-glue': 10, 'carpet-color': 10, 'zipper-broken_teeth': 10, 'leather-color': 10, 'carpet-hole': 9, 'zipper-fabric_border': 9, 'hazelnut-crack': 9, 'zipper-split_teeth': 9, 'zipper-rough': 9, 'carpet-metal_contamination': 9, 'leather-fold': 9, 'tile-glue_strip': 9, 'hazelnut-cut': 9, 'hazelnut-hole': 9, 'leather-poke': 9, 'pill-combined': 9, 'hazelnut-print': 9, 'tile-oil': 9, 'carpet-cut': 9, 'tile-crack': 9, 'zipper-fabric_interior': 8, 'zipper-squeezed_teeth': 8, 'tile-gray_stroke': 8, 'zipper-combined': 8, 'tile-rough': 8, 'cable-bent_wire': 7, 'cable-cut_inner_insulation': 7, 'wood-combined': 6, 'cable-missing_cable': 6, 'grid-broken': 6, 'grid-glue': 6, 'grid-bent': 6, 'cable-combined': 6, 'grid-thread': 6, 'grid-metal_contamination': 6, 'cable-cable_swap': 6, 'pill-pill_type': 5, 'transistor-bent_lead': 5, 'cable-cut_outer_insulation': 5, 'cable-missing_wire': 5, 'transistor-damaged_case': 5, 'transistor-misplaced': 5, 'cable-poke_insulation': 5, 'transistor-cut_lead': 5, 'wood-hole': 5, 'wood-liquid': 5, 'wood-color': 4})
Class=transistor-good, n=213 (4.980%)
Class=capsule-good, n=219 (5.120%)
Class=wood-good, n=247 (5.775%)
Class=bottle-good, n=209 (4.887%)
Class=screw-good, n=320 (7.482%)
Class=cable-bent_wire, n=7 (0.164%)
Class=carpet-hole, n=9 (0.210%)
Class=hazelnut-good, n=391 (9.142%)
Class=pill-pill_type, n=5 (0.117%)
Class=cable-good, n=224 (5.237%)
Class=metal_nut-scratch, n=12 (0.281%)
Class=pill-good, n=267 (6.243%)
Class=screw-thread_side, n=12 (0.281%)
Class=zipper-fabric_border, n=9 (0.210%)
Class=leather-good, n=245 (5.728%)
Class=pill-scratch, n=12 (0.281%)
Class=toothbrush-good, n=60 (1.403%)
Class=hazelnut-crack, n=9 (0.210%)
Class=screw-manipulated_front, n=12 (0.281%)
Class=zipper-good, n=240 (5.611%)
Class=tile-good, n=230 (5.378%)
Class=carpet-good, n=280 (6.547%)
Class=metal_nut-good, n=220 (5.144%)
Class=bottle-contamination, n=11 (0.257%)
Class=grid-good, n=264 (6.173%)
Class=zipper-split_teeth, n=9 (0.210%)
Class=pill-crack, n=13 (0.304%)
Class=wood-combined, n=6 (0.140%)
Class=pill-color, n=13 (0.304%)

Class=screw-thread_top, n=12 (0.281%)
Class=cable-missing_cable, n=6 (0.140%)
Class=capsule-squeeze, n=10 (0.234%)
Class=zipper-rough, n=9 (0.210%)
Class=capsule-crack, n=12 (0.281%)
Class=capsule-poke, n=11 (0.257%)
Class=metal_nut-flip, n=12 (0.281%)
Class=carpet-metal_contamination, n=9 (0.210%)
Class=metal_nut-color, n=11 (0.257%)
Class=transistor-bent_lead, n=5 (0.117%)
Class=zipper-fabric_interior, n=8 (0.187%)
Class=leather-fold, n=9 (0.210%)
Class=tile-glue_strip, n=9 (0.210%)
Class=screw-scratch_neck, n=13 (0.304%)
Class=screw-scratch_head, n=12 (0.281%)
Class=hazelnut-cut, n=9 (0.210%)
Class=bottle-broken_large, n=10 (0.234%)
Class=bottle-broken_small, n=11 (0.257%)
Class=leather-cut, n=10 (0.234%)
Class=cable-cut_outer_insulation, n=5 (0.117%)
Class=zipper-squeezed_teeth, n=8 (0.187%)
Class=toothbrush-defective, n=15 (0.351%)
Class=cable-cut_inner_insulation, n=7 (0.164%)
Class=pill-contamination, n=11 (0.257%)
Class=cable-missing_wire, n=5 (0.117%)
Class=carpet-thread, n=10 (0.234%)
Class=grid-broken, n=6 (0.140%)
Class=pill-faulty_imprint, n=10 (0.234%)
Class=hazelnut-hole, n=9 (0.210%)
Class=leather-glue, n=10 (0.234%)
Class=leather-poke, n=9 (0.210%)
Class=transistor-damaged_case, n=5 (0.117%)
Class=wood-scratch, n=11 (0.257%)
Class=tile-gray_stroke, n=8 (0.187%)
Class=capsule-faulty_imprint, n=11 (0.257%)
Class=grid-glue, n=6 (0.140%)
Class=zipper-combined, n=8 (0.187%)
Class=carpet-color, n=10 (0.234%)
Class=grid-bent, n=6 (0.140%)
Class=pill-combined, n=9 (0.210%)
Class=hazelnut-print, n=9 (0.210%)
Class=cable-combined, n=6 (0.140%)
Class=capsule-scratch, n=12 (0.281%)
Class=metal_nut-bent, n=13 (0.304%)
Class=zipper-broken_teeth, n=10 (0.234%)
Class=tile-oil, n=9 (0.210%)
Class=transistor-misplaced, n=5 (0.117%)
Class=grid-thread, n=6 (0.140%)

```
Class=grid-metal_contamination, n=6 (0.140%)
Class=carpet-cut, n=9 (0.210%)
Class=wood-color, n=4 (0.094%)
Class=cable-cable_swap, n=6 (0.140%)
Class=tile-crack, n=9 (0.210%)
Class=leather-color, n=10 (0.234%)
Class=cable-poke_insulation, n=5 (0.117%)
Class=transistor-cut_lead, n=5 (0.117%)
Class=wood-hole, n=5 (0.117%)
Class=tile-rough, n=8 (0.187%)
Class=wood-liquid, n=5 (0.117%)
```




```
Counter({'cable-bent_wire': 164, 'zipper-fabric_border': 163, 'leather-poke':
161, 'zipper-rough': 160, 'leather-fold': 160, 'carpet-color': 155, 'pill-
faulty_imprint': 154, 'wood-good': 153, 'grid-thread': 153, 'carpet-
metal_contamination': 153, 'screw-good': 150, 'metal_nut-scratch': 150,
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'zipper-split_teeth': 149, 'metal_nut-flip': 149, 'wood-liquid': 149, 'leather-
good': 148, 'capsule-squeeze': 148, 'toothbrush-good': 148, 'zipper-
broken_teeth': 148, 'screw-thread_top': 148, 'leather-color': 148, 'cable-
cut_outer_insulation': 147, 'bottle-contamination': 147, 'cable-combined': 147,
'grid-broken': 146, 'hazelnut-hole': 146, 'transistor-bent_lead': 146, 'capsule-
crack': 145, 'zipper-combined': 145, 'pill-scratch': 144, 'bottle-broken_large':
144, 'carpet-cut': 144, 'zipper-fabric_interior': 143, 'hazelnut-crack': 142,
'grid-glue': 142, 'tile-rough': 141, 'cable-poke_insulation': 141, 'transistor-
good': 140, 'screw-thread_side': 140, 'bottle-good': 140, 'bottle-broken_small':
```

