Eugenio J. Caraballo Justiniano

RISE-E-BASE

Undergraduate Research Programs

EIS Import Data (MATLAB)

```
%%          DiazLab Microfluidics Laboratory
%                  Marco A. Becerra Arias
%               Eugenio Caraballo Justiniano
%                       11072019
%         University of Puerto Rico at Mayaguez
%           Import Data uPore without cells
%   New Experiment Data analysis without previous data
close all
clear all
clc

%%           Data Without Cells - HeLa

a=5;         %Number of samples per uPore
b=5;         %Number of uPores evaluated
c=1;         %iniciate uPores evaluated
d=1;         %Iniciate Samples per uPore.
i=1;         %Iniciate Matrix

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_NO_CELL_30MV_';        %String for reading
Excel document

Zmod=[];
Zphz=[];
Freq=[];

for c=1:b

        Zmod=[Zmod  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz=[Zphz  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq=[Freq  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];
```

```
    c=c+1;
end
save('ZmodWoCellsHeLa30.mat','Zmod')
save('ZphzWoCellsHeLa30.mat','Zphz')
save('FreqWoCellsHeLa30.mat','Freq')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_NO_CELL_60MV_';        %String for reading
Excel document

Zmod1=[];
Zphz1=[];
Freq1=[];

for c=1:b

        Zmod1=[Zmod1  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz1=[Zphz1  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq1=[Freq1  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsHeLa60.mat','Zmod1')
save('ZphzWoCellsHeLa60.mat','Zphz1')
save('FreqWoCellsHeLa60.mat','Freq1')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_NO_CELL_90MV_';        %String for reading
Excel document

Zmod2=[];
Zphz2=[];
Freq2=[];

for c=1:b

        Zmod2=[Zmod2  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
```

```
        Zphz2=[Zphz2  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq2=[Freq2  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsHeLa90.mat','Zmod2')
save('ZphzWoCellsHeLa90.mat','Zphz2')
save('FreqWoCellsHeLa90.mat','Freq2')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_NO_CELL_120MV_';        %String for reading
Excel document

Zmod3=[];
Zphz3=[];
Freq3=[];

for c=1:b

        Zmod3=[Zmod3  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz3=[Zphz3  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq3=[Freq3  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsHeLa120.mat','Zmod3')
save('ZphzWoCellsHeLa120.mat','Zphz3')
save('FreqWoCellsHeLa120.mat','Freq3')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_NO_CELL_150MV_';        %String for reading
Excel document

Zmod4=[];
Zphz4=[];
Freq4=[];
```

```
for c=1:b

        Zmod4=[Zmod4  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz4=[Zphz4  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq4=[Freq4  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsHeLa150.mat','Zmod4')
save('ZphzWoCellsHeLa150.mat','Zphz4')
save('FreqWoCellsHeLa150.mat','Freq4')


%%            Data With Cells - HeLa

e=5;         %Number of uPores evaluated
c=1;         %iniciate uPores evaluated

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_CELL_30MV_';        %String for reading
Excel document. URL documents

Zmod5=[];
Zphz5=[];
Freq5=[];

for c=1:e

        Zmod5=[Zmod5  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz5=[Zphz5  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq5=[Freq5  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsHeLa30.mat','Zmod5')
save('ZphzWCellsHeLa30.mat','Zphz5')
save('FreqWCellsHeLa30.mat','Freq5')
```

```
STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_CELL_60MV_';        %String for reading
Excel document. URL documents

Zmod6=[];
Zphz6=[];
Freq6=[];

for c=1:e

        Zmod6=[Zmod6  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz6=[Zphz6  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq6=[Freq6  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsHeLa60.mat','Zmod6')
save('ZphzWCellsHeLa60.mat','Zphz6')
save('FreqWCellsHeLa60.mat','Freq6')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_CELL_90MV_';        %String for reading
Excel document. URL documents

Zmod7=[];
Zphz7=[];
Freq7=[];

for c=1:e

        Zmod7=[Zmod7  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz7=[Zphz7  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq7=[Freq7  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
```

```
end
save('ZmodWCellsHeLa90.mat','Zmod7')
save('ZphzWCellsHeLa90.mat','Zphz7')
save('FreqWCellsHeLa90.mat','Freq7')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_CELL_120MV_';        %String for reading
Excel document. URL documents

Zmod8=[];
Zphz8=[];
Freq8=[];

for c=1:e

        Zmod8=[Zmod8  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz8=[Zphz8  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq8=[Freq8  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsHeLa120.mat','Zmod8')
save('ZphzWCellsHeLa120.mat','Zphz8')
save('FreqWCellsHeLa120.mat','Freq8')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Excel
Data\P_EIS_HELA_CELL_150MV_';        %String for reading
Excel document. URL documents

Zmod9=[];
Zphz9=[];
Freq9=[];

for c=1:e

        Zmod9=[Zmod9  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz9=[Zphz9  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
```

```
        Freq9=[Freq9  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsHeLa150.mat','Zmod9')
save('ZphzWCellsHeLa150.mat','Zphz9')
save('FreqWCellsHeLa150.mat','Freq9')


%%          Data Without Cells - MDA-MB-231

a=5;         %Number of samples per uPore
b=5;         %Number of uPores evaluated
c=1;         %iniciate uPores evaluated
d=1;         %Iniciate Samples per uPore.
i=1;         %Iniciate Matrix

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_30MV_';        %String for reading
Excel document

Zmod10=[];
Zphz10=[];
Freq10=[];

for c=1:b

        Zmod10=[Zmod10  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz10=[Zphz10  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq10=[Freq10  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMDA30.mat','Zmod10')
save('ZphzWoCellsMDA30.mat','Zphz10')
save('FreqWoCellsMDA30.mat','Freq10')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
```

```
Data\P_EIS_MDA_NO_CELL_60MV_';        %String for reading
Excel document

Zmod11=[];
Zphz11=[];
Freq11=[];

for c=1:b

        Zmod11=[Zmod11  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz11=[Zphz11  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq11=[Freq11  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMDA60.mat','Zmod11')
save('ZphzWoCellsMDA60.mat','Zphz11')
save('FreqWoCellsMDA60.mat','Freq11')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_90MV_';        %String for reading
Excel document

Zmod12=[];
Zphz12=[];
Freq12=[];

for c=1:b

        Zmod12=[Zmod12  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz12=[Zphz12  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq12=[Freq12  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMDA90.mat','Zmod12')
save('ZphzWoCellsMDA90.mat','Zphz12')
```

```
save('FreqWoCellsMDA90.mat','Freq12')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_120MV_';        %String for reading
Excel document

Zmod13=[];
Zphz13=[];
Freq13=[];

for c=1:b

        Zmod13=[Zmod13  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz13=[Zphz13  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq13=[Freq13  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMDA120.mat','Zmod13')
save('ZphzWoCellsMDA120.mat','Zphz13')
save('FreqWoCellsMDA120.mat','Freq13')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_150MV_';        %String for reading
Excel document

Zmod14=[];
Zphz14=[];
Freq14=[];

for c=1:b

        Zmod14=[Zmod14  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz14=[Zphz14  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq14=[Freq14  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];
```

```
    c=c+1;
end
save('ZmodWoCellsMDA150.mat','Zmod14')
save('ZphzWoCellsMDA150.mat','Zphz14')
save('FreqWoCellsMDA150.mat','Freq14')


%%          Data With Cells - MDA-MB-231

e=5;        %Number of uPores evaluated
c=1;        %iniciate uPores evaluated

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_30MV_';        %String for reading
Excel document. URL documents

Zmod15=[];
Zphz15=[];
Freq15=[];


for c=1:e

        Zmod15=[Zmod15  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz15=[Zphz15  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq15=[Freq15  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMDA30.mat','Zmod15')
save('ZphzWCellsMDA30.mat','Zphz15')
save('FreqWCellsMDA30.mat','Freq15')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_60MV_';        %String for reading
Excel document. URL documents

Zmod16=[];
Zphz16=[];
```

```
Freq16=[];


for c=1:e

        Zmod16=[Zmod16  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz16=[Zphz16  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq16=[Freq16  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMDA60.mat','Zmod16')
save('ZphzWCellsMDA60.mat','Zphz16')
save('FreqWCellsMDA60.mat','Freq16')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_90MV_';        %String for reading
Excel document. URL documents

Zmod17=[];
Zphz17=[];
Freq17=[];


for c=1:e

        Zmod17=[Zmod17  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz17=[Zphz17  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq17=[Freq17  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMDA90.mat','Zmod17')
save('ZphzWCellsMDA90.mat','Zphz17')
save('FreqWCellsMDA90.mat','Freq17')
```

```
STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_120MV_';        %String for reading
Excel document. URL documents

Zmod18=[];
Zphz18=[];
Freq18=[];


for c=1:e

        Zmod18=[Zmod18  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz18=[Zphz18  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq18=[Freq18  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMDA120.mat','Zmod18')
save('ZphzWCellsMDA120.mat','Zphz18')
save('FreqWCellsMDA120.mat','Freq18')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_150MV_';        %String for reading
Excel document. URL documents

Zmod19=[];
Zphz19=[];
Freq19=[];


for c=1:e

        Zmod19=[Zmod19  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz19=[Zphz19  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq19=[Freq19  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];
```

```
    c=c+1;
end
save('ZmodWCellsMDA150.mat','Zmod19')
save('ZphzWCellsMDA150.mat','Zphz19')
save('FreqWCellsMDA150.mat','Freq19')

%%          Data Without Cells - MCF-7

a=5;          %Number of samples per uPore
b=5;          %Number of uPores evaluated
c=1;          %iniciate uPores evaluated
d=1;          %Iniciate Samples per uPore.
