```
% Repackage NN model.
clc; clear all; close all;
NormalNN.createNN();
clc; clear all;
load('NN Model Library.mat');
```

```
% Import cell architecture library with all parameters and models.
clc; clear all; close all;
CellArchLib.createLib();
```

```
Unit Cell Architecture Library created successfully.
```

```
% Check cell architecture library with all parameters and models.
clc; clear all; close all;
load('Unit Cell Architecture.mat');
cellArchLib.disp();
```

```
CellArchLib containing:
S/N:        1
Name:        SC
Cell Type:    Strut
# Nodes:    1
# Struts:    3
Max Degree:    6
Min Degree:    6
c2s Factor:    1.00000

S/N:        2
Name:        BCC
Cell Type:    Strut
# Nodes:    2
# Struts:    8
Max Degree:    8
Min Degree:    8
c2s Factor:    0.86603

S/N:        3
Name:        FCC
Cell Type:    Strut
# Nodes:    4
# Struts:    12
Max Degree:    12
Min Degree:    4
c2s Factor:    0.70711

S/N:        4
Name:        BCC+FCC
Cell Type:    Strut
# Nodes:    5
# Struts:    20
Max Degree:    20
Min Degree:    4
c2s Factor:    0.74684

S/N:        5
Name:        Octet
Cell Type:    Strut
# Nodes:    4
```

```
# Struts:    24
Max Degree:    12
Min Degree:    12
c2s Factor:    0.70711

S/N:        6
Name:        Kelvin Cell
Cell Type:    Strut
# Nodes:    12
# Struts:    24
Max Degree:    4
Min Degree:    4
c2s Factor:    0.35355

S/N:        7
Name:        Rhombic Dodecahedron
Cell Type:    Strut
# Nodes:    12
# Struts:    32
Max Degree:    8
Min Degree:    4
c2s Factor:    0.43301
```

```
% Check methods in CellArchLib
cellArchLib.findCellArch("SC")
```

```
ans =
S/N:        1
Name:        SC
Cell Type:    Strut
# Nodes:    1
# Struts:    3
Max Degree:    6
Min Degree:    6
c2s Factor:    1.00000
```

```
cellArchLib.findCellArch("BCC+FCC")
```

```
ans =
S/N:        4
Name:        BCC+FCC
Cell Type:    Strut
# Nodes:    5
# Struts:    20
Max Degree:    20
Min Degree:    4
c2s Factor:    0.74684
```

```
cellArchLib.findCellArch("Octet")
```

```
ans =
S/N:        5
Name:        Octet
Cell Type:    Strut
# Nodes:    4
# Struts:    24
Max Degree:    12
Min Degree:    12
c2s Factor:    0.70711
```

```
cellArchLib.findCellArch("Rhombic")
```

```
ans =

    []
```

```
cellArchLib.findCellArch("Rhombic Dodecahedron")
```

```
ans =
S/N:        7
Name:        Rhombic Dodecahedron
Cell Type:    Strut
# Nodes:    12
# Struts:    32
Max Degree:    8
Min Degree:    4
c2s Factor:    0.43301
```

```
clc; clear all; close all;
load('Lattice Data.mat');

% Create UnitCellStrut objects
num_cases = 0;
for idx_cell = 1:length(unit_cell)
    for idx_length = 1:length(cell_length)
        for idx_density = 1:length(rel_density)
            num_cases = num_cases + 1;
            ExptCases{num_cases,:} = ...

UnitCellStrut(unit_cell(idx_cell),cell_length(idx_length),rel_density(idx_density));
        end
    end
end
save('Experiment Unit
Cells.mat','unit_cell','cell_length','rel_density','ExptCases');
```

```
clear all; clc;
load('Experiment Unit Cells.mat');
% Check UnitCell objects.
cases = [1 5 12 21 35 48 56 84];
for idx = cases
    disp(ExptCases{idx,:});
end
```

```
S/N:        1
Name:        SC
Cell Length:    4.00000
Rel Density:    0.10000
Strut Length:    4.00000
Strut Width:    0.87490

S/N:        1
Name:        SC
Cell Length:    6.00000
Rel Density:    0.10000
Strut Length:    6.00000
```

```
Strut Width:    1.31235

S/N:        1
Name:        SC
Cell Length:    8.00000
Rel Density:    0.40000
Strut Length:    8.00000
Strut Width:    3.90653

S/N:        2
Name:        BCC
Cell Length:    8.00000
Rel Density:    0.10000
Strut Length:    6.92820
Strut Width:    1.15074

S/N:        3
Name:        FCC
Cell Length:    8.00000
Rel Density:    0.30000
Strut Length:    5.65685
Strut Width:    1.97118

S/N:        4
Name:        BCC+FCC
Cell Length:    8.00000
Rel Density:    0.40000
Strut Length:    5.97469
Strut Width:    1.73082

S/N:        5
Name:        Octet
Cell Length:    6.00000
Rel Density:    0.40000
Strut Length:    4.24264
Strut Width:    1.23602

S/N:        7
Name:        Rhombic Dodecahedron
Cell Length:    8.00000
Rel Density:    0.40000
Strut Length:    3.46410
Strut Width:    1.83837
```

```
clc; clear all; close all;
load('Lattice Data.mat');
section = "Circular";

freq = 100:10:6300;
% Create StrutLattLayer objects
num_cases = 0;
for idx_cell = 1:length(unit_cell)
    for idx_length = 1:length(cell_length)
        for idx_density = 1:length(rel_density)
            num_cases = num_cases + 1;
            labels(:,num_cases) = strcat(unit_cell(idx_cell),sprintf("; L=%dmm;
RD=%.1f", ...
                cell_length(idx_length),rel_density(idx_density)));
            part = LattLayerStrut(unit_cell(idx_cell), ...