140, 'transistor-misplaced': 140, 'transistor-cut_lead': 139, 'metal_nut-good': 138, 'tile-good': 138, 'leather-cut': 138, 'cable-cable_swap': 138, 'capsule-good': 136, 'carpet-good': 136, 'zipper-good': 136, 'grid-bent': 136, 'hazelnut-print': 136, 'carpet-thread': 136, 'wood-scratch': 135, 'screw-scratch_neck': 135, 'cable-missing_wire': 134, 'pill-crack': 134, 'cable-cut_inner_insulation': 134, 'tile-crack': 134, 'cable-good': 133, 'grid-metal_contamination': 133, 'zipper-squeezed_teeth': 133, 'pill-good': 132, 'pill-color': 132, 'pill-combined': 132, 'metal_nut-color': 131, 'leather-glue': 131, 'pill-contamination': 131, 'capsule-scratch': 131, 'capsule-faulty_imprint': 131, 'tile-glue_strip': 131, 'carpet-hole': 130, 'cable-missing_cable': 130, 'toothbrush-defective': 130, 'screw-scratch_head': 130, 'pill-pill_type': 130, 'wood-hole': 130, 'hazelnut-good': 129, 'transistor-damaged_case': 128, 'tile-oil': 127, 'capsule-poke': 127, 'grid-good': 126, 'hazelnut-cut': 125, 'wood-color': 118, 'wood-combined': 115})
Class=transistor-good, n=140 (1.135%)
Class=capsule-good, n=136 (1.102%)
Class=wood-good, n=153 (1.240%)
Class=screw-good, n=150 (1.216%)
Class=cable-bent_wire, n=164 (1.329%)
Class=carpet-hole, n=130 (1.053%)
Class=hazelnut-good, n=129 (1.045%)
Class=metal_nut-scratch, n=150 (1.216%)
Class=pill-good, n=132 (1.070%)
Class=screw-thread_side, n=140 (1.135%)
Class=zipper-fabric_border, n=163 (1.321%)
Class=leather-good, n=148 (1.199%)
Class=cable-good, n=133 (1.078%)
Class=carpet-good, n=136 (1.102%)
Class=metal_nut-good, n=138 (1.118%)
Class=grid-good, n=126 (1.021%)
Class=bottle-good, n=140 (1.135%)
Class=zipper-good, n=136 (1.102%)
Class=hazelnut-crack, n=142 (1.151%)
Class=cable-missing_cable, n=130 (1.053%)
Class=pill-color, n=132 (1.070%)
Class=capsule-squeeze, n=148 (1.199%)
Class=zipper-rough, n=160 (1.297%)
Class=capsule-crack, n=145 (1.175%)
Class=tile-good, n=138 (1.118%)
Class=metal_nut-color, n=131 (1.062%)
Class=zipper-fabric_interior, n=143 (1.159%)
Class=toothbrush-good, n=148 (1.199%)
Class=leather-cut, n=138 (1.118%)
Class=cable-cut_outer_insulation, n=147 (1.191%)
Class=toothbrush-defective, n=130 (1.053%)
Class=bottle-broken_small, n=140 (1.135%)
Class=cable-missing_wire, n=134 (1.086%)
Class=pill-faulty_imprint, n=154 (1.248%)