i=1;          %Iniciate Matrix

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_30MV_';        %String for reading
Excel document

Zmod20=[];
Zphz20=[];
Freq20=[];

for c=1:b

        Zmod20=[Zmod20  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz20=[Zphz20  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq20=[Freq20  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMCF730.mat','Zmod20')
save('ZphzWoCellsMCF730.mat','Zphz20')
save('FreqWoCellsMCF730.mat','Freq20')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_60MV_';        %String for reading
Excel document

Zmod21=[];
```

```
Zphz21=[];
Freq21=[];

for c=1:b

        Zmod21=[Zmod21  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz21=[Zphz21  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq21=[Freq21  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMCF760.mat','Zmod21')
save('ZphzWoCellsMCF760.mat','Zphz21')
save('FreqWoCellsMCF760.mat','Freq21')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_90MV_';        %String for reading
Excel document

Zmod22=[];
Zphz22=[];
Freq22=[];

for c=1:b

        Zmod22=[Zmod22  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz22=[Zphz22  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq22=[Freq22  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMCF790.mat','Zmod22')
save('ZphzWoCellsMCF790.mat','Zphz22')
save('FreqWoCellsMCF790.mat','Freq22')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
```

```
Data\P_EIS_MDA_NO_CELL_120MV_';        %String for reading
Excel document

Zmod23=[];
Zphz23=[];
Freq23=[];

for c=1:b

        Zmod23=[Zmod23  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz23=[Zphz23  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq23=[Freq23  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMCF7120.mat','Zmod23')
save('ZphzWoCellsMCF7120.mat','Zphz23')
save('FreqWoCellsMCF7120.mat','Freq23')

STR = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_NO_CELL_150MV_';        %String for reading
Excel document

Zmod24=[];
Zphz24=[];
Freq24=[];

for c=1:b

        Zmod24=[Zmod24  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz24=[Zphz24  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq24=[Freq24  xlsread([STR num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWoCellsMCF7150.mat','Zmod24')
save('ZphzWoCellsMCF7150.mat','Zphz24')
```

```
save('FreqWoCellsMCF7150.mat','Freq24')


%%          Data With Cells - MCF-7

e=5;        %Number of uPores evaluated
c=1;        %iniciate uPores evaluated

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_30MV_';        %String for reading
Excel document. URL documents

Zmod25=[];
Zphz25=[];
Freq25=[];


for c=1:e

        Zmod25=[Zmod25  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz25=[Zphz25  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq25=[Freq25  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMCF730.mat','Zmod25')
save('ZphzWCellsMCF730.mat','Zphz25')
save('FreqWCellsMCF730.mat','Freq25')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_60MV_';        %String for reading
Excel document. URL documents

Zmod26=[];
Zphz26=[];
Freq26=[];


for c=1:e
```

```
        Zmod26=[Zmod26  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz26=[Zphz26  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq26=[Freq26  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMCF760.mat','Zmod26')
save('ZphzWCellsMCF760.mat','Zphz26')
save('FreqWCellsMCF760.mat','Freq26')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_90MV_';        %String for reading
Excel document. URL documents

Zmod27=[];
Zphz27=[];
Freq27=[];


for c=1:e

        Zmod27=[Zmod27  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz27=[Zphz27  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq27=[Freq27  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMCF790.mat','Zmod27')
save('ZphzWCellsMCF790.mat','Zphz27')
save('FreqWCellsMCF790.mat','Freq27')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_120MV_';        %String for reading
Excel document. URL documents

Zmod28=[];
```

```
Zphz28=[];
Freq28=[];


for c=1:e

        Zmod28=[Zmod28  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz28=[Zphz28  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq28=[Freq28  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMCF7120.mat','Zmod28')
save('ZphzWCellsMCF7120.mat','Zphz28')
save('FreqWCellsMCF7120.mat','Freq28')

STR1 = 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190401 Wcells MDA\Excel
Data\P_EIS_MDA_CELL_150MV_';        %String for reading
Excel document. URL documents

Zmod29=[];
Zphz29=[];
Freq29=[];


for c=1:e

        Zmod29=[Zmod29  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz29=[Zphz29  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq29=[Freq29  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
save('ZmodWCellsMCF7150.mat','Zmod29')
save('ZphzWCellsMCF7150.mat','Zphz29')
save('FreqWCellsMCF7150.mat','Freq29')
```

EIS Plot Cells (MATLAB)

```
%%          DiazLab Microfluidics Laboratory
%               Marco A. Becerra Arias
%             Eugenio Caraballo Justiniano
%                       03262019
%         University of Puerto Rico at Mayaguez
%           Plot Data uPore with & w/o cells
%   New Experiment Data analysis without previous data


A = load('ZmodWoCellsHeLa30.mat');
B = load('ZphzWoCellsHeLa30.mat');
C = load('FreqWoCellsHeLa30.mat');
D = load('ZmodWCellsHeLa30.mat');
E = load('ZphzWCellsHeLa30.mat');
F = load('FreqWCellsHeLa30.mat');

G = load('ZmodWoCellsHeLa60.mat');
H = load('ZphzWoCellsHeLa60.mat');
I = load('FreqWoCellsHeLa60.mat');
J = load('ZmodWCellsHeLa60.mat');
K = load('ZphzWCellsHeLa60.mat');
L = load('FreqWCellsHeLa60.mat');

M = load('ZmodWoCellsHeLa90.mat');
N = load('ZphzWoCellsHeLa90.mat');
O = load('FreqWoCellsHeLa90.mat');
P = load('ZmodWCellsHeLa90.mat');
Q = load('ZphzWCellsHeLa90.mat');
R = load('FreqWCellsHeLa90.mat');

S = load('ZmodWoCellsHeLa120.mat');
T = load('ZphzWoCellsHeLa120.mat');
U = load('FreqWoCellsHeLa120.mat');
V = load('ZmodWCellsHeLa120.mat');
W = load('ZphzWCellsHeLa120.mat');
X = load('FreqWCellsHeLa120.mat');

Y = load('ZmodWoCellsHeLa150.mat');
Z = load('ZphzWoCellsHeLa150.mat');
AA = load('FreqWoCellsHeLa150.mat');
AB = load('ZmodWCellsHeLa150.mat');
```

```
AC = load('ZphzWCellsHeLa150.mat');
AD = load('FreqWCellsHeLa150.mat');


AE = load('ZmodWoCellsMDA30.mat');
AF = load('ZphzWoCellsMDA30.mat');
AG = load('FreqWoCellsMDA30.mat');
AH = load('ZmodWCellsMDA30.mat');
AI = load('ZphzWCellsMDA30.mat');
AJ = load('FreqWCellsMDA30.mat');

AK = load('ZmodWoCellsMDA60.mat');
AL = load('ZphzWoCellsMDA60.mat');
AM = load('FreqWoCellsMDA60.mat');
AN = load('ZmodWCellsMDA60.mat');
AO = load('ZphzWCellsMDA60.mat');
AP = load('FreqWCellsMDA60.mat');

AQ = load('ZmodWoCellsMDA90.mat');
AR = load('ZphzWoCellsMDA90.mat');
AS = load('FreqWoCellsMDA90.mat');
AT = load('ZmodWCellsMDA90.mat');
AU = load('ZphzWCellsMDA90.mat');
AV = load('FreqWCellsMDA90.mat');

AW = load('ZmodWoCellsMDA120.mat');
AX = load('ZphzWoCellsMDA120.mat');
AY = load('FreqWoCellsMDA120.mat');
AZ = load('ZmodWCellsMDA120.mat');
BA = load('ZphzWCellsMDA120.mat');
BB = load('FreqWCellsMDA120.mat');

BC = load('ZmodWoCellsMDA150.mat');
BD = load('ZphzWoCellsMDA150.mat');
BE = load('FreqWoCellsMDA150.mat');
BF = load('ZmodWCellsMDA150.mat');
BG = load('ZphzWCellsMDA150.mat');
BH = load('FreqWCellsMDA150.mat');

BI = load('ZmodWoCellsMCF730.mat');
BJ = load('ZphzWoCellsMCF730.mat');
BK = load('FreqWoCellsMCF730.mat');
BL = load('ZmodWCellsMCF730.mat');
BM = load('ZphzWCellsMCF730.mat');
```

```
BN = load('FreqWCellsMCF730.mat');

BO = load('ZmodWoCellsMCF760.mat');
BP = load('ZphzWoCellsMCF760.mat');
BQ = load('FreqWoCellsMCF760.mat');
BR = load('ZmodWCellsMCF760.mat');
BS = load('ZphzWCellsMCF760.mat');
BT = load('FreqWCellsMCF760.mat');

BU = load('ZmodWoCellsMCF790.mat');
BV = load('ZphzWoCellsMCF790.mat');
BW = load('FreqWoCellsMCF790.mat');
BX = load('ZmodWCellsMCF790.mat');
BY = load('ZphzWCellsMCF790.mat');
BZ = load('FreqWCellsMCF790.mat');

CA = load('ZmodWoCellsMCF7120.mat');
CB = load('ZphzWoCellsMCF7120.mat');
CC = load('FreqWoCellsMCF7120.mat');
CD = load('ZmodWCellsMCF7120.mat');
CE = load('ZphzWCellsMCF7120.mat');
CF = load('FreqWCellsMCF7120.mat');

CG = load('ZmodWoCellsMCF7150.mat');
CH = load('ZphzWoCellsMCF7150.mat');
CI = load('FreqWoCellsMCF7150.mat');
CJ = load('ZmodWCellsMCF7150.mat');
CK = load('ZphzWCellsMCF7150.mat');
CL = load('FreqWCellsMCF7150.mat');


ZmodWoHeLa30 = A.Zmod;
ZphzWoHeLa30 = B.Zphz;
FreqWoHeLa30 = C.Freq;

ZmodWoHeLa60 = G.Zmod1;
ZphzWoHeLa60 = H.Zphz1;
FreqWoHeLa60 = I.Freq1;

ZmodWoHeLa90 = M.Zmod2;
ZphzWoHeLa90 = N.Zphz2;
FreqWoHeLa90 = O.Freq2;

ZmodWoHeLa120 = S.Zmod3;
```

```
ZphzWoHeLa120 = T.Zphz3;
FreqWoHeLa120 = U.Freq3;

ZmodWoHeLa150 = Y.Zmod4;
ZphzWoHeLa150 = Z.Zphz4;
FreqWoHeLa150 = AA.Freq4;


ZmodWHeLa30 = D.Zmod5;
ZphzWHeLa30 = E.Zphz5;
FreqWHeLa30 = F.Freq5;

ZmodWHeLa60 = J.Zmod6;
ZphzWHeLa60 = K.Zphz6;
FreqWHeLa60 = L.Freq6;

ZmodWHeLa90 = P.Zmod7;
ZphzWHeLa90 = Q.Zphz7;
FreqWHeLa90 = R.Freq7;

ZmodWHeLa120 = V.Zmod8;
ZphzWHeLa120 = W.Zphz8;
FreqWHeLa120 = X.Freq8;

ZmodWHeLa150 = AB.Zmod9;
ZphzWHeLa150 = AC.Zphz9;
FreqWHeLa150 = AD.Freq9;


ZmodWoMCF730 = BI.Zmod20;
ZphzWoMCF730 = BJ.Zphz20;
FreqWoMCF730 = BK.Freq20;

ZmodWoMCF760 = BO.Zmod21;
ZphzWoMCF760 = BP.Zphz21;
FreqWoMCF760 = BQ.Freq21;

ZmodWoMCF790 = BU.Zmod22;
ZphzWoMCF790 = BV.Zphz22;
FreqWoMCF790 = BW.Freq22;

ZmodWoMCF7120 = CA.Zmod23;
ZphzWoMCF7120 = CB.Zphz23;
FreqWoMCF7120 = CC.Freq23;
```

```
ZmodWoMCF7150 = CG.Zmod24;
ZphzWoMCF7150 = CH.Zphz24;
FreqWoMCF7150 = CI.Freq24;


ZmodWMCF730 = BL.Zmod25;
ZphzWMCF730 = BM.Zphz25;
FreqWMCF730 = BN.Freq25;

ZmodWMCF760 = BR.Zmod26;
ZphzWMCF760 = BS.Zphz26;
FreqWMCF760 = BT.Freq26;

ZmodWMCF790 = BX.Zmod27;
ZphzWMCF790 = BY.Zphz27;
