**[Calibration]**

clc

Ra = [-1,0,0.01;-0.01,-1,0.01;0,-0.04,1];

Ka = [96,0,0;0,100,0;0,0,98];

Ba = [1926;2150;1695];

iRa = inv(Ra);

iKa = inv(Ka);

Rg = [-0.01,-1,0.03;-1,0.01,-0.01;0.02,-0.01,-1];

Kg = [2.77,0,0;0,2.77,0;0,0,2.8];

Bg = [1830;1836;1881];

iRg = inv(Rg);

iKg = inv(Kg);

Rm = [1,0,0;0,1,0;0,0,-1];

Km = [706,0,0;0,708,0;0,0,629];

Bm = [-9;149;90];

iRm = inv(Rm);

iKm = inv(Km);

Alphabet='ABCDEFGHIJKLMNOPQRSTUVWXYZ';

for j=1:26,

clearvars A;

clearvars m;

clearvars n;

clearvars openFileName;

clearvars saveFileName;

clearvars a\_row\_final\_calibrated;

openFileName = ['./uncalibrated/',Alphabet(j),'/',Alphabet(j),'-10cm-100Hz.xlsx'];

saveFileName = ['./calibrated/',Alphabet(j),'-10cm-100Hz-calibrated.xlsx'];

A = xlsread(openFileName, 1);

A = A(1:end,2:end);

[m,n] = size(A);

for i=1:m,

A\_row\_a = rot90(A(i,1:3),3);

A\_row\_ca = iRa \* iKa \* (A\_row\_a-Ba);

A\_row\_ca = rot90(A\_row\_ca);

Axyz2 = sqrt(power(A\_row\_ca(1),2)+power(A\_row\_ca(2),2)+power(A\_row\_ca(3),2));

A\_row\_g = rot90(A(i,4:6),3);

A\_row\_cg = iRg \* iKg \* (A\_row\_g-Bg);

A\_row\_cg = rot90(A\_row\_cg);

Gxyz2 = sqrt(power(A\_row\_cg(1),2)+power(A\_row\_cg(2),2)+power(A\_row\_cg(3),2));

A\_row\_m = rot90(A(i,7:9),3);

A\_row\_cm = iRm \* iKm \* (A\_row\_m-Bm);

A\_row\_cm = rot90(A\_row\_cm);

Mxyz2 = sqrt(power(A\_row\_cm(1),2)+power(A\_row\_cm(2),2)+power(A\_row\_cm(3),2));

AGxyz2 = sqrt(power(Axyz2,2)+power(Gxyz2,2));

AGMxyz2 = sqrt(power(Axyz2,2)+power(Gxyz2,2)+power(Mxyz2,2));

a\_row\_final\_calibrated(i,:) = [i,A(i,1:3),A\_row\_ca,A(i,4:6),A\_row\_cg,A(i,7:9),A\_row\_cm,Axyz2,Gxyz2,Mxyz2,AGxyz2,AGMxyz2];

end

xlswrite(saveFileName,a\_row\_final\_calibrated);

end

**[Distance]**

clc

Alphabet='ABCDEFGHIJKLMNOPQRSTUVWXYZ';