Class=leather-glue, n=131 (1.062%)
Class=screw-scratch_head, n=130 (1.053%)
Class=transistor-damaged_case, n=128 (1.037%)
Class=pill-crack, n=134 (1.086%)
Class=wood-scratch, n=135 (1.094%)
Class=screw-scratch_neck, n=135 (1.094%)
Class=zipper-combined, n=145 (1.175%)
Class=grid-bent, n=136 (1.102%)
Class=pill-combined, n=132 (1.070%)
Class=zipper-split_teeth, n=149 (1.207%)
Class=metal_nut-flip, n=149 (1.207%)
Class=pill-scratch, n=144 (1.167%)
Class=leather-poke, n=161 (1.305%)
Class=bottle-contamination, n=147 (1.191%)
Class=pill-contamination, n=131 (1.062%)
Class=zipper-broken_teeth, n=148 (1.199%)
Class=hazelnut-print, n=136 (1.102%)
Class=carpet-thread, n=136 (1.102%)
Class=tile-oil, n=127 (1.029%)
Class=hazelnut-cut, n=125 (1.013%)
Class=grid-metal_contamination, n=133 (1.078%)
Class=bottle-broken_large, n=144 (1.167%)
Class=grid-broken, n=146 (1.183%)
Class=hazelnut-hole, n=146 (1.183%)
Class=capsule-scratch, n=131 (1.062%)
Class=zipper-squeezed_teeth, n=133 (1.078%)
Class=metal_nut-bent, n=150 (1.216%)
Class=screw-thread_top, n=148 (1.199%)
Class=carpet-cut, n=144 (1.167%)
Class=capsule-faulty_imprint, n=131 (1.062%)
Class=grid-glue, n=142 (1.151%)
Class=grid-thread, n=153 (1.240%)
Class=capsule-poke, n=127 (1.029%)
Class=leather-color, n=148 (1.199%)
Class=pill-pill_type, n=130 (1.053%)
Class=transistor-bent_lead, n=146 (1.183%)
Class=cable-cut_inner_insulation, n=134 (1.086%)
Class=tile-rough, n=141 (1.143%)
Class=transistor-misplaced, n=140 (1.135%)
Class=tile-gray_stroke, n=150 (1.216%)
Class=cable-combined, n=147 (1.191%)
Class=wood-combined, n=115 (0.932%)
Class=cable-cable_swap, n=138 (1.118%)
Class=tile-crack, n=134 (1.086%)
Class=transistor-cut_lead, n=139 (1.126%)
Class=wood-liquid, n=149 (1.207%)
Class=tile-glue_strip, n=131 (1.062%)
Class=leather-fold, n=160 (1.297%)

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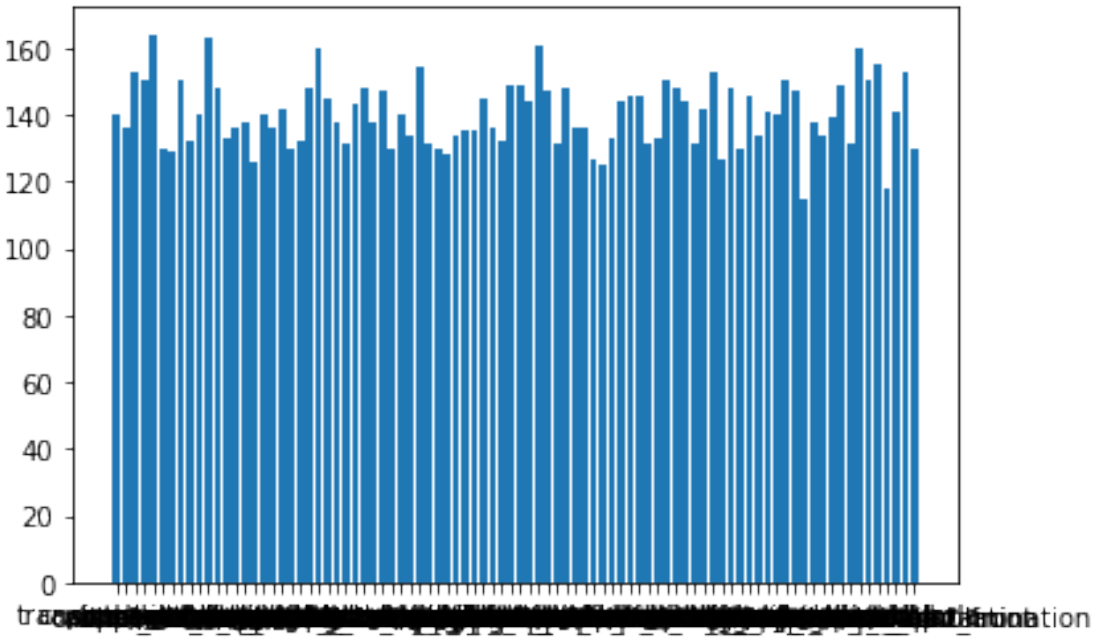
Class=screw-manipulated_front, n=150 (1.216%)
Class=carpet-color, n=155 (1.256%)
Class=wood-color, n=118 (0.956%)
Class=cable-poke_insulation, n=141 (1.143%)
Class=carpet-metal_contamination, n=153 (1.240%)
Class=wood-hole, n=130 (1.053%)
```




```
oversampling      :  [134, 129, 136, -69, 157, 132, 141, 127, 142, -91, 124,
129, 136, 133, 120, -83, 116, 119, 138, 145, 135, -144, 121, 144, 126, 130, 140,
136, -138, 127, 147, 133, 116, -262, 137, 127, 138, 128, 151, 121, -97, 152,
137, 120, 137, -82, 138, 119, 123, 120, 121, 144, -135, 125, 132, -170, 138,
118, 122, 128, 136, 125, 122, -92, 142, 118, 133, 115, 88, 141, 134, 123, -73,
135, 114, 109, -94, 125, 144, 124, 138, 137, 154, 135, -104, 151, 140, 125]
total num :  88