FreqWMCF790 = BZ.Freq27;

ZmodWMCF7120 = CD.Zmod28;
ZphzWMCF7120 = CE.Zphz28;
FreqWMCF7120 = CF.Freq28;

ZmodWMCF7150 = CJ.Zmod29;
ZphzWMCF7150 = CK.Zphz29;
FreqWMCF7150 = CL.Freq29;

ZmodAvgWoHeLa30 = (mean(ZmodWoHeLa30'))';
ZphzAvgWoHeLa30 = (mean(ZphzWoHeLa30'))';
FreqAvgWoHeLa30 = (mean(FreqWoHeLa30'))';
ZmodAvgWHeLa30 = (mean(ZmodWHeLa30'))';
ZphzAvgWHeLa30 = (mean(ZphzWHeLa30'))';
FreqAvgWHeLa30 = (mean(FreqWHeLa30'))';

ZmodAvgWoHeLa60 = (mean(ZmodWoHeLa60'))';
ZphzAvgWoHeLa60 = (mean(ZphzWoHeLa60'))';
FreqAvgWoHeLa60 = (mean(FreqWoHeLa60'))';
ZmodAvgWHeLa60 = (mean(ZmodWHeLa60'))';
ZphzAvgWHeLa60 = (mean(ZphzWHeLa60'))';
FreqAvgWHeLa60 = (mean(FreqWHeLa60'))';

ZmodAvgWoHeLa90 = (mean(ZmodWoHeLa90'))';
ZphzAvgWoHeLa90 = (mean(ZphzWoHeLa90'))';
FreqAvgWoHeLa90 = (mean(FreqWoHeLa90'))';
ZmodAvgWHeLa90 = (mean(ZmodWHeLa90'))';
ZphzAvgWHeLa90 = (mean(ZphzWHeLa90'))';
```

```
FreqAvgWHeLa90 = (mean(FreqWHeLa90'))';

ZmodAvgWoHeLa120 = (mean(ZmodWoHeLa120'))';
ZphzAvgWoHeLa120 = (mean(ZphzWoHeLa120'))';
FreqAvgWoHeLa120 = (mean(FreqWoHeLa120'))';
ZmodAvgWHeLa120 = (mean(ZmodWHeLa120'))';
ZphzAvgWHeLa120 = (mean(ZphzWHeLa120'))';
FreqAvgWHeLa120 = (mean(FreqWHeLa120'))';

ZmodAvgWoHeLa150 = (mean(ZmodWoHeLa150'))';
ZphzAvgWoHeLa150 = (mean(ZphzWoHeLa150'))';
FreqAvgWoHeLa150 = (mean(FreqWoHeLa150'))';
ZmodAvgWHeLa150 = (mean(ZmodWHeLa150'))';
ZphzAvgWHeLa150 = (mean(ZphzWHeLa150'))';
FreqAvgWHeLa150 = (mean(FreqWHeLa150'))';


ZmodAvgWoMDA30 = (mean(ZmodWoMDA30'))';
ZphzAvgWoMDA30 = (mean(ZphzWoMDA30'))';
FreqAvgWoMDA30 = (mean(FreqWoMDA30'))';
ZmodAvgWMDA30 = (mean(ZmodWMDA30'))';
ZphzAvgWMDA30 = (mean(ZphzWMDA30'))';
FreqAvgWMDA30 = (mean(FreqWMDA30'))';

ZmodAvgWoMDA60 = (mean(ZmodWoMDA60'))';
ZphzAvgWoMDA60 = (mean(ZphzWoMDA60'))';
FreqAvgWoMDA60 = (mean(FreqWoMDA60'))';
ZmodAvgWMDA60 = (mean(ZmodWMDA60'))';
ZphzAvgWMDA60 = (mean(ZphzWMDA60'))';
FreqAvgWMDA60 = (mean(FreqWMDA60'))';

ZmodAvgWoMDA90 = (mean(ZmodWoMDA90'))';
ZphzAvgWoMDA90 = (mean(ZphzWoMDA90'))';
FreqAvgWoMDA90 = (mean(FreqWoMDA90'))';
ZmodAvgWMDA90 = (mean(ZmodWMDA90'))';
ZphzAvgWMDA90 = (mean(ZphzWMDA90'))';
FreqAvgWMDA90 = (mean(FreqWMDA90'))';

ZmodAvgWoMDA120 = (mean(ZmodWoMDA120'))';
ZphzAvgWoMDA120 = (mean(ZphzWoMDA120'))';
FreqAvgWoMDA120 = (mean(FreqWoMDA120'))';
ZmodAvgWMDA120 = (mean(ZmodWMDA120'))';
ZphzAvgWMDA120 = (mean(ZphzWMDA120'))';
FreqAvgWMDA120 = (mean(FreqWMDA120'))';
```

```
ZmodAvgWoMDA150 = (mean(ZmodWoMDA150'))';
ZphzAvgWoMDA150 = (mean(ZphzWoMDA150'))';
FreqAvgWoMDA150 = (mean(FreqWoMDA150'))';
ZmodAvgWMDA150 = (mean(ZmodWMDA150'))';
ZphzAvgWMDA150 = (mean(ZphzWMDA150'))';
FreqAvgWMDA150 = (mean(FreqWMDA150'))';


ZmodAvgWoMCF730 = (mean(ZmodWoMCF730'))';
ZphzAvgWoMCF730 = (mean(ZphzWoMCF730'))';
FreqAvgWoMCF730 = (mean(FreqWoMCF730'))';
ZmodAvgWMCF730 = (mean(ZmodWMCF730'))';
ZphzAvgWMCF730 = (mean(ZphzWMCF730'))';
FreqAvgWMCF730 = (mean(FreqWMCF730'))';

ZmodAvgWoMCF760 = (mean(ZmodWoMCF760'))';
ZphzAvgWoMCF760 = (mean(ZphzWoMCF760'))';
FreqAvgWoMCF760 = (mean(FreqWoMCF760'))';
ZmodAvgWMCF760 = (mean(ZmodWMCF760'))';
ZphzAvgWMCF760 = (mean(ZphzWMCF760'))';
FreqAvgWMCF760 = (mean(FreqWMCF760'))';

ZmodAvgWoMCF790 = (mean(ZmodWoMCF790'))';
ZphzAvgWoMCF790 = (mean(ZphzWoMCF790'))';
FreqAvgWoMCF790 = (mean(FreqWoMCF790'))';
ZmodAvgWMCF790 = (mean(ZmodWMCF790'))';
ZphzAvgWMCF790 = (mean(ZphzWMCF790'))';
FreqAvgWMCF790 = (mean(FreqWMCF790'))';

ZmodAvgWoMCF7120 = (mean(ZmodWoMCF7120'))';
ZphzAvgWoMCF7120 = (mean(ZphzWoMCF7120'))';
FreqAvgWoMCF7120 = (mean(FreqWoMCF7120'))';
ZmodAvgWMCF7120 = (mean(ZmodWMCF7120'))';
ZphzAvgWMCF7120 = (mean(ZphzWMCF7120'))';
FreqAvgWMCF7120 = (mean(FreqWMCF7120'))';

ZmodAvgWoMCF7150 = (mean(ZmodWoMCF7150'))';
ZphzAvgWoMCF7150 = (mean(ZphzWoMCF7150'))';
FreqAvgWoMCF7150 = (mean(FreqWoMCF7150'))';
ZmodAvgWMCF7150 = (mean(ZmodWMCF7150'))';
ZphzAvgWMCF7150 = (mean(ZphzWMCF7150'))';
FreqAvgWMCF7150 = (mean(FreqWMCF7150'))';
```

```
FREQ=FreqAvgWHeLa30;


%       Removing the background noise in the data - HeLa
(30 mV)


[a3,a4]=size(ZmodWHeLa30);
ZmodAbsHeLa30=[];
ZphzAbsHeLa30=[];
for i=1:a4
   ZmodAbsHeLa30=[ZmodAbsHeLa30 (ZmodWHeLa30(:,i)-
ZmodAvgWoHeLa30)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsHeLa30=[ZphzAbsHeLa30 (ZphzWHeLa30(:,i)-
ZphzAvgWoHeLa30)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgHeLa30= (mean(ZmodAbsHeLa30'))';
ZphzAbsAvgHeLa30= (mean(ZphzAbsHeLa30'))';

%       Removing the background noise in the data - HeLa
(60 mV)


[a5,a6]=size(ZmodWHeLa60);
ZmodAbsHeLa60=[];
ZphzAbsHeLa60=[];
for i=1:a6
   ZmodAbsHeLa60=[ZmodAbsHeLa60 (ZmodWHeLa60(:,i)-
ZmodAvgWoHeLa60)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsHeLa60=[ZphzAbsHeLa60 (ZphzWHeLa60(:,i)-
ZphzAvgWoHeLa60)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgHeLa60= (mean(ZmodAbsHeLa60'))';
ZphzAbsAvgHeLa60= (mean(ZphzAbsHeLa60'))';
```

```
%       Removing the background noise in the data - HeLa
(90 mV)


[a7,a8]=size(ZmodWHeLa90);
ZmodAbsHeLa90=[];
ZphzAbsHeLa90=[];
for i=1:a8
   ZmodAbsHeLa90=[ZmodAbsHeLa90 (ZmodWHeLa90(:,i)-
ZmodAvgWoHeLa90)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsHeLa90=[ZphzAbsHeLa90 (ZphzWHeLa90(:,i)-
ZphzAvgWoHeLa90)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgHeLa90= (mean(ZmodAbsHeLa90'))';
ZphzAbsAvgHeLa90= (mean(ZphzAbsHeLa90'))';

%       Removing the background noise in the data - HeLa
(120 mV)


[a9,a10]=size(ZmodWHeLa120);
ZmodAbsHeLa120=[];
ZphzAbsHeLa120=[];
for i=1:a10
   ZmodAbsHeLa120=[ZmodAbsHeLa120 (ZmodWHeLa120(:,i)-
ZmodAvgWoHeLa120)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsHeLa120=[ZphzAbsHeLa120 (ZphzWHeLa120(:,i)-
ZphzAvgWoHeLa120)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgHeLa120= (mean(ZmodAbsHeLa120'))';
ZphzAbsAvgHeLa120= (mean(ZphzAbsHeLa120'))';

%       Removing the background noise in the data - HeLa
(150 mV)
```

```
[a11,a12]=size(ZmodWHeLa150);
ZmodAbsHeLa150=[];
ZphzAbsHeLa150=[];
for i=1:a12
   ZmodAbsHeLa150=[ZmodAbsHeLa150 (ZmodWHeLa150(:,i)-
ZmodAvgWoHeLa150)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsHeLa150=[ZphzAbsHeLa150 (ZphzWHeLa150(:,i)-
ZphzAvgWoHeLa150)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgHeLa150= (mean(ZmodAbsHeLa150'))';
ZphzAbsAvgHeLa150= (mean(ZphzAbsHeLa150'))';



%       Removing the background noise in the data - MDA (30
mV)


[a13,a14]=size(ZmodWMDA30);
ZmodAbsMDA30=[];
ZphzAbsMDA30=[];
for i=1:a14
   ZmodAbsMDA30=[ZmodAbsMDA30 (ZmodWMDA30(:,i)-
ZmodAvgWoMDA30)];                           %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMDA30=[ZphzAbsMDA30 (ZphzWMDA30(:,i)-
ZphzAvgWoMDA30)];                           %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMDA30= (mean(ZmodAbsMDA30'))';
ZphzAbsAvgMDA30= (mean(ZphzAbsMDA30'))';

%       Removing the background noise in the data - MDA (60
mV)


[a15,a16]=size(ZmodWMDA60);
ZmodAbsMDA60=[];
```

```
ZphzAbsMDA60=[];
for i=1:a16
   ZmodAbsMDA60=[ZmodAbsMDA60 (ZmodWMDA60(:,i)-
ZmodAvgWoMDA60)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMDA60=[ZphzAbsMDA60 (ZphzWMDA60(:,i)-
ZphzAvgWoMDA60)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMDA60= (mean(ZmodAbsMDA60'))';
ZphzAbsAvgMDA60= (mean(ZphzAbsMDA60'))';

%       Removing the background noise in the data - MDA (90
mV)


[a17,a18]=size(ZmodWMDA90);
ZmodAbsMDA90=[];
ZphzAbsMDA90=[];
for i=1:a18
   ZmodAbsMDA90=[ZmodAbsMDA90 (ZmodWMDA90(:,i)-
ZmodAvgWoMDA90)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMDA90=[ZphzAbsMDA90 (ZphzWMDA90(:,i)-
ZphzAvgWoMDA90)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMDA90= (mean(ZmodAbsMDA90'))';
ZphzAbsAvgMDA90= (mean(ZphzAbsMDA90'))';

%       Removing the background noise in the data - MDA
(120 mV)


[a19,a20]=size(ZmodWMDA120);
ZmodAbsMDA120=[];
ZphzAbsMDA120=[];
for i=1:a20
```

```
   ZmodAbsMDA120=[ZmodAbsMDA120 (ZmodWMDA120(:,i)-
ZmodAvgWoMDA120)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMDA120=[ZphzAbsMDA120 (ZphzWMDA120(:,i)-
ZphzAvgWoMDA120)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMDA120= (mean(ZmodAbsMDA120'))';
ZphzAbsAvgMDA120= (mean(ZphzAbsMDA120'))';

%       Removing the background noise in the data - MDA
(150 mV)


[a21,a22]=size(ZmodWMDA30);
ZmodAbsMDA150=[];
ZphzAbsMDA150=[];
for i=1:a22
   ZmodAbsMDA150=[ZmodAbsMDA150 (ZmodWMDA150(:,i)-
ZmodAvgWoMDA150)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMDA150=[ZphzAbsMDA150 (ZphzWMDA150(:,i)-
ZphzAvgWoMDA150)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMDA150= (mean(ZmodAbsMDA150'))';
ZphzAbsAvgMDA150= (mean(ZphzAbsMDA150'))';


%       Removing the background noise in the data - MCF-7
(30 mV)


[a23,a24]=size(ZmodWMCF730);
ZmodAbsMCF730=[];
ZphzAbsMCF730=[];
for i=1:a24
   ZmodAbsMCF730=[ZmodAbsMCF730 (ZmodWMCF730(:,i)-
ZmodAvgWoMCF730)];                          %Cell Impedance
without device background noise -Absolute cell impedance
```

```
   ZphzAbsMCF730=[ZphzAbsMCF730 (ZphzWMCF730(:,i)-
ZphzAvgWoMCF730)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMCF730= (mean(ZmodAbsMCF730'))';
ZphzAbsAvgMCF730= (mean(ZphzAbsMCF730'))';

%       Removing the background noise in the data - MCF-7
(60 mV)


[a25,a26]=size(ZmodWMCF760);
ZmodAbsMCF760=[];
ZphzAbsMCF760=[];
for i=1:a26
   ZmodAbsMCF760=[ZmodAbsMCF760 (ZmodWMCF760(:,i)-
ZmodAvgWoMCF760)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMCF760=[ZphzAbsMCF760 (ZphzWMCF760(:,i)-
ZphzAvgWoMCF760)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMCF760= (mean(ZmodAbsMCF760'))';
ZphzAbsAvgMCF760= (mean(ZphzAbsMCF760'))';

%       Removing the background noise in the data - MCF-7
(90 mV)


[a27,a28]=size(ZmodWMCF790);
ZmodAbsMCF790=[];
ZphzAbsMCF790=[];
for i=1:a28
   ZmodAbsMCF790=[ZmodAbsMCF790 (ZmodWMCF790(:,i)-
ZmodAvgWoMCF790)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMCF790=[ZphzAbsMCF790 (ZphzWMCF790(:,i)-
ZphzAvgWoMCF790)];                          %Cell Phase
without device background noise -Absolute cell phase