```

```
                cell_length(idx_length),rel_density(idx_density), ...
                section,30,30,24/cell_length(idx_length));
            layer = LattLayer(section,freq);
            layer.insertPart(part,1);
            ExptCases{num_cases,:} = layer;
        end
    end
end
save('Experiment Unit Cell
Layers.mat','labels','unit_cell','cell_length','rel_density','ExptCases');
```

```
clc; clear all; close all;
load('Experiment Unit Cell Layers.mat');
% Check UnitCell objects.
cases = [3 10 17 24 31 39 45 55 69 81];
for idx = cases
    disp(ExptCases{idx,:});
end
```

```
Lattice Layer containing:
Number:        1
Name:        SC
Cell Length:    4.00000
Rel Density:    0.30000
Strut Length:    4.00000
Strut Width:    1.65340
Cross Section:    Circular
# layers:    6


Lattice Layer containing:
Number:        1
Name:        SC
Cell Length:    8.00000
Rel Density:    0.20000
Strut Length:    8.00000
Strut Width:    2.61450
Cross Section:    Circular
# layers:    3


Lattice Layer containing:
Number:        1
Name:        BCC
Cell Length:    6.00000
Rel Density:    0.10000
Strut Length:    5.19615
Strut Width:    0.86305
Cross Section:    Circular
# layers:    4


Lattice Layer containing:
Number:        1
Name:        BCC
Cell Length:    8.00000
Rel Density:    0.40000
Strut Length:    6.92820
```

```
Strut Width:    2.56134
Cross Section:    Circular
# layers:    3


Lattice Layer containing:
Number:        1
Name:        FCC
Cell Length:    6.00000
Rel Density:    0.30000
Strut Length:    4.24264
Strut Width:    1.47838
Cross Section:    Circular
# layers:    4


Lattice Layer containing:
Number:        1
Name:        BCC+FCC
Cell Length:    4.00000
Rel Density:    0.30000
Strut Length:    2.98735
Strut Width:    0.73179
Cross Section:    Circular
# layers:    6


Lattice Layer containing:
Number:        1
Name:        BCC+FCC
Cell Length:    8.00000
Rel Density:    0.10000
Strut Length:    5.97469
Strut Width:    0.77140
Cross Section:    Circular
# layers:    3


Lattice Layer containing:
Number:        1
Name:        Octet
Cell Length:    6.00000
Rel Density:    0.30000
Strut Length:    4.24264
Strut Width:    1.04542
Cross Section:    Circular
# layers:    4


Lattice Layer containing:
Number:        1
Name:        Kelvin Cell
Cell Length:    8.00000
Rel Density:    0.10000
Strut Length:    2.82843
Strut Width:    1.04714
Cross Section:    Circular
# layers:    3


Lattice Layer containing:
Number:        1
Name:        Rhombic Dodecahedron
Cell Length:    8.00000
```

```
Rel Density:    0.10000
Strut Length:    3.46410
Strut Width:    0.81703
Cross Section:    Circular
# layers:    3
```

```
clc; clear all; close all;
load('Experiment Unit Cell Layers.mat');
load('Lattice SAC.mat','freq');
sample = Lattice('Circle',freq(:,1));
insertLayer(sample,ExptCases{10},1);
insertLayer(sample,ExptCases{20},2);
insertLayer(sample,ExptCases{30},3);
sample
```

```
sample =
Lattice containing:
Number:        1
Lattice Layer containing:
Number:        1
Name:        SC
Cell Length:    8.00000
Rel Density:    0.20000
Strut Length:    8.00000
Strut Width:    2.61450
Cross Section:    Circular
# layers:    3



Number:        2
Lattice Layer containing:
Number:        1
Name:        BCC
Cell Length:    6.00000
Rel Density:    0.40000
Strut Length:    5.19615
Strut Width:    1.92101
Cross Section:    Circular
# layers:    4



Number:        3
Lattice Layer containing:
Number:        1
Name:        FCC
Cell Length:    6.00000
Rel Density:    0.20000
Strut Length:    4.24264
Strut Width:    1.16856
Cross Section:    Circular
# layers:    4
```

```
sample.t_sample
```

```
ans = 72
```

```
removeLayer(sample,1);
sample
```

```
sample =
Lattice containing:
Number:        1
Lattice Layer containing:
Number:        1
Name:        BCC
Cell Length:    6.00000
Rel Density:    0.40000
Strut Length:    5.19615
Strut Width:    1.92101
Cross Section:    Circular
# layers:    4



Number:        2
Lattice Layer containing:
Number:        1
Name:        FCC
Cell Length:    6.00000
Rel Density:    0.20000
Strut Length:    4.24264
Strut Width:    1.16856
Cross Section:    Circular
# layers:    4
```

```
removeLayer(sample,2);
sample
```