1 : bottle-broken_large label's deleting process:
100%|                  | 8/8 [00:00<00:00, 7790.67it/s]
1 : bottle-broken_large label's augmentation process:
100%|              | 142/142 [00:15<00:00,  9.09it/s]
2 : bottle-broken_small label's deleting process:
100%|                  | 5/5 [00:00<00:00, 5008.72it/s]
2 : bottle-broken_small label's augmentation process:
100%|              | 134/134 [00:16<00:00,  8.35it/s]
3 : bottle-contamination label's deleting process:
100%|                 | 8/8 [00:00<00:00, 3950.37it/s]
3 : bottle-contamination label's augmentation process:
100%|              | 144/144 [00:19<00:00,  7.45it/s]
```

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4 : bottle-good label's deleting process:
100%|                    | 138/138 [00:00<00:00, 5130.78it/s]
4 : bottle-good label's augmentation process:
100%|                    | 69/69 [00:08<00:00,  7.90it/s]
5 : cable-bent_wire label's deleting process:
100%|                          | 3/3 [00:00<?, ?it/s]
5 : cable-bent_wire label's augmentation process:
100%|                 | 160/160 [00:47<00:00,  3.38it/s]
6 : cable-cable_swap label's deleting process:
100%|                    | 5/5 [00:00<00:00, 4949.62it/s]
6 : cable-cable_swap label's augmentation process:
100%|                | 137/137 [00:42<00:00,  3.24it/s]
7 : cable-combined label's deleting process:
100%|                     | 2/2 [00:00<00:00, 2004.93it/s]
7 : cable-combined label's augmentation process:
100%|                 | 143/143 [00:42<00:00,  3.34it/s]
8 : cable-cut_inner_insulation label's deleting process:
100%|              | 6/6 [00:00<00:00, 2968.02it/s]
8 : cable-cut_inner_insulation label's augmentation process:
100%|          | 133/133 [00:38<00:00,  3.50it/s]
9 : cable-cut_outer_insulation label's deleting process:
100%|                    | 1/1 [00:00<?, ?it/s]
9 : cable-cut_outer_insulation label's augmentation process:
100%|          | 143/143 [00:39<00:00,  3.60it/s]
10 : cable-good label's deleting process:
100%|                    | 152/152 [00:00<00:00, 4233.52it/s]
10 : cable-good label's augmentation process:
100%|                    | 61/61 [00:21<00:00,  2.87it/s]
11 : cable-missing_cable label's deleting process:
100%|                  | 4/4 [00:00<00:00, 4120.14it/s]
11 : cable-missing_cable label's augmentation process:
100%|              | 128/128 [00:30<00:00,  4.15it/s]
12 : cable-missing_wire label's deleting process:
100%|                   | 4/4 [00:00<00:00, 3965.31it/s]
12 : cable-missing_wire label's augmentation process:
100%|               | 133/133 [00:41<00:00,  3.20it/s]
13 : cable-poke_insulation label's deleting process:
100%|                | 5/5 [00:00<00:00, 4955.46it/s]
13 : cable-poke_insulation label's augmentation process:
100%|             | 141/141 [00:44<00:00,  3.18it/s]
14 : capsule-crack label's deleting process:
100%|                     | 8/8 [00:00<00:00, 2542.00it/s]
14 : capsule-crack label's augmentation process:
100%|                  | 141/141 [00:42<00:00,  3.30it/s]
15 : capsule-faulty_imprint label's deleting process:
100%|                | 8/8 [00:00<00:00, 4010.81it/s]
15 : capsule-faulty_imprint label's augmentation process:
100%|            | 128/128 [00:34<00:00,  3.66it/s]
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16 : capsule-good label's deleting process:
100%|                  | 146/146 [00:00<00:00, 3326.90it/s]
16 : capsule-good label's augmentation process:
100%|                  | 63/63 [00:15<00:00,  4.10it/s]
17 : capsule-poke label's deleting process:
100%|                    | 8/8 [00:00<00:00, 2699.91it/s]
17 : capsule-poke label's augmentation process:
100%|                 | 124/124 [00:35<00:00,  3.45it/s]
18 : capsule-scratch label's deleting process:
100%|                       | 4/4 [00:00<?, ?it/s]
18 : capsule-scratch label's augmentation process:
100%|                | 123/123 [00:35<00:00,  3.44it/s]
19 : capsule-squeeze label's deleting process:
100%|                   | 6/6 [00:00<00:00, 2787.22it/s]
19 : capsule-squeeze label's augmentation process:
100%|                | 144/144 [00:37<00:00,  3.86it/s]
20 : carpet-color label's deleting process:
100%|                    | 8/8 [00:00<00:00, 2672.38it/s]
20 : carpet-color label's augmentation process:
100%|                 | 153/153 [00:17<00:00,  8.51it/s]
21 : carpet-cut label's deleting process:
100%|                     | 6/6 [00:00<00:00, 2030.32it/s]
21 : carpet-cut label's augmentation process:
100%|                  | 141/141 [00:16<00:00,  8.60it/s]
22 : carpet-good label's deleting process:
100%|                   | 182/182 [00:00<00:00, 3092.94it/s]
22 : carpet-good label's augmentation process:
100%|                   | 38/38 [00:03<00:00,  9.77it/s]
23 : carpet-hole label's deleting process:
100%|                     | 7/7 [00:00<00:00, 3449.67it/s]
23 : carpet-hole label's augmentation process:
100%|                 | 128/128 [00:16<00:00,  7.91it/s]
24 : carpet-metal_contamination label's deleting process:
100%|             | 9/9 [00:00<00:00, 4519.18it/s]
24 : carpet-metal_contamination label's augmentation process:
100%|          | 153/153 [00:20<00:00,  7.37it/s]
25 : carpet-thread label's deleting process:
100%|                    | 7/7 [00:00<00:00, 3457.39it/s]
25 : carpet-thread label's augmentation process:
100%|                | 133/133 [00:15<00:00,  8.66it/s]
26 : grid-bent label's deleting process:
100%|                     | 4/4 [00:00<00:00, 4053.45it/s]
26 : grid-bent label's augmentation process:
100%|                   | 134/134 [00:11<00:00, 11.49it/s]
27 : grid-broken label's deleting process:
100%|                     | 3/3 [00:00<00:00, 3011.71it/s]
27 : grid-broken label's augmentation process:
100%|                  | 143/143 [00:13<00:00, 10.68it/s]
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28 : grid-glue label's deleting process:
100%|                       | 4/4 [00:00<00:00, 2003.01it/s]
28 : grid-glue label's augmentation process:
100%|                    | 140/140 [00:14<00:00,  9.42it/s]
29 : grid-good label's deleting process:
100%|                      | 180/180 [00:00<00:00, 4242.12it/s]
29 : grid-good label's augmentation process:
100%|                      | 42/42 [00:04<00:00,  9.84it/s]
30 : grid-metal_contamination label's deleting process:
100%|               | 4/4 [00:00<00:00, 4009.85it/s]
30 : grid-metal_contamination label's augmentation process:
100%|           | 131/131 [00:12<00:00, 10.28it/s]
31 : grid-thread label's deleting process:
100%|                       | 4/4 [00:00<00:00, 4018.49it/s]
31 : grid-thread label's augmentation process:
100%|                   | 151/151 [00:15<00:00, 10.04it/s]
32 : hazelnut-crack label's deleting process:
100%|                     | 4/4 [00:00<00:00, 4009.85it/s]
32 : hazelnut-crack label's augmentation process:
100%|                 | 137/137 [00:42<00:00,  3.21it/s]
33 : hazelnut-cut label's deleting process:
100%|                       | 6/6 [00:00<00:00, 3009.55it/s]
33 : hazelnut-cut label's augmentation process:
100%|                  | 122/122 [00:31<00:00,  3.87it/s]
34 : hazelnut-good label's deleting process:
100%|                   | 262/262 [00:00<00:00, 4047.51it/s]
34 : hazelnut-good label's augmentation process: 0it [00:00, ?it/s]
35 : hazelnut-hole label's deleting process:
100%|                      | 5/5 [00:00<00:00, 4990.84it/s]
35 : hazelnut-hole label's augmentation process:
100%|                 | 142/142 [00:38<00:00,  3.68it/s]
36 : hazelnut-print label's deleting process:
100%|                     | 7/7 [00:00<00:00, 3508.62it/s]
36 : hazelnut-print label's augmentation process:
100%|                 | 134/134 [00:37<00:00,  3.56it/s]
37 : leather-color label's deleting process:
100%|                      | 6/6 [00:00<00:00, 2952.70it/s]
37 : leather-color label's augmentation process:
100%|                 | 144/144 [00:33<00:00,  4.34it/s]
38 : leather-cut label's deleting process:
100%|                       | 4/4 [00:00<00:00, 4011.77it/s]
38 : leather-cut label's augmentation process:
100%|                   | 132/132 [00:30<00:00,  4.29it/s]
39 : leather-fold label's deleting process:
100%|                      | 7/7 [00:00<00:00, 2340.01it/s]
39 : leather-fold label's augmentation process:
100%|                  | 158/158 [00:33<00:00,  4.66it/s]
40 : leather-glue label's deleting process:
```

```
100%|                     | 5/5 [00:00<00:00, 5011.12it/s]
40 : leather-glue label's augmentation process:
100%|                  | 126/126 [00:29<00:00,  4.20it/s]
41 : leather-good label's deleting process:
100%|                   | 161/161 [00:00<00:00, 3681.76it/s]
41 : leather-good label's augmentation process:
100%|                   | 64/64 [00:13<00:00,  4.90it/s]
42 : leather-poke label's deleting process:
100%|                     | 4/4 [00:00<00:00, 4008.89it/s]
42 : leather-poke label's augmentation process:
100%|                  | 156/156 [00:34<00:00,  4.58it/s]
43 : metal_nut-bent label's deleting process:
100%|                    | 9/9 [00:00<00:00, 4510.00it/s]
43 : metal_nut-bent label's augmentation process:
100%|                 | 146/146 [00:07<00:00, 19.64it/s]
44 : metal_nut-color label's deleting process:
100%|                    | 7/7 [00:00<00:00, 3529.71it/s]
44 : metal_nut-color label's augmentation process:
100%|                | 127/127 [00:06<00:00, 19.09it/s]
45 : metal_nut-flip label's deleting process:
100%|                    | 8/8 [00:00<00:00, 4009.37it/s]
45 : metal_nut-flip label's augmentation process:
100%|                 | 145/145 [00:07<00:00, 18.76it/s]
46 : metal_nut-good label's deleting process:
100%|                  | 143/143 [00:00<00:00, 4949.05it/s]
46 : metal_nut-good label's augmentation process:
100%|                   | 61/61 [00:03<00:00, 17.19it/s]
47 : metal_nut-scratch label's deleting process:
100%|                   | 8/8 [00:00<00:00, 2673.66it/s]
47 : metal_nut-scratch label's augmentation process:
100%|               | 146/146 [00:07<00:00, 18.63it/s]
48 : pill-color label's deleting process:
100%|                      | 8/8 [00:00<00:00, 4064.74it/s]
48 : pill-color label's augmentation process:
100%|                   | 127/127 [00:20<00:00,  6.28it/s]
49 : pill-combined label's deleting process:
100%|                    | 5/5 [00:00<00:00, 5199.98it/s]
49 : pill-combined label's augmentation process:
100%|                 | 128/128 [00:24<00:00,  5.24it/s]
50 : pill-contamination label's deleting process:
100%|                   | 7/7 [00:00<00:00, 3510.30it/s]
50 : pill-contamination label's augmentation process:
100%|               | 127/127 [00:19<00:00,  6.42it/s]
51 : pill-crack label's deleting process:
100%|                      | 7/7 [00:00<00:00, 3509.46it/s]
51 : pill-crack label's augmentation process:
100%|                   | 128/128 [00:20<00:00,  6.10it/s]
52 : pill-faulty_imprint label's deleting process:
```

```
100%|                 | 6/6 [00:00<00:00, 6014.78it/s]
52 : pill-faulty_imprint label's augmentation process:
100%|              | 150/150 [00:26<00:00,  5.56it/s]
53 : pill-good label's deleting process:
100%|                     | 176/176 [00:00<00:00, 4545.78it/s]
53 : pill-good label's augmentation process:
100%|                     | 41/41 [00:05<00:00,  7.24it/s]
54 : pill-pill_type label's deleting process:
100%|                    | 3/3 [00:00<00:00, 2979.61it/s]
54 : pill-pill_type label's augmentation process:
100%|                | 128/128 [00:20<00:00,  6.37it/s]
55 : pill-scratch label's deleting process:
100%|                     | 8/8 [00:00<00:00, 2674.09it/s]
55 : pill-scratch label's augmentation process:
100%|                  | 140/140 [00:24<00:00,  5.80it/s]
56 : screw-good label's deleting process:
100%|                    | 193/193 [00:00<00:00, 4933.78it/s]
56 : screw-good label's augmentation process:
100%|                    | 23/23 [00:02<00:00,  9.41it/s]
57 : screw-manipulated_front label's deleting process:
100%|              | 11/11 [00:00<00:00, 3677.75it/s]
57 : screw-manipulated_front label's augmentation process:
100%|           | 149/149 [00:16<00:00,  9.14it/s]
58 : screw-scratch_head label's deleting process:
100%|                  | 8/8 [00:00<00:00, 2543.16it/s]
58 : screw-scratch_head label's augmentation process:
100%|               | 126/126 [00:13<00:00,  9.00it/s]
59 : screw-scratch_neck label's deleting process:
100%|                  | 9/9 [00:00<00:00, 4400.13it/s]
59 : screw-scratch_neck label's augmentation process:
100%|               | 131/131 [00:15<00:00,  8.38it/s]
60 : screw-thread_side label's deleting process:
100%|                 | 10/10 [00:00<00:00, 5011.71it/s]
60 : screw-thread_side label's augmentation process:
100%|               | 138/138 [00:14<00:00,  9.29it/s]
61 : screw-thread_top label's deleting process:
100%|                   | 7/7 [00:00<00:00, 3509.04it/s]
61 : screw-thread_top label's augmentation process:
100%|               | 143/143 [00:16<00:00,  8.72it/s]
62 : tile-crack label's deleting process:
100%|                     | 5/5 [00:00<00:00, 5013.51it/s]
62 : tile-crack label's augmentation process:
100%|                   | 130/130 [00:19<00:00,  6.56it/s]
63 : tile-glue_strip label's deleting process:
100%|                   | 7/7 [00:00<00:00, 3509.04it/s]
63 : tile-glue_strip label's augmentation process:
100%|                | 129/129 [00:16<00:00,  7.63it/s]
64 : tile-good label's deleting process:
```

```
100%|                    | 161/161 [00:00<00:00, 4045.84it/s]
64 : tile-good label's augmentation process:
100%|                    | 69/69 [00:10<00:00,  6.90it/s]
65 : tile-gray_stroke label's deleting process:
100%|                   | 7/7 [00:00<00:00, 3476.63it/s]
65 : tile-gray_stroke label's augmentation process:
100%|               | 149/149 [00:23<00:00,  6.27it/s]
66 : tile-oil label's deleting process:
100%|                      | 4/4 [00:00<00:00, 4006.98it/s]
66 : tile-oil label's augmentation process:
100%|                   | 122/122 [00:18<00:00,  6.73it/s]
67 : tile-rough label's deleting process:
100%|                     | 7/7 [00:00<00:00, 6990.51it/s]
67 : tile-rough label's augmentation process:
100%|                   | 140/140 [00:21<00:00,  6.56it/s]
68 : toothbrush-defective label's deleting process:
100%|                 | 6/6 [00:00<00:00, 3008.47it/s]
68 : toothbrush-defective label's augmentation process:
100%|             | 121/121 [00:32<00:00,  3.68it/s]
69 : toothbrush-good label's deleting process:
100%|                  | 37/37 [00:00<00:00, 3531.52it/s]
69 : toothbrush-good label's augmentation process:
100%|                | 125/125 [00:33<00:00,  3.74it/s]
70 : transistor-bent_lead label's deleting process:
100%|                 | 4/4 [00:00<00:00, 4006.02it/s]
70 : transistor-bent_lead label's augmentation process:
100%|             | 145/145 [00:50<00:00,  2.85it/s]
71 : transistor-cut_lead label's deleting process:
100%|                 | 3/3 [00:00<00:00, 2966.27it/s]
71 : transistor-cut_lead label's augmentation process:
100%|              | 137/137 [00:39<00:00,  3.48it/s]
72 : transistor-damaged_case label's deleting process:
100%|               | 3/3 [00:00<00:00, 3008.83it/s]
72 : transistor-damaged_case label's augmentation process:
100%|           | 126/126 [00:34<00:00,  3.67it/s]
73 : transistor-good label's deleting process:
100%|                 | 135/135 [00:00<00:00, 3869.18it/s]
73 : transistor-good label's augmentation process:
100%|                 | 62/62 [00:17<00:00,  3.59it/s]
74 : transistor-misplaced label's deleting process:
100%|                 | 4/4 [00:00<00:00, 4011.77it/s]
74 : transistor-misplaced label's augmentation process:
100%|             | 139/139 [00:39<00:00,  3.55it/s]
75 : wood-color label's deleting process:
100%|                     | 3/3 [00:00<00:00, 2965.57it/s]
75 : wood-color label's augmentation process:
100%|                   | 117/117 [00:20<00:00,  5.57it/s]
76 : wood-combined label's deleting process:
```

```
100%|                    | 5/5 [00:00<00:00, 2507.96it/s]
76 : wood-combined label's augmentation process:
100%|                 | 114/114 [00:22<00:00,  5.07it/s]
77 : wood-good label's deleting process:
100%|                    | 149/149 [00:00<00:00, 3626.14it/s]
77 : wood-good label's augmentation process:
100%|                    | 55/55 [00:10<00:00,  5.18it/s]
78 : wood-hole label's deleting process:
100%|                      | 5/5 [00:00<00:00, 5013.51it/s]
78 : wood-hole label's augmentation process:
100%|                   | 130/130 [00:24<00:00,  5.37it/s]
79 : wood-liquid label's deleting process:
100%|                     | 4/4 [00:00<00:00, 4010.81it/s]
79 : wood-liquid label's augmentation process:
100%|                  | 148/148 [00:27<00:00,  5.30it/s]
80 : wood-scratch label's deleting process:
100%|                     | 8/8 [00:00<00:00, 2670.68it/s]
80 : wood-scratch label's augmentation process:
100%|                  | 132/132 [00:26<00:00,  5.02it/s]
81 : zipper-broken_teeth label's deleting process:
100%|                 | 8/8 [00:00<00:00, 4071.65it/s]
81 : zipper-broken_teeth label's augmentation process:
100%|              | 146/146 [00:10<00:00, 14.58it/s]
82 : zipper-combined label's deleting process:
100%|                   | 7/7 [00:00<00:00, 7015.56it/s]
82 : zipper-combined label's augmentation process:
100%|                | 144/144 [00:08<00:00, 16.68it/s]
83 : zipper-fabric_border label's deleting process:
100%|                 | 5/5 [00:00<00:00, 5012.31it/s]
83 : zipper-fabric_border label's augmentation process:
100%|              | 159/159 [00:09<00:00, 16.01it/s]
84 : zipper-fabric_interior label's deleting process:
100%|               | 5/5 [00:00<00:00, 5011.12it/s]
84 : zipper-fabric_interior label's augmentation process:
100%|            | 140/140 [00:09<00:00, 14.69it/s]
85 : zipper-good label's deleting process:
100%|                   | 155/155 [00:00<00:00, 4856.73it/s]
85 : zipper-good label's augmentation process:
100%|                   | 51/51 [00:02<00:00, 17.05it/s]
86 : zipper-rough label's deleting process:
100%|                     | 5/5 [00:00<00:00, 5012.31it/s]
86 : zipper-rough label's augmentation process:
100%|                  | 156/156 [00:09<00:00, 15.62it/s]
87 : zipper-split_teeth label's deleting process:
100%|                  | 6/6 [00:00<00:00, 6024.86it/s]
87 : zipper-split_teeth label's augmentation process:
100%|              | 146/146 [00:09<00:00, 15.52it/s]
88 : zipper-squeezed_teeth label's deleting process:
```

```
100%|                | 6/6 [00:00<00:00, 6016.21it/s]
88 : zipper-squeezed_teeth label's augmentation process:
100%|             | 131/131 [00:08<00:00, 16.26it/s]
```