```

```
end

ZmodAbsAvgMCF790= (mean(ZmodAbsMCF790'))';
ZphzAbsAvgMCF790= (mean(ZphzAbsMCF790'))';

%       Removing the background noise in the data - MCF-7
(120 mV)


[a29,a30]=size(ZmodWMCF7120);
ZmodAbsMCF7120=[];
ZphzAbsMCF7120=[];
for i=1:a30
   ZmodAbsMCF7120=[ZmodAbsMCF7120 (ZmodWMCF7120(:,i)-
ZmodAvgWoMCF7120)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMCF7120=[ZphzAbsMCF7120 (ZphzWMCF7120(:,i)-
ZphzAvgWoMCF7120)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMCF7120= (mean(ZmodAbsMCF7120'))';
ZphzAbsAvgMCF7120= (mean(ZphzAbsMCF7120'))';

%       Removing the background noise in the data - MCF-7
(150 mV)


[a31,a32]=size(ZmodWMCF730);
ZmodAbsMCF7150=[];
ZphzAbsMCF7150=[];
for i=1:a32
   ZmodAbsMCF7150=[ZmodAbsMCF7150 (ZmodWMCF7150(:,i)-
ZmodAvgWoMCF7150)];                          %Cell Impedance
without device background noise -Absolute cell impedance
   ZphzAbsMCF7150=[ZphzAbsMCF7150 (ZphzWMCF7150(:,i)-
ZphzAvgWoMCF7150)];                          %Cell Phase
without device background noise -Absolute cell phase

end

ZmodAbsAvgMCF7150= (mean(ZmodAbsMCF7150'))';
ZphzAbsAvgMCF7150= (mean(ZphzAbsMCF7150'))';
```

```
%            Difference or Substraction of MDA-MB-231 &
HeLa (30 mV)

DifZmodHeLa30 = ZmodAvgWHeLa30 - ZmodAvgWoHeLa30;
DifZphzHeLa30 = ZphzAvgWHeLa30 - ZphzAvgWoHeLa30;

DifZmodMCF730 = ZmodAvgWMDA30 - ZmodAvgWoMDA30;
DifZphzMCF730 = ZphzAvgWMDA30 - ZphzAvgWoMDA30;


DifZmodHeLaMCF730 = DifZmodHeLa30 - DifZmodMCF730;
DifZphzHeLaMCF730 = DifZphzHeLa30 - DifZphzMCF730;

%            Difference or Substraction of MDA-MB-231 &
HeLa (60 mV)

DifZmodHeLa60 = ZmodAvgWHeLa60 - ZmodAvgWoHeLa60;
DifZphzHeLa60 = ZphzAvgWHeLa60 - ZphzAvgWoHeLa60;

DifZmodMCF760 = ZmodAvgWMDA60 - ZmodAvgWoMDA60;
DifZphzMCF760 = ZphzAvgWMDA60 - ZphzAvgWoMDA60;


DifZmodHeLaMCF760 = DifZmodHeLa60 - DifZmodMCF760;
DifZphzHeLaMCF760 = DifZphzHeLa60 - DifZphzMCF760;

%            Difference or Substraction of MDA-MB-231 &
HeLa (90 mV)

DifZmodHeLa90 = ZmodAvgWHeLa90 - ZmodAvgWoHeLa90;
DifZphzHeLa90 = ZphzAvgWHeLa90 - ZphzAvgWoHeLa90;

DifZmodMCF790 = ZmodAvgWMDA90 - ZmodAvgWoMDA90;
DifZphzMCF790 = ZphzAvgWMDA90 - ZphzAvgWoMDA90;


DifZmodHeLaMCF790 = DifZmodHeLa90 - DifZmodMCF790;
DifZphzHeLaMCF790 = DifZphzHeLa90 - DifZphzMCF790;

%            Difference or Substraction of MDA-MB-231 &
HeLa (120 mV)
```

```
DifZmodHeLa120 = ZmodAvgWHeLa120 - ZmodAvgWoHeLa120;
DifZphzHeLa120 = ZphzAvgWHeLa120 - ZphzAvgWoHeLa120;

DifZmodMCF7120 = ZmodAvgWMDA120 - ZmodAvgWoMDA120;
DifZphzMCF7120 = ZphzAvgWMDA120 - ZphzAvgWoMDA120;


DifZmodHeLaMCF7120 = DifZmodHeLa120 - DifZmodMCF7120;
DifZphzHeLaMCF7120 = DifZphzHeLa120 - DifZphzMCF7120;

%            Difference or Substraction of MDA-MB-231 &
HeLa (150 mV)

DifZmodHeLa150 = ZmodAvgWHeLa150 - ZmodAvgWoHeLa150;
DifZphzHeLa150 = ZphzAvgWHeLa150 - ZphzAvgWoHeLa150;

DifZmodMCF7150 = ZmodAvgWMDA150 - ZmodAvgWoMDA150;
DifZphzMCF7150 = ZphzAvgWMDA150 - ZphzAvgWoMDA150;


DifZmodHeLaMCF7150 = DifZmodHeLa150 - DifZmodMCF7150;
DifZphzHeLaMCF7150 = DifZphzHeLa150 - DifZphzMCF7150;



%            Difference or Substraction of MCF-7 & HeLa (30
mV)

DifZmodHeLa30 = ZmodAvgWHeLa30 - ZmodAvgWoHeLa30;
DifZphzHeLa30 = ZphzAvgWHeLa30 - ZphzAvgWoHeLa30;

DifZmodMCF730 = ZmodAvgWMCF730 - ZmodAvgWoMCF730;
DifZphzMCF730 = ZphzAvgWMCF730 - ZphzAvgWoMCF730;


DifZmodHeLaMCF730 = DifZmodHeLa30 - DifZmodMCF730;
DifZphzHeLaMCF730 = DifZphzHeLa30 - DifZphzMCF730;

%            Difference or Substraction of MCF-7 & HeLa (60
mV)

DifZmodHeLa60 = ZmodAvgWHeLa60 - ZmodAvgWoHeLa60;
DifZphzHeLa60 = ZphzAvgWHeLa60 - ZphzAvgWoHeLa60;

DifZmodMCF760 = ZmodAvgWMCF760 - ZmodAvgWoMCF760;
```

```
DifZphzMCF760 = ZphzAvgWMCF760 - ZphzAvgWoMCF760;


DifZmodHeLaMCF760 = DifZmodHeLa60 - DifZmodMCF760;
DifZphzHeLaMCF760 = DifZphzHeLa60 - DifZphzMCF760;

%            Difference or Substraction of MCF-7 & HeLa (90
mV)

DifZmodHeLa90 = ZmodAvgWHeLa90 - ZmodAvgWoHeLa90;
DifZphzHeLa90 = ZphzAvgWHeLa90 - ZphzAvgWoHeLa90;

DifZmodMCF790 = ZmodAvgWMCF790 - ZmodAvgWoMCF790;
DifZphzMCF790 = ZphzAvgWMCF790 - ZphzAvgWoMCF790;


DifZmodHeLaMCF790 = DifZmodHeLa90 - DifZmodMCF790;
DifZphzHeLaMCF790 = DifZphzHeLa90 - DifZphzMCF790;

%            Difference or Substraction of MCF-7 & HeLa
(120 mV)

DifZmodHeLa120 = ZmodAvgWHeLa120 - ZmodAvgWoHeLa120;
DifZphzHeLa120 = ZphzAvgWHeLa120 - ZphzAvgWoHeLa120;

DifZmodMCF7120 = ZmodAvgWMCF7120 - ZmodAvgWoMCF7120;
DifZphzMCF7120 = ZphzAvgWMCF7120 - ZphzAvgWoMCF7120;


DifZmodHeLaMCF7120 = DifZmodHeLa120 - DifZmodMCF7120;
DifZphzHeLaMCF7120 = DifZphzHeLa120 - DifZphzMCF7120;

%            Difference or Substraction of MCF-7 & HeLa
(150 mV)

DifZmodHeLa150 = ZmodAvgWHeLa150 - ZmodAvgWoHeLa150;
DifZphzHeLa150 = ZphzAvgWHeLa150 - ZphzAvgWoHeLa150;

DifZmodMCF7150 = ZmodAvgWMCF7150 - ZmodAvgWoMCF7150;
DifZphzMCF7150 = ZphzAvgWMCF7150 - ZphzAvgWoMCF7150;


DifZmodHeLaMCF7150 = DifZmodHeLa150 - DifZmodMCF7150;
DifZphzHeLaMCF7150 = DifZphzHeLa150 - DifZphzMCF7150;
```

```
% StdZmodMDA=std(ZmodWMDA,0,2);
% LowmodMDA=ZmodAvgWMDA-StdZmodMDA;
% UpmodMDA=ZmodAvgWMDA+StdZmodMDA;
%
% StdZmodHeLa=std(ZmodWHeLa,0,2);
% LowmodHeLa=ZmodAvgWHeLa-StdZmodHeLa;
% UpmodHeLa=ZmodAvgWHeLa+StdZmodHeLa;
%
% StdZphzMDA=std(ZphzWMDA,0,2);
% LowphzMDA=ZphzAvgWMDA-StdZphzMDA;
% UpphzMDA=ZphzAvgWMDA+StdZphzMDA;
%
% StdZphzHeLa=std(ZphzWHeLa,0,2);
% LowphzHeLa=ZphzAvgWHeLa-StdZphzHeLa;
% UpphzHeLa=ZphzAvgWHeLa+StdZphzHeLa;
%
% StdZmodAvgWoPrueba=std(ZmodWoPrueba,0,2);
% LowZmodAvgWoPrueba=ZmodAvgWoPrueba-StdZmodAvgWoPrueba;
% UpZmodAvgWoPrueba=ZmodAvgWoPrueba+StdZmodAvgWoPrueba;
%
% StdZphzAvgWoPrueba=std(ZphzWoPrueba,0,2);
% LowZphzAvgWoPrueba=(ZphzAvgWoPrueba-StdZphzAvgWoPrueba);
% UpZphzAvgWoPrueba=(ZphzAvgWoPrueba+StdZphzAvgWoPrueba);
%
% StdZmodWcellsMDA=std(ZmodWcellsMDA,0,2);
% LowZmodWcellsMDA=ZmodAvgWcellsMDA-StdZmodWcellsMDA;
% UpZmodWcellsMDA=ZmodAvgWcellsMDA+StdZmodWcellsMDA;
%
% StdZphzWcellsMDA=std(ZphzWcellsMDA,0,2);
% LowZphzWcellsMDA=(ZphzAvgWcellsMDA-StdZphzWcellsMDA);
% UpZphzWcellsMDA=(ZphzAvgWcellsMDA+StdZphzWcellsMDA);


%%

%                                        WITH & WITHOUT CELLS -
HeLa (30 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(1)
semilogx(FREQ,ZphzWHeLa30)
```

```
hold on
semilogx(FREQ,ZphzAvgWoHeLa30, '--r')
hold on
title('HeLa Phase Angle (30 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Phase Angle (30 mV)'];
    saveas(gcf, stra, 'png')


figure(2)
loglog(FREQ,ZmodWHeLa30)
hold on
loglog(FREQ,ZmodAvgWoHeLa30, '--r')
hold on
title('HeLa Impedance (30 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
```

```
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Impedance (30 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       WITH & WITHOUT CELLS -
HeLa (60 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(3)
semilogx(FREQ,ZphzWHeLa60)
hold on
semilogx(FREQ,ZphzAvgWoHeLa60, '--r')
hold on
title('HeLa Phase Angle (60 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Phase Angle (60 mV)'];
```

```
    saveas(gcf, stra, 'png')


figure(4)
loglog(FREQ,ZmodWHeLa60)
hold on
loglog(FREQ,ZmodAvgWoHeLa60, '--r')
hold on
title('HeLa Impedance (60 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Impedance (60 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
HeLa (90 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(5)
semilogx(FREQ,ZphzWHeLa90)
hold on
semilogx(FREQ,ZphzAvgWoHeLa90, '--r')
hold on
title('HeLa Phase Angle (90 mV)','FontSize',20)
```

```
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Phase Angle (90 mV)'];
    saveas(gcf, stra, 'png')


figure(6)
loglog(FREQ,ZmodWHeLa90)
hold on
loglog(FREQ,ZmodAvgWoHeLa90, '--r')
hold on
title('HeLa Impedance (90 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Impedance (90 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
HeLa (120 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(7)
semilogx(FREQ,ZphzWHeLa120)
hold on
semilogx(FREQ,ZphzAvgWoHeLa120, '--r')
hold on
title('HeLa Phase Angle (120 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Phase Angle (120 mV)'];
    saveas(gcf, stra, 'png')


figure(8)
```

```
loglog(FREQ,ZmodWHeLa120)
hold on
loglog(FREQ,ZmodAvgWoHeLa120, '--r')
hold on
title('HeLa Impedance (120 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Impedance (120 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
HeLa (150 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(9)
semilogx(FREQ,ZphzWHeLa150)
hold on
semilogx(FREQ,ZphzAvgWoHeLa150, '--r')
hold on
title('HeLa Phase Angle (150 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
```

```
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa & No Cell Phase Angle (150 mV)'];
    saveas(gcf, stra, 'png')


figure(10)
loglog(FREQ,ZmodWHeLa150)
hold on
loglog(FREQ,ZmodAvgWoHeLa150, '--r')
hold on
title('HeLa Impedance (150 mV)','FontSize',20)
legend('HeLa','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
```

```
        grid on
    stra= [STR 'HeLa & No Cell Impedance (150 mV)'];
    saveas(gcf, stra, 'png')


%%

%                                   NO BACKGROUND NOISE -
HeLa (30 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(11)
semilogx(FREQ,ZphzAbsAvgHeLa30)
hold on
title('HeLa Average Phase Angle (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (30 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(12)
semilogx(FREQ,ZmodAbsAvgHeLa30)
hold on
title('HeLa Average Impedance (30 mV)','FontSize',20)
```

```
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Impedance (30 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                   NO BACKGROUND NOISE -
HeLa (60 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(13)
semilogx(FREQ,ZphzAbsAvgHeLa60)
hold on
title('HeLa Average Phase Angle (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
```

```
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (60 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(14)