inputBoundry(:,:,1)=[2970 3090; 3470 3590; 3870 3990; 4315 4435; 4735 4855]; %A

inputBoundry(:,:,2)=[580 690; 990 1100; 1380 1490; 1760 1870; 2270 2380]; %B

inputBoundry(:,:,3)=[570 650; 980 1060; 1410 1490; 3430 3510; 4010 4090]; %C

inputBoundry(:,:,4)=[900 1060; 1350 1510; 1780 1940; 2240 2400; 2860 3020]; %D

inputBoundry(:,:,5)=[1840 1990; 2235 2385; 2560 2710; 2900 3050; 3220 3370]; %E

inputBoundry(:,:,6)=[1600 1800; 2200 2400; 2745 2945; 3420 3620; 4545 4745]; %F

inputBoundry(:,:,7)=[1360 1520; 1880 2040; 2760 2920; 3620 3780; 4240 4400]; %G

inputBoundry(:,:,8)=[650 820; 1140 1310; 2150 2320; 2660 2830; 3160 3330]; %H

inputBoundry(:,:,9)=[1280 1550; 1735 2005; 2140 2410; 2670 2940; 3120 3390]; %I

inputBoundry(:,:,10)=[2010 2180; 2490 2660; 3160 3330; 3820 3990; 4420 4590]; %J

inputBoundry(:,:,11)=[540 740; 1210 1410; 1930 2130; 2790 2990; 3480 3680]; %K

inputBoundry(:,:,12)=[1020 1130; 1660 1770; 2280 2390; 2850 2960; 3460 3570]; %L

inputBoundry(:,:,13)=[660 830; 1620 1790; 2250 2420; 2760 2930; 3260 3430]; %M

inputBoundry(:,:,14)=[1330 1480; 1910 2060; 2630 2780; 3310 3460; 3900 4050]; %N

inputBoundry(:,:,15)=[880 1030; 1250 1400; 1650 1800; 2140 2290; 2630 2780]; %O

inputBoundry(:,:,16)=[1160 1320; 1700 1860; 2180 2340; 2680 2840; 3170 3330]; %P

inputBoundry(:,:,17)=[1130 1340; 1740 1950; 2360 2570; 3000 3210; 3680 3890]; %Q

inputBoundry(:,:,18)=[2070 2320; 2700 2950; 3250 3500; 3850 4100; 4500 4750]; %R

inputBoundry(:,:,19)=[1150 1330; 1900 2080; 2520 2700; 3270 3450; 3950 4130]; %S

inputBoundry(:,:,20)=[1500 1650; 1990 2140; 2920 3070; 3340 3490; 3830 3980]; %T

inputBoundry(:,:,21)=[1340 1490; 1790 1940; 2180 2330; 2520 2670; 3050 3200]; %U

inputBoundry(:,:,22)=[2220 2400; 2595 2775; 2980 3160; 3320 3500; 3660 3840]; %V

inputBoundry(:,:,23)=[2090 2290; 2760 2960; 3280 3480; 3820 4020; 4320 4520]; %W

inputBoundry(:,:,24)=[850 1000; 1370 1520; 1800 1950; 2225 2375; 2650 2800]; %X

inputBoundry(:,:,25)=[660 840; 1150 1330; 1760 1940; 2260 2440; 2660 2840]; %Y

inputBoundry(:,:,26)=[2530 2730; 2920 3120; 3330 3530; 3770 3970; 4160 4360]; %Z

dataUsed=24

[m,n,o]=size(inputBoundry(:,:,:));

for i=1:o,

arraySize(i)=inputBoundry(1,2,i)-inputBoundry(1,1,i);

end

inputArraySeprate=zeros(300,24,26,5);

for i=1:o,

openFileName=['./calibrated/',Alphabet(i),'-10cm-100Hz-calibrated.xlsx'];

size(xlsread(openFileName, 1));

inputArray = xlsread(openFileName, 1);

for j=1:m,

inputArraySeprate(1:arraySize(i)+1,:,i,j)=inputArray(inputBoundry(j,1,i):inputBoundry(j,2,i),1:end);

end

clearvars inputArray;

end

distanceAv=zeros(26,26);

for i=1:o,

traningInput=rot90(inputArraySeprate(1:arraySize(i)+1,dataUsed,i,1));

for j=1:o,

distance=0;

for k=2:5,

sampleInput=rot90(inputArraySeprate(1:arraySize(j)+1,dataUsed,j,k));

distance=distance+dtw(traningInput,sampleInput);

clearvars sampleInput;

end

distanceAv(i,j)=distance/5;

end

clearvars traningInput;

end

distanceAv

plot(distanceAv)