[3]:
```
print(y)
print(y.shape)
##
y_df =pd.DataFrame(y, columns=['label'])
y_df.to_csv('smotetomek_label.csv')
####
```

```
['transistor-good' 'capsule-good' 'wood-good' … 'zipper-squeezed_teeth'
 'zipper-squeezed_teeth' 'zipper-squeezed_teeth']
(12340,)
```

[4]:
```
y = pd.read_csv('smotetomek_result.csv')
print(y)
y['0'] = y['0'].astype(str)
y['0'] +='.png'
y['0'] = y['0'].str.replace('.0.png', '.png')

y = y.sort_values(by=['0'])
print("---------------------------------")
print(y)
train_labels = y['1']
print(train_labels)
```

```
                0                     1
0      10000.000000        transistor-good
1      10001.000000           capsule-good
2      10003.000000              wood-good
3      10006.000000           capsule-good
4      10007.000000             screw-good
…               …                      …
12335  11562.854328  zipper-squeezed_teeth
12336  13592.718605  zipper-squeezed_teeth
12337  10898.441693  zipper-squeezed_teeth
12338  13306.808308  zipper-squeezed_teeth
12339  13232.091829  zipper-squeezed_teeth

[12340 rows x 2 columns]
---------------------------------
                            0               1
10404  10000.490216033772.png  transistor-good
0                   10000.png  transistor-good
1                   10001.png     capsule-good
2                   10003.png        wood-good
3                   10006.png     capsule-good
…                         …               …
```

```
10399  14272.562912938318.png  transistor-good
1476                14273.png  transistor-good
1477                14274.png        grid-good
1478                14275.png      zipper-good
1479                14276.png       screw-good

[12340 rows x 2 columns]
10404    transistor-good
0        transistor-good
1           capsule-good
2              wood-good
3           capsule-good
              …
10399    transistor-good
1476     transistor-good
1477           grid-good
1478         zipper-good
1479          screw-good
Name: 1, Length: 12340, dtype: object
```