semilogx(FREQ,ZmodAbsAvgHeLa60)
hold on
title('HeLa Average Impedance (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Impedance (60 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%
```

```
%                                       NO BACKGROUND NOISE -
HeLa (90 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(15)
semilogx(FREQ,ZphzAbsAvgHeLa90)
hold on
title('HeLa Average Phase Angle (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (90 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(16)
semilogx(FREQ,ZmodAbsAvgHeLa90)
hold on
title('HeLa Average Impedance (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Impedance (90 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                       NO BACKGROUND NOISE -
HeLa (120 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(17)
semilogx(FREQ,ZphzAbsAvgHeLa120)
hold on
title('HeLa Average Phase Angle (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
```

```
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (120 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(18)
semilogx(FREQ,ZmodAbsAvgHeLa120)
hold on
title('HeLa Average Impedance (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Impedance (120 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                   NO BACKGROUND NOISE -
HeLa (150 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells HeLa\Images\';

figure(19)
semilogx(FREQ,ZphzAbsAvgHeLa150)
hold on
```

```
title('HeLa Average Phase Angle (150 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (150 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(20)
semilogx(FREQ,ZmodAbsAvgHeLa150)
hold on
title('HeLa Average Impedance (150 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Impedance (150 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


%%

%                                   WITH & WITHOUT CELLS -
MDA (30mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(21)
semilogx(FREQ,ZphzWMDA30)
hold on
semilogx(FREQ,ZphzAvgWoMDA30, '--r')
hold on
title('MDA-MB-231 Phase Angle (30 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Phase Angle (30 mV)'];
    saveas(gcf, stra, 'png')
```

```
figure(22)
loglog(FREQ,ZmodWMDA30)
hold on
loglog(FREQ,ZmodAvgWoMDA30, '--r')
hold on
title('MDA-MB-231 Impedance (30 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Impedance (30 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MDA (60mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(23)
semilogx(FREQ,ZphzWMDA60)
hold on
semilogx(FREQ,ZphzAvgWoMDA60, '--r')
hold on
title('MDA-MB-231 Phase Angle (60 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
```

```
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Phase Angle (60 mV)'];
    saveas(gcf, stra, 'png')


figure(24)
loglog(FREQ,ZmodWMDA60)
hold on
loglog(FREQ,ZmodAvgWoMDA60, '--r')
hold on
title('MDA-MB-231 Impedance (60 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
```

```
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Impedance (60 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MDA (90mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(25)
semilogx(FREQ,ZphzWMDA90)
hold on
semilogx(FREQ,ZphzAvgWoMDA90, '--r')
hold on
title('MDA-MB-231 Phase Angle (90 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Phase Angle (90 mV)'];
    saveas(gcf, stra, 'png')


figure(26)
loglog(FREQ,ZmodWMDA90)
hold on
```

```
loglog(FREQ,ZmodAvgWoMDA90, '--r')
hold on
title('MDA-MB-231 Impedance (90 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Impedance (90 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MDA (120mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(27)
semilogx(FREQ,ZphzWMDA120)
hold on
semilogx(FREQ,ZphzAvgWoMDA120, '--r')
hold on
title('MDA-MB-231 Phase Angle (120 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
```

```
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Phase Angle (120
mV)'];
    saveas(gcf, stra, 'png')


figure(28)
loglog(FREQ,ZmodWMDA120)
hold on
loglog(FREQ,ZmodAvgWoMDA120, '--r')
hold on
title('MDA-MB-231 Impedance (120 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
```

```
    stra= [STR 'MDA-MB-231 & No Cell Impedance (120 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MDA (150mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(29)
semilogx(FREQ,ZphzWMDA150)
hold on
semilogx(FREQ,ZphzAvgWoMDA150, '--r')
hold on
title('MDA-MB-231 Phase Angle (150 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Phase Angle (150
mV)'];
    saveas(gcf, stra, 'png')


figure(30)
loglog(FREQ,ZmodWMDA150)
hold on
loglog(FREQ,ZmodAvgWoMDA150, '--r')
```

```
hold on
title('MDA-MB-231 Impedance (150 mV)','FontSize',20)
legend('MDA-MB-231','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 & No Cell Impedance (150 mV)'];
    saveas(gcf, stra, 'png')


%%

%                                       NO BACKGROUND NOISE -
MDA (30 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(31)
semilogx(FREQ,ZphzAbsAvgMDA30)
hold on
title('MDA-MB-231 Average Phase Angle (30
mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (30 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(32)
semilogx(FREQ,ZmodAbsAvgMDA30)
hold on
title('MDA-MB-231 Average Impedance (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 Average Impedance (30 mV)
Without Background Noise'];
    saveas(gcf, stra, 'png')
```

```
%%

%                                       NO BACKGROUND NOISE -
MDA (60 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(33)
semilogx(FREQ,ZphzAbsAvgMDA60)
hold on
title('MDA-MB-231 Average Phase Angle (60
mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (60 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(34)
semilogx(FREQ,ZmodAbsAvgMDA60)
hold on
title('MDA-MB-231 Average Impedance (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
```

```
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 Average Impedance (60 mV)
Without Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                       NO BACKGROUND NOISE -
MDA (90 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(35)
semilogx(FREQ,ZphzAbsAvgMDA90)
hold on
title('MDA-MB-231 Average Phase Angle (90
mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
```

```
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (90 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(36)
semilogx(FREQ,ZmodAbsAvgMDA90)
hold on
title('MDA-MB-231 Average Impedance (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 Average Impedance (90 mV)
Without Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                   NO BACKGROUND NOISE -
MDA (120 mV)
```

```
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(37)
semilogx(FREQ,ZphzAbsAvgMDA120)
hold on
title('MDA-MB-231 Average Phase Angle (120
mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (120 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(38)
semilogx(FREQ,ZmodAbsAvgMDA120)
hold on
title('MDA-MB-231 Average Impedance (120
mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 Average Impedance (120 mV)
Without Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                       NO BACKGROUND NOISE -
MDA (150 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(39)
semilogx(FREQ,ZphzAbsAvgMDA150)
hold on
title('MDA-MB-231 Average Phase Angle (150
mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'HeLa Average Phase Angle (150 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(40)
semilogx(FREQ,ZmodAbsAvgMDA150)
hold on
title('MDA-MB-231 Average Impedance (150
mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MDA-MB-231 Average Impedance (150 mV)
Without Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MCF-7 (30mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';
```

```
figure(41)
semilogx(FREQ,ZphzWMCF730)
hold on
semilogx(FREQ,ZphzAvgWoMCF730, '--r')
hold on
title('MCF-7 Phase Angle (30 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Phase Angle (30 mV)'];
    saveas(gcf, stra, 'png')


figure(42)
loglog(FREQ,ZmodWMCF730)
hold on
loglog(FREQ,ZmodAvgWoMCF730, '--r')
hold on
title('MCF-7 Impedance (30 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
```

```
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Impedance (30 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MCF-7 (60mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(43)
semilogx(FREQ,ZphzWMCF760)
hold on
semilogx(FREQ,ZphzAvgWoMCF760, '--r')
hold on
title('MCF-7 Phase Angle (60 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
```

```
        grid on
    stra= [STR 'MCF-7 & No Cell Phase Angle (60 mV)'];
    saveas(gcf, stra, 'png')


figure(44)
loglog(FREQ,ZmodWMCF760)
hold on
loglog(FREQ,ZmodAvgWoMCF760, '--r')
hold on
title('MCF-7 Impedance (60 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Impedance (60 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MCF-7 (90mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(45)
semilogx(FREQ,ZphzWMCF790)
hold on
semilogx(FREQ,ZphzAvgWoMCF790, '--r')
```

```
hold on
title('MCF-7 Phase Angle (90 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Phase Angle (90 mV)'];
    saveas(gcf, stra, 'png')


figure(46)
loglog(FREQ,ZmodWMCF790)
hold on
loglog(FREQ,ZmodAvgWoMCF790, '--r')
hold on
title('MCF-7 Impedance (90 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
```

```
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Impedance (90 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MCF-7 (120mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(47)
semilogx(FREQ,ZphzWMCF7120)
hold on
semilogx(FREQ,ZphzAvgWoMCF7120, '--r')
hold on
title('MCF-7 Phase Angle (120 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Phase Angle (120 mV)'];
    saveas(gcf, stra, 'png')
```

```
figure(48)
loglog(FREQ,ZmodWMCF7120)
hold on
loglog(FREQ,ZmodAvgWoMCF7120, '--r')
hold on
