Window size:1024

Stride: 512

Raw data with detrend(lambda:50)

Lowpass filter(300Hz)

Use all channels

Use standard scaler. No shuffle and split data into 20% for test, 20% for validation and 60% for training.

Feature: Integrated EMG, Simple Square Integral, Waveform Length, Zero crossing, kurtosis, Slop Sign Change, Willison Amplitude, skewness, Activity, Auto-regressive coefficients, EMG Histogram, Max Frequency, Median Frequency, Mean Frequency, Marginal Discrete Wavelet Transform.

## XGBoost

model = xgb.XGBClassifier(max\_depth=4,

learning\_rate=0.1,

n\_estimators=200,

objective='binary:logistic',

scale\_pos\_weight = 30,

subsample=0.8,

reg\_lambda = 25,

)

Use MinMaxScaler(0,1) on features

Class 0 : others

Train (acc 0.992)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 4536 | 37 |
| Actual others | 0 | 583 |

Valid (acc 0.977)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1514 | 30 |
| Actual others | 9 | 174 |

Test (acc 0.980)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1583 | 28 |
| Actual others | 8 | 187 |

subsample=0.9

Class 1 : 2 : 6

Train (acc 0.957)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 107 | 9 | 4 |
| Actual 2 | 4 | 234 | 3 |
| Actual 6 | 2 | 1 | 174 |

Valid (acc 0.765)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 12 | 7 | 22 |
| Actual 2 | 1 | 69 | 12 |
| Actual 6 | 0 | 1 | 59 |

Test (acc 0.737)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 6 | 11 | 27 |
| Actual 2 | 1 | 84 | 4 |
| Actual 6 | 0 | 8 | 53 |

Class 2 : 6

Train (acc 0.973)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 234 | 7 |
| Actual 6 | 4 | 173 |

Valid (acc 0.915)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 70 | 12 |
| Actual 6 | 0 | 60 |

Test (acc 0.900)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 80 | 9 |
| Actual 6 | 6 | 55 |

Class 1 : 6

Train (acc 0.956)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 109 | 11 |
| Actual 6 | 2 | 175 |

Valid (acc 0.772)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 22 | 19 |
| Actual 6 | 4 | 56 |

Test (acc 0.704)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 30 | 14 |
| Actual 6 | 17 | 44 |

Class 1 : 2

Train (acc 0952)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 108 | 12 |
| Actual 2 | 5 | 236 |

Valid (acc 0.869)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 30 | 11 |
| Actual 2 | 5 | 77 |

Test (acc 0.842)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 24 | 20 |
| Actual 2 | 1 | 88 |

## SVM

model = SVC(kernel="rbf",C=10,

class\_weight={0:1,1:5},

gamma='auto'

)

Use MinMaxScaler(0,1) on features

PCA(component = 150)

Class 0 : others

Train (acc 0.977)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 4467 | 106 |
| Actual others | 9 | 529 |

Valid (acc 0.978)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1518 | 26 |
| Actual others | 11 | 172 |

Test (acc 0.967)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1563 | 48 |
| Actual others | 11 | 184 |

Class 1 : 2 : 6

Train (acc 0.840)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 84 | 17 | 19 |
| Actual 2 | 22 | 210 | 9 |
| Actual 6 | 13 | 6 | 158 |

Valid (acc 0.770)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 9 | 10 | 22 |
| Actual 2 | 2 | 73 | 7 |
| Actual 6 | 0 | 1 | 59 |

Test (acc 0.747)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 10 | 16 | 18 |
| Actual 2 | 4 | 82 | 3 |
| Actual 6 | 1 | 7 | 53 |

Class 2 : 6

Train (acc 0.940)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 227 | 14 |
| Actual 6 | 11 | 166 |

Valid (acc 0.943)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 75 | 7 |
| Actual 6 | 1 | 59 |

Test (acc 0.920)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 85 | 4 |
| Actual 6 | 8 | 53 |

Class 1 : 6

Train (acc 0.882)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 101 | 19 |
| Actual 6 | 16 | 161 |

Valid (acc 0.742)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 15 | 26 |
| Actual 6 | 0 | 60 |

Test (acc 0.780)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 23 | 21 |
| Actual 6 | 2 | 59 |

Class 1 : 2

Train (acc 0.867)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 97 | 23 |
| Actual 2 | 25 | 216 |

Valid (acc 0.837)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 25 | 16 |
| Actual 2 | 4 | 78 |

Test (acc 0.819)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 24 | 20 |
| Actual 2 | 4 | 85 |

## DNN

model = models.Sequential()

model.add(layers.Dense(128))

model.add(layers.BatchNormalization())

model.add(layers.Activation('relu'))

model.add(layers.Dropout(0.2))

model.add(layers.Dense(64))

model.add(layers.BatchNormalization())

model.add(layers.Activation('relu'))

model.add(layers.Dropout(0.2))

model.add(layers.Dense(32))

model.add(layers.BatchNormalization())

model.add(layers.Activation('relu'))

model.add(layers.Dropout(0.2))

model.add(layers.Dense(16))

model.add(layers.BatchNormalization())

model.add(layers.Activation('relu'))

model.add(layers.Dropout(0.2))

model.add(layers.Dense(2,activation='softmax'))

use StandardScaler on features

Class 0 : others

Train (acc 0.995)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 4550 | 23 |
| Actual others | 0 | 538 |

Valid (acc 0.983)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1525 | 19 |
| Actual others | 10 | 173 |

Test (acc 0.977)

|  |  |  |
| --- | --- | --- |
|  | Predicted 0 | Predicted others |
| Actual 0 | 1582 | 29 |
| Actual others | 11 | 184 |

Class 1 : 2 : 6

Train (acc 0.951)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 118 | 2 | 0 |
| Actual 2 | 10 | 231 | 0 |
| Actual 6 | 10 | 4 | 163 |

Valid (acc 0852)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 28 | 6 | 7 |
| Actual 2 | 5 | 73 | 4 |
| Actual 6 | 4 | 1 | 55 |

Test (acc 0.685)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Predicted 1 | Predicted 2 | Predicted 6 |
| Actual 1 | 11 | 31 | 2 |
| Actual 2 | 1 | 88 | 0 |
| Actual 6 | 8 | 19 | 34 |

Class 2 : 6

Train (acc 1.000)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 241 | 0 |
| Actual 6 | 0 | 177 |

Valid (acc 0.950)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 77 | 5 |
| Actual 6 | 2 | 58 |

Test (acc 0.860)

|  |  |  |
| --- | --- | --- |
|  | Predicted 2 | Predicted 6 |
| Actual 2 | 89 | 0 |
| Actual 6 | 21 | 40 |

Class 1 : 6

Train (acc 0.996)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 119 | 1 |
| Actual 6 | 0 | 177 |

Valid (acc 0.910)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 36 | 5 |
| Actual 6 | 4 | 56 |

Test (acc 0.750)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 6 |
| Actual 1 | 36 | 8 |
| Actual 6 | 18 | 43 |

Class 1 : 2

Train (acc 0.991)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 120 | 0 |
| Actual 2 | 3 | 238 |

Valid (acc 0.837)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 31 | 10 |
| Actual 2 | 10 | 72 |

Test (acc 0.796)

|  |  |  |
| --- | --- | --- |
|  | Predicted 1 | Predicted 2 |
| Actual 1 | 22 | 22 |
| Actual 2 | 5 | 84 |