[5]:
```
label_unique = sorted(np.unique(train_labels))
label_unique = {key:value for key,value in zip(label_unique,␣
 ↪range(len(label_unique)))}

train_labels = [label_unique[k] for k in train_labels]
```

[6]:
```
from glob import glob
train_png = sorted(glob('data/train/*.png'))
test_png = sorted(glob('data/test/*.png'))
```

[7]:
```
# train, test
def img_load(path):
    img = cv2.imread(path)[:,:,::-1]
    img = cv2.resize(img, (512, 512))
    return img
```

[8]:
```
train_imgs = [img_load(m) for m in tqdm(train_png)]
test_imgs = [img_load(n) for n in tqdm(test_png)]
```

```
100%|
 | 12340/12340 [03:36<00:00, 57.13it/s]
100%|
  | 2154/2154 [01:18<00:00, 27.43it/s]
```

[9]:
```
class Custom_dataset(Dataset):
    def __init__(self, img_paths, labels, mode='train'):
        self.img_paths = img_paths
        self.labels = labels
```

```
        self.mode=mode
    def __len__(self):
        return len(self.img_paths)
    def __getitem__(self, idx):
        img = self.img_paths[idx]
        if self.mode=='train':
            augmentation = random.randint(0,2)
            if augmentation==1:
                img = img[::-1].copy()
            elif augmentation==2:
                img = img[:,::-1].copy()
        img = transforms.ToTensor()(img)
        if self.mode=='test':
            pass

        label = self.labels[idx]
        return img, label

class Network(nn.Module):
    def __init__(self):
        super(Network, self).__init__()
        self.model = timm.create_model('efficientnet_b4', pretrained=True,␣
 ↪num_classes=88) # label   : 88

    def forward(self, x):
        x = self.model(x)
        return x
```