title('MCF-7 Impedance (120 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Impedance (120 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                   WITH & WITHOUT CELLS -
MCF-7 (150mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(49)
semilogx(FREQ,ZphzWMCF7150)
hold on
semilogx(FREQ,ZphzAvgWoMCF7150, '--r')
hold on
title('MCF-7 Phase Angle (150 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
```

```
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Phase Angle (150 mV)'];
    saveas(gcf, stra, 'png')


figure(50)
loglog(FREQ,ZmodWMCF7150)
hold on
loglog(FREQ,ZmodAvgWoMCF7150, '--r')
hold on
title('MCF-7 Impedance (150 mV)','FontSize',20)
legend('MCF-7','W/o Cells')
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
```

```
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 & No Cell Impedance (150 mV)'];
    saveas(gcf, stra, 'png')


%%

%                                       NO BACKGROUND NOISE -
MCF-7 (30 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(51)
semilogx(FREQ,ZphzAbsAvgMCF730)
hold on
title('MCF-7 Average Phase Angle (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Phase Angle (30 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(52)
semilogx(FREQ,ZmodAbsAvgMCF730)
hold on
```

```
title('MCF-7 Average Impedance (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Impedance (30 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                       NO BACKGROUND NOISE -
MCF-7 (60 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(53)
semilogx(FREQ,ZphzAbsAvgMCF760)
hold on
title('MCF-7 Average Phase Angle (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
```

```
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Phase Angle (60 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(54)
semilogx(FREQ,ZmodAbsAvgMCF760)
hold on
title('MCF-7 Average Impedance (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Impedance (60 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%
```

```
%                                       NO BACKGROUND NOISE -
MCF-7 (90 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(55)
semilogx(FREQ,ZphzAbsAvgMCF790)
hold on
title('MCF-7 Average Phase Angle (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Phase Angle (90 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(56)
semilogx(FREQ,ZmodAbsAvgMCF790)
hold on
title('MCF-7 Average Impedance (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Impedance (90 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                       NO BACKGROUND NOISE -
MCF-7 (120 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(57)
semilogx(FREQ,ZphzAbsAvgMCF7120)
hold on
title('MCF-7 Average Phase Angle (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
```

```
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Phase Angle (120 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(58)
semilogx(FREQ,ZmodAbsAvgMCF7120)
hold on
title('MCF-7 Average Impedance (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Impedance (120 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')

%%

%                                   NO BACKGROUND NOISE -
MCF-7 (150 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\20190404 Wcells MDA\Images\';

figure(59)
semilogx(FREQ,ZphzAbsAvgMCF7150)
hold on
```

```
title('MCF-7 Average Phase Angle (150 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Phase Angle (150 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')


figure(60)
semilogx(FREQ,ZmodAbsAvgMCF7150)
hold on
title('MCF-7 Average Impedance (150 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
```

```
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'MCF-7 Average Impedance (150 mV) Without
Background Noise'];
    saveas(gcf, stra, 'png')



%%

%                                       Difference of HeLa &
MDA (30 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\W All HeLa, MDA
(20190328)\Images\';

figure(61)
semilogx(FREQ,DifZphzHeLaMDA30)
hold on
title('Difference in Phase Angle (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (30 mV)'];
    saveas(gcf, stra, 'png')
```

```
figure(62)
semilogx(FREQ,DifZmodHeLaMDA30)
hold on
title('Difference in Impedance (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (30 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       Difference of HeLa &
MDA (60 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\W All HeLa, MDA
(20190328)\Images\';

figure(63)
semilogx(FREQ,DifZphzHeLaMDA60)
hold on
title('Difference in Phase Angle (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
```

```
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (60 mV)'];
    saveas(gcf, stra, 'png')


figure(64)
semilogx(FREQ,DifZmodHeLaMDA60)
hold on
title('Difference in Impedance (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
```

```
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (60 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       Difference of HeLa &
MDA (90 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\W All HeLa, MDA
(20190328)\Images\';

figure(65)
semilogx(FREQ,DifZphzHeLaMDA90)
hold on
title('Difference in Phase Angle (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (90 mV)'];
    saveas(gcf, stra, 'png')


figure(66)
semilogx(FREQ,DifZmodHeLaMDA90)
hold on
title('Difference in Impedance (90 mV)','FontSize',20)
```

```
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (90 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       Difference of HeLa &
MDA (120 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\W All HeLa, MDA
(20190328)\Images\';

figure(67)
semilogx(FREQ,DifZphzHeLaMDA120)
hold on
title('Difference in Phase Angle (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
```

```
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (120 mV)'];
    saveas(gcf, stra, 'png')


figure(68)
semilogx(FREQ,DifZmodHeLaMDA120)
hold on
title('Difference in Impedance (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (120 mV)'];
    saveas(gcf, stra, 'png')

%%
```

```
%                                       Difference of HeLa &
MDA (150 mV)
STR= 'C:\Users\Eugenio J\Google Drive\DIAZ LAB\PRUEBAS
EXPERIMENTALES\2019 tests\W All HeLa, MDA
(20190328)\Images\';

figure(69)
semilogx(FREQ,DifZphzHeLaMDA150)
hold on
title('Difference in Phase Angle (150 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (150 mV)'];
    saveas(gcf, stra, 'png')


figure(70)
semilogx(FREQ,DifZmodHeLaMDA150)
hold on
title('Difference in Impedance (150 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
```

```
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MDA-MB-231 &
HeLa (150 mV)'];
    saveas(gcf, stra, 'png')


%%

%                                       Difference of MCF-7
& HeLa (30 mV)
STR= 'G:\My Drive\DIAZ LAB\PRUEBAS EXPERIMENTALES\2019
tests\20191106 Wcells MCF7\Images\';

figure(71)
semilogx(FREQ,DifZphzHeLaMCF730)
hold on
title('Difference in Phase Angle (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
```

```
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MCF-7 & HeLa
(30 mV)'];
    saveas(gcf, stra, 'png')


figure(72)
semilogx(FREQ,DifZmodHeLaMCF730)
hold on
title('Difference in Impedance (30 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Impedance for MCF-7 & HeLa
(30 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       Difference of MCF-7
& HeLa (60 mV)
STR= 'G:\My Drive\DIAZ LAB\PRUEBAS EXPERIMENTALES\2019
tests\20191106 Wcells MCF7\Images\';
```

```
figure(73)
semilogx(FREQ,DifZphzHeLaMCF760)
hold on
title('Difference in Phase Angle (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MCF-7 & HeLa
(60 mV)'];
    saveas(gcf, stra, 'png')


figure(74)
semilogx(FREQ,DifZmodHeLaMCF760)
hold on
title('Difference in Impedance (60 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
```

```
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Impedance for MCF-7 & HeLa
(60 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       Difference of MCF-7
& HeLa (90 mV)
STR= 'G:\My Drive\DIAZ LAB\PRUEBAS EXPERIMENTALES\2019
tests\20191106 Wcells MCF7\Images\';

figure(75)
semilogx(FREQ,DifZphzHeLaMCF790)
hold on
title('Difference in Phase Angle (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MCF-7 & HeLa
(90 mV)'];
```

```
    saveas(gcf, stra, 'png')


figure(76)
semilogx(FREQ,DifZmodHeLaMCF790)
hold on
title('Difference in Impedance (90 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Impedance for MCF-7 & HeLa
(90 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       Difference of MCF-7
& HeLa (120 mV)
STR= 'G:\My Drive\DIAZ LAB\PRUEBAS EXPERIMENTALES\2019
tests\20191106 Wcells MCF7\Images\';

figure(77)
semilogx(FREQ,DifZphzHeLaMCF7120)
hold on
title('Difference in Phase Angle (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
```

```
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MCF-7 & HeLa
(120 mV)'];
    saveas(gcf, stra, 'png')


figure(78)
semilogx(FREQ,DifZmodHeLaMCF7120)
hold on
title('Difference in Impedance (120 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
```

```
    stra= [STR 'Difference in Impedance for MCF-7 & HeLa
(120 mV)'];
    saveas(gcf, stra, 'png')

%%

%                                       Difference of MCF-7
& HeLa (150 mV)
STR= 'G:\My Drive\DIAZ LAB\PRUEBAS EXPERIMENTALES\2019
tests\20191106 Wcells MCF7\Images\';

figure(79)
semilogx(FREQ,DifZphzHeLaMCF7150)
hold on
title('Difference in Phase Angle (150 mV)','FontSize',20)

        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Angle (Degrees)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Phase Angle for MCF-7 & HeLa
(150 mV)'];
    saveas(gcf, stra, 'png')


figure(80)
semilogx(FREQ,DifZmodHeLaMCF7150)
hold on
title('Difference in Impedance (150 mV)','FontSize',20)
```

```
        xlabel('Frequency (Hz)',...         % letra miu \mu
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        ylabel('Impedance (Ohms)',...
            'FontName','Arial',...          % tipo de letra
            'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
            'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
            'FontSize',14);                 % Tamaño de
letra
        set(gca, 'fontsize', 12)
        grid on
    stra= [STR 'Difference in Impedance for MCF-7 & HeLa
(150 mV)'];
    saveas(gcf, stra, 'png')


%%
%
%                                       STANDARD DEVIATION
%STR= 'C:\Users\Eugenio J\Desktop\20190319 Wcells
HeLa\Images';
%
% figure(9)
% semilogx(Freq,ZphzAvgWHeLa)
% hold on
% semilogx(Freq,UpZphzWcellsMDA, '-.b')
% hold on
% semilogx(Freq,LowZphzWcellsMDA, '--r')
% hold on
% title('MDA-MB-231 Average Phase Angle
(90mV)','FontSize',20)
% legend('MDA-MB-231','Upper Standard Deviation','Lower
Standard Deviation')
%         xlabel('Frequency (Hz)',...         % letra miu
\mu
%             'FontName','Arial',...          % tipo de
letra
```

```
%             'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
%             'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
%             'FontSize',14);                 % Tamaño de
letra
%         ylabel('Angle (Degrees)',...
%             'FontName','Arial',...          % tipo de
letra
%             'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
%             'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
%             'FontSize',14);                 % Tamaño de
letra
%         set(gca, 'fontsize', 12)
%         grid on
%     stra= [STR 'MDA-MB-231 Average Phase Angle (90 mV)
Prueba w. Std Dev'];
%     saveas(gcf, stra, 'png')
%
%
% figure(10)
% loglog(Freq,ZmodAvgWcellsMDA)
% hold on
% loglog(Freq,UpZmodWcellsMDA, '-.b')
% hold on
% loglog(Freq,LowZmodWcellsMDA, '--r')
% hold on
% title('MDA-MB-231 Average Impedance
(90mV)','FontSize',20)
% legend('MDA-MB-231','Upper Standard Deviation','Lower
Standard Deviation')
%         xlabel('Frequency (Hz)',...         % letra miu
\mu
%             'FontName','Arial',...          % tipo de
letra
%             'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
%             'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
%             'FontSize',14);                 % Tamaño de
letra
%         ylabel('Impedance (Ohms)',...
```

```
%             'FontName','Arial',...          % tipo de
letra
%             'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
%             'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
%             'FontSize',14);                 % Tamaño de
letra
%         set(gca, 'fontsize', 12)
%         grid on
%     stra= [STR 'MDA-MB-231 Average Impedance (90 mV)
Prueba w. Std Dev'];
%     saveas(gcf, stra, 'png')

%% Running by steps
%
%
%     for i=1:5
%
%         figure(2)
% loglog(Freq,ZmodWHeLa(:,i))
% hold on
% title('HeLa Impedance (150 mV)','FontSize',20)
% legend('HeLa','W/o Cells')
%         xlabel('Frequency (Hz)',...        % letra miu
\mu
%             'FontName','Arial',...          % tipo de
letra
%             'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
%             'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
%             'FontSize',14);                 % Tamaño de
letra
%         ylabel('Impedance (Ohms)',...
%             'FontName','Arial',...          % tipo de
letra
%             'FontWeight','b',...            %
Normal(n),Light (l),Demi (d),Bold (b)
%             'FontAngle','n',...             %
Normal(n),italic (i),oblique(o)
%             'FontSize',14);                 % Tamaño de
letra
%         set(gca, 'fontsize', 12)
```

```
%         grid on
%     stra= [STR 'HeLa & No Cell Impedance (150 mV)'];
%     saveas(gcf, stra, 'png')
%     pause(2)
%     end
%
```

EIS Transpose Data (MATLAB)

```
%%          DiazLab Microfluidics Laboratory
%            Eugenio J. Caraballo Justiniano
%                      09222019
%         University of Puerto Rico at Mayaguez
%       Import Data uPore with Cells & Transpose
close all
clear all
clc

%%            Data With Cells - HeLa

e=40;         %Number of uPores evaluated
c=1;         %iniciate uPores evaluated

STR1 = 'C:\Users\alber\Desktop\All HeLa Excel
Data\P_EIS_HELA_CELL_30MV_ (';        %String for reading
Excel document. URL documents

Zmod=[];
Zphz=[];
Freq=[];

for c=1:e

        Zmod=[Zmod  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz=[Zphz  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq=[Freq  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

ZmodT = Zmod.';
```

```
ZphzT = Zphz.';
xlswrite('P_EIS_HELA_CELL_30MV_ZMOD_TRANSPOSED.xlsx',ZmodT)
xlswrite('P_EIS_HELA_CELL_30MV_ZPHZ_TRANSPOSED.xlsx',ZphzT)

STR1 = 'C:\Users\alber\Desktop\All HeLa Excel
Data\P_EIS_HELA_CELL_60MV_ (';        %String for reading
Excel document. URL documents

Zmod1=[];
Zphz1=[];
Freq1=[];

for c=1:e

        Zmod1=[Zmod1  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz1=[Zphz1  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq1=[Freq1  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod1T = Zmod1.';
Zphz1T = Zphz1.';
xlswrite('P_EIS_HELA_CELL_60MV_ZMOD_TRANSPOSED.xlsx',Zmod1T
)
xlswrite('P_EIS_HELA_CELL_60MV_ZPHZ_TRANSPOSED.xlsx',Zphz1T
)

STR1 = 'C:\Users\alber\Desktop\All HeLa Excel
Data\P_EIS_HELA_CELL_90MV_ (';        %String for reading
Excel document. URL documents

Zmod2=[];
Zphz2=[];
Freq2=[];

for c=1:e

        Zmod2=[Zmod2  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
```

```
        Zphz2=[Zphz2  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq2=[Freq2  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod2T = Zmod2.';
Zphz2T = Zphz2.';
xlswrite('P_EIS_HELA_CELL_90MV_ZMOD_TRANSPOSED.xlsx',Zmod2T
)
xlswrite('P_EIS_HELA_CELL_90MV_ZPHZ_TRANSPOSED.xlsx',Zphz2T
)

STR1 = 'C:\Users\alber\Desktop\All HeLa Excel
Data\P_EIS_HELA_CELL_120MV_ (';        %String for reading
Excel document. URL documents

Zmod3=[];
Zphz3=[];
Freq3=[];

for c=1:e

        Zmod3=[Zmod3  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz3=[Zphz3  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq3=[Freq3  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod3T = Zmod3.';
Zphz3T = Zphz3.';
xlswrite('P_EIS_HELA_CELL_120MV_ZMOD_TRANSPOSED.xlsx',Zmod3
T)
xlswrite('P_EIS_HELA_CELL_120MV_ZPHZ_TRANSPOSED.xlsx',Zphz3
T)
```

```
STR1 = 'C:\Users\alber\Desktop\All HeLa Excel
Data\P_EIS_HELA_CELL_150MV_ (';        %String for reading
Excel document. URL documents

Zmod4=[];
Zphz4=[];
Freq4=[];

for c=1:e

        Zmod4=[Zmod4  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz4=[Zphz4  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq4=[Freq4  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod4T = Zmod4.';
Zphz4T = Zphz4.';
xlswrite('P_EIS_HELA_CELL_150MV_ZMOD_TRANSPOSED.xlsx',Zmod4
T)
xlswrite('P_EIS_HELA_CELL_150MV_ZPHZ_TRANSPOSED.xlsx',Zphz4
T)

%%          Data With Cells - MDA-MB-231

e=40;         %Number of uPores evaluated
c=1;         %iniciate uPores evaluated

STR1 = 'C:\Users\alber\Desktop\All MDA Excel
Data\P_EIS_MDA_CELL_30MV_ (';        %String for reading
Excel document. URL documents

Zmod5=[];
Zphz5=[];
Freq5=[];


for c=1:e
```

```
        Zmod5=[Zmod5  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz5=[Zphz5  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq5=[Freq5  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod5T = Zmod5.';
Zphz5T = Zphz5.';
xlswrite('P_EIS_MDA_CELL_30MV_ZMOD_TRANSPOSED.xlsx',Zmod5T)
xlswrite('P_EIS_MDA_CELL_30MV_ZPHZ_TRANSPOSED.xlsx',Zphz5T)

STR1 = 'C:\Users\alber\Desktop\All MDA Excel
Data\P_EIS_MDA_CELL_60MV_ (';        %String for reading
Excel document. URL documents

Zmod6=[];
Zphz6=[];
Freq6=[];


for c=1:e

        Zmod6=[Zmod6  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz6=[Zphz6  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq6=[Freq6  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod6T = Zmod6.';
Zphz6T = Zphz6.';
xlswrite('P_IS_MDA_CELL_60MV_ZMOD_TRANSPOSED.xlsx',Zmod6T)
xlswrite('P_EIS_MDA_CELL_60MV_ZPHZ_TRANSPOSED.xlsx',Zphz6T)

STR1 = 'C:\Users\alber\Desktop\All MDA Excel
Data\P_EIS_MDA_CELL_90MV_ (';        %String for reading
Excel document. URL documents
```

```
Zmod7=[];
Zphz7=[];
Freq7=[];


for c=1:e

        Zmod7=[Zmod7  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz7=[Zphz7  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq7=[Freq7  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod7T = Zmod7.';
Zphz7T = Zphz7.';