[10]:
```
batch_size = 12 #    = 32
epochs = 30

# Train
train_dataset = Custom_dataset(np.array(train_imgs), np.array(train_labels),␣
 ↪mode='train')
train_loader = DataLoader(train_dataset, shuffle=True, batch_size=batch_size)

# Test
test_dataset = Custom_dataset(np.array(test_imgs), np.
 ↪array(["tmp"]*len(test_imgs)), mode='test')
test_loader = DataLoader(test_dataset, shuffle=False, batch_size=batch_size)
```

[11]:
```
def score_function(real, pred):
    score = f1_score(real, pred, average="macro")
    return score

model = Network().to(device)
```

```
#
optimizer = torch.optim.NAdam(model.parameters(), lr=1e-3)
#
criterion = nn.CrossEntropyLoss()
#             ,
scaler = torch.cuda.amp.GradScaler()

for epoch in range(epochs):
    start=time.time()
    train_loss = 0
    train_pred=[]
    train_y=[]
    model.train()
    for batch in (train_loader):
        optimizer.zero_grad() # gradient  0
        x = torch.tensor(batch[0], dtype=torch.float32, device=device)
        y = torch.tensor(batch[1], dtype=torch.long, device=device)
        with torch.cuda.amp.autocast():
            pred = model(x)
        loss = criterion(pred, y)


        scaler.scale(loss).backward()
        scaler.step(optimizer)
        scaler.update()

        train_loss += loss.item()/len(train_loader)
        train_pred += pred.argmax(1).detach().cpu().numpy().tolist()
        train_y += y.detach().cpu().numpy().tolist()


    train_f1 = score_function(train_y, train_pred)

    TIME = time.time() - start
    print(f'epoch : {epoch+1}/{epochs}    time : {TIME:.0f}s/
 ↪{TIME*(epochs-epoch-1):.0f}s')
    print(f'TRAIN    loss : {train_loss:.5f}    f1 : {train_f1:.5f}')
    if(train_loss < 0.03 and train_f1 > 0.994):
        break
```

```
epoch : 1/30    time : 252s/7295s
TRAIN    loss : 0.68679    f1 : 0.78673
epoch : 2/30    time : 241s/6762s
TRAIN    loss : 0.17712    f1 : 0.94824
epoch : 3/30    time : 242s/6521s
TRAIN    loss : 0.12865    f1 : 0.96415
epoch : 4/30    time : 241s/6262s
TRAIN    loss : 0.09940    f1 : 0.97364
```

```
epoch : 5/30    time : 242s/6056s
TRAIN    loss : 0.09608    f1 : 0.97451
epoch : 6/30    time : 245s/5871s
TRAIN    loss : 0.07847    f1 : 0.97811
epoch : 7/30    time : 241s/5540s
TRAIN    loss : 0.06991    f1 : 0.98117
epoch : 8/30    time : 243s/5340s
TRAIN    loss : 0.05673    f1 : 0.98644
epoch : 9/30    time : 242s/5076s
TRAIN    loss : 0.06387    f1 : 0.98451
epoch : 10/30    time : 242s/4838s
TRAIN    loss : 0.06672    f1 : 0.98380
epoch : 11/30    time : 241s/4587s
TRAIN    loss : 0.05644    f1 : 0.98623
epoch : 12/30    time : 243s/4368s
TRAIN    loss : 0.05096    f1 : 0.98609
epoch : 13/30    time : 243s/4125s
TRAIN    loss : 0.05269    f1 : 0.98635
epoch : 14/30    time : 243s/3883s
TRAIN    loss : 0.04852    f1 : 0.98778
epoch : 15/30    time : 244s/3657s
TRAIN    loss : 0.03722    f1 : 0.99073
epoch : 16/30    time : 241s/3373s
TRAIN    loss : 0.04554    f1 : 0.98952
epoch : 17/30    time : 242s/3146s
TRAIN    loss : 0.04418    f1 : 0.98785
epoch : 18/30    time : 243s/2922s
TRAIN    loss : 0.03821    f1 : 0.99093
epoch : 19/30    time : 250s/2752s
TRAIN    loss : 0.03794    f1 : 0.99058
epoch : 20/30    time : 250s/2502s
TRAIN    loss : 0.03561    f1 : 0.99153
epoch : 21/30    time : 252s/2264s
TRAIN    loss : 0.03612    f1 : 0.99201
epoch : 22/30    time : 252s/2014s
TRAIN    loss : 0.03937    f1 : 0.98921
epoch : 23/30    time : 252s/1763s
TRAIN    loss : 0.02773    f1 : 0.99258
epoch : 24/30    time : 252s/1511s
TRAIN    loss : 0.03456    f1 : 0.99222
epoch : 25/30    time : 251s/1255s
TRAIN    loss : 0.03742    f1 : 0.99007
epoch : 26/30    time : 247s/986s
TRAIN    loss : 0.03759    f1 : 0.98917
epoch : 27/30    time : 242s/726s
TRAIN    loss : 0.02409    f1 : 0.99370
epoch : 28/30    time : 243s/487s
TRAIN    loss : 0.02634    f1 : 0.99487
```

[17]:
```
model.eval()
f_pred = []

with torch.no_grad():
    for batch in (test_loader):
        x = torch.tensor(batch[0], dtype = torch.float32, device = device)
        with torch.cuda.amp.autocast():
            pred = model(x)
        f_pred.extend(pred.argmax(1).detach().cpu().numpy().tolist())
```

[18]:
```
label_decoder = {val:key for key, val in label_unique.items()}

f_result = [label_decoder[result] for result in f_pred]
```

[19]:
```
submission = pd.read_csv("data/sample_submission.csv")

submission["label"] = f_result

submission
```

[19]:

	index	label
0	0	tile-glue_strip
1	1	grid-good
2	2	transistor-good
3	3	tile-gray_stroke
4	4	tile-good
…	…	…
2149	2149	tile-gray_stroke
2150	2150	screw-good
2151	2151	grid-good
2152	2152	leather-poke
2153	2153	zipper-good

[2154 rows x 2 columns]

[20]:
```
submission.to_csv("efficientnet_b4_smotetomek-oversampling.csv", index = False)
```

[ ]:
```

```