xlswrite('P_EIS_MDA_CELL_90MV_ZMOD_TRANSPOSED.xlsx',Zmod7T)
xlswrite('P_EIS_MDA_CELL_90MV_ZPHZ_TRANSPOSED.xlsx',Zphz7T)

STR1 = 'C:\Users\alber\Desktop\All MDA Excel
Data\P_EIS_MDA_CELL_120MV_ (';        %String for reading
Excel document. URL documents

Zmod8=[];
Zphz8=[];
Freq8=[];


for c=1:e

        Zmod8=[Zmod8  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz8=[Zphz8  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq8=[Freq8  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod8T = Zmod8.';
```

```
Zphz8T = Zphz8.';
xlswrite('P_EIS_MDA_CELL_120MV_ZMOD_TRANSPOSED.xlsx',Zmod8T
)
xlswrite('P_EIS_MDA_CELL_120MV_ZPHZ_TRANSPOSED.xlsx',Zphz8T
)

STR1 = 'C:\Users\alber\Desktop\All MDA Excel
Data\P_EIS_MDA_CELL_150MV_ (';        %String for reading
Excel document. URL documents

Zmod9=[];
Zphz9=[];
Freq9=[];


for c=1:e

        Zmod9=[Zmod9  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','H71:H126')];
        Zphz9=[Zphz9  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','I71:I126')];
        Freq9=[Freq9  xlsread([STR1 num2str(c)
'.xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod9T = Zmod9.';
Zphz9T = Zphz9.';
xlswrite('P_EIS_MDA_CELL_150MV_ZMOD_TRANSPOSED.xlsx',Zmod9T
)
xlswrite('P_EIS_MDA_CELL_150MV_ZPHZ_TRANSPOSED.xlsx',Zphz9T
)

%%          Data With Cells - MCF12A

e=40;         %Number of uPores evaluated
c=1;         %iniciate uPores evaluated

STR1 = 'C:\Users\alber\Desktop\All MCF12A Excel
Data\P_EIS_MCF_CELL_30MV_ (';        %String for reading
Excel document. URL documents

Zmod10=[];
```

```
Zphz10=[];
Freq10=[];


for c=1:e

        Zmod10=[Zmod10  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','H71:H126')];
        Zphz10=[Zphz10  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','I71:I126')];
        Freq10=[Freq10  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod10T = Zmod10.';
Zphz10T = Zphz10.';
xlswrite('P_EIS_MCF_CELL_30MV_ZMOD_TRANSPOSED.xlsx',Zmod10T
)
xlswrite('P_EIS_MCF_CELL_30MV_ZPHZ_TRANSPOSED.xlsx',Zphz10T
)

STR1 = 'C:\Users\alber\Desktop\All MCF12A Excel
Data\P_EIS_MCF_CELL_60MV_ (';        %String for reading
Excel document. URL documents

Zmod11=[];
Zphz11=[];
Freq11=[];


for c=1:e

        Zmod11=[Zmod11  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','H71:H126')];
        Zphz11=[Zphz11  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','I71:I126')];
        Freq611=[Freq11  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end
```

```
Zmod11T = Zmod11.';
Zphz11T = Zphz11.';
xlswrite('P_IS_MCF_CELL_60MV_ZMOD_TRANSPOSED.xlsx',Zmod11T)
xlswrite('P_EIS_MCF_CELL_60MV_ZPHZ_TRANSPOSED.xlsx',Zphz11T
)

STR1 = 'C:\Users\alber\Desktop\All MCF12A Excel
Data\P_EIS_MCF_CELL_90MV_ (';        %String for reading
Excel document. URL documents

Zmod12=[];
Zphz12=[];
Freq12=[];


for c=1:e

        Zmod12=[Zmod12  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','H71:H126')];
        Zphz12=[Zphz12  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','I71:I126')];
        Freq12=[Freq12  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod12T = Zmod12.';
Zphz12T = Zphz12.';
xlswrite('P_EIS_MCF_CELL_90MV_ZMOD_TRANSPOSED.xlsx',Zmod12T
)
xlswrite('P_EIS_MCF_CELL_90MV_ZPHZ_TRANSPOSED.xlsx',Zphz12T
)

STR1 = 'C:\Users\alber\Desktop\All MCF12A Excel
Data\P_EIS_MCF_CELL_120MV_ (';        %String for reading
Excel document. URL documents

Zmod13=[];
Zphz13=[];
Freq13=[];


for c=1:e
```

```
        Zmod13=[Zmod13  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','H71:H126')];
        Zphz13=[Zphz13  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','I71:I126')];
        Freq13=[Freq13  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod13T = Zmod13.';
Zphz13T = Zphz13.';
xlswrite('P_EIS_MCF_CELL_120MV_ZMOD_TRANSPOSED.xlsx',Zmod13
T)
xlswrite('P_EIS_MCF_CELL_120MV_ZPHZ_TRANSPOSED.xlsx',Zphz13
T)

STR1 = 'C:\Users\alber\Desktop\All MCF12A Excel
Data\P_EIS_MCF_CELL_150MV_ (';        %String for reading
Excel document. URL documents

Zmod14=[];
Zphz14=[];
Freq14=[];


for c=1:e

        Zmod14=[Zmod14  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','H71:H126')];
        Zphz14=[Zphz14  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','I71:I126')];
        Freq14=[Freq14  xlsread([STR1 num2str(c)
').xlsx'],'Sheet1','D71:D126')];

    c=c+1;
end

Zmod14T = Zmod14.';
Zphz14T = Zphz14.';
xlswrite('P_EIS_MCF_CELL_150MV_ZMOD_TRANSPOSED.xlsx',Zmod14
T)
```

```
xlswrite('P_EIS_MCF_CELL_150MV_ZPHZ_TRANSPOSED.xlsx',Zphz14
T)
```

PCA for EIS Data (R)

```
library(utils)

library(base)

library(stats)

library(mdatools)

library(prospectr)

library(ellipse)

library(plotrix)

library(ggplot2)

library(tiger)


setwd("C:\\Users\\Eugenio J. Caraballo\\Desktop\\Jurkat, HeLa, MDA-MB-231, and MCF12A without Baseline\\Jurkat & MDA-MB-231\\CSV Files")



#---------------------------------------------------- Scores Plot ----------------------------------------------------



spectra = read.csv('Jurkat & MDA-MB-231 - Impedance Magnitude (90 mV) {Impedance Magnitude as a Function of Frequency}.csv')


rownames(spectra) = spectra[,2]

colnames(spectra)[3:57] = spectra[1,3:57]

spectra = spectra[-1,-1]

spectra = spectra[,-1]


pca.res = pca(spectra[,1:55], ncomp = 7, method = 'nipals', center = TRUE , scale = TRUE)
```

```
p = plotScores(pca.res$res$cal, xlim = c(-250,250), ylim = c(-100,100), show.labels = FALSE,
col=c(rep('red',40),rep('blue',40)))

plotHotellingEllipse(p, conf.lim = 0.99, col = "black")

legend(-250,100,legend = c('Jurkat','MDA-MB-231'), pch = c(16,16), col = c('red','blue'))



spectra = read.csv('Reduced Jurkat & MDA-MB-231 - Impedance Magnitude (90 mV) {Impedance
Magnitude as a Function of Frequency}.csv')


rownames(spectra) = spectra[,2]

colnames(spectra)[3:6] = spectra[1,3:6]

spectra = spectra[-1,-1]

spectra = spectra[,-1]


pca.res = pca(spectra[,1:4], ncomp = 7, method = 'nipals', center = TRUE, scale = TRUE)


p = plotScores(pca.res$res$cal, xlim = c(-10,10), ylim = c(-0.3,0.3), show.labels = FALSE,
col=c(rep('red',40),rep('blue',40)))

plotHotellingEllipse(p, conf.lim = 0.99, col = "black")

legend(-10,0.3,legend = c('Jurkat','MDA-MB-231'), pch = c(16,16), col = c('red','blue'))



spectra = read.csv('Jurkat & MDA-MB-231 - Phase Angle (90 mV) {Phase Angle as a Function of
Frequency}.csv')


rownames(spectra) = spectra[,2]

colnames(spectra)[3:57] = spectra[1,3:57]

spectra = spectra[-1,-1]

spectra = spectra[,-1]
```

```
pca.res = pca(spectra[,1:55], ncomp = 7, method = 'nipals', center = TRUE, scale = TRUE)


p = plotScores(pca.res$res$cal, xlim = c(-20,20), ylim = c(-20,20), show.labels = FALSE,
col=c(rep('red',40),rep('blue',40)))

plotHotellingEllipse(p, conf.lim = 0.99, col = "black")

legend(-20,20,legend = c('Jurkat','MDA-MB-231'), pch = c(16,16), col = c('red','blue'))



spectra = read.csv('Reduced Jurkat & MDA-MB-231 - Phase Angle (90 mV) {Phase Angle as a Function of
Frequency}.csv')


rownames(spectra) = spectra[,2]

colnames(spectra)[3:7] = spectra[1,3:7]

spectra = spectra[-1,-1]

spectra = spectra[,-1]


pca.res = pca(spectra[,1:5], ncomp = 7, method = 'nipals', center = TRUE, scale = TRUE)


p = plotScores(pca.res$res$cal, xlim = c(-10,10), ylim = c(-0.4,0.4), show.labels = FALSE,
col=c(rep('red',40),rep('blue',40)))

plotHotellingEllipse(p, conf.lim = 0.99, col = "black")

legend(-10,0.4,legend = c('Jurkat','MDA-MB-231'), pch = c(16,16), col = c('red','blue'))


#---------------------------------------------------- Loadings Plot ----------------------------------------------------



spectra = read.csv('Jurkat & MDA-MB-231 - Impedance Magnitude (90 mV) {Impedance Magnitude as a
Function of Frequency}.csv')
```

```
rownames(spectra) = spectra[,2]

colnames(spectra)[3:57] = spectra[1,3:57]

spectra = spectra[-1,-1]

spectra = spectra[,-1]


pca.res = pca(spectra[,1:55], ncomp = 7, method = 'nipals')


loadings = pca.res$loadings


plot(rownames(loadings), loadings[,1], xlab = 'Frequency (Hz)', ylab = 'Loading', , cex.lab = 1, main =
'Loadings', type = 'b')



spectra = read.csv('Jurkat & MDA-MB-231 - Phase Angle (90 mV) {Phase Angle as a Function of
Frequency}.csv')


rownames(spectra) = spectra[,2]

colnames(spectra)[3:57] = spectra[1,3:57]

spectra = spectra[-1,-1]

spectra = spectra[,-1]


pca.res = pca(spectra[,1:55], ncomp = 7, method = 'nipals')


loadings = pca.res$loadings


plot(rownames(loadings), loadings[,1], xlab = 'Frequency (Hz)', ylab = 'Loading', , cex.lab = 1, main =
'Loadings', type = 'b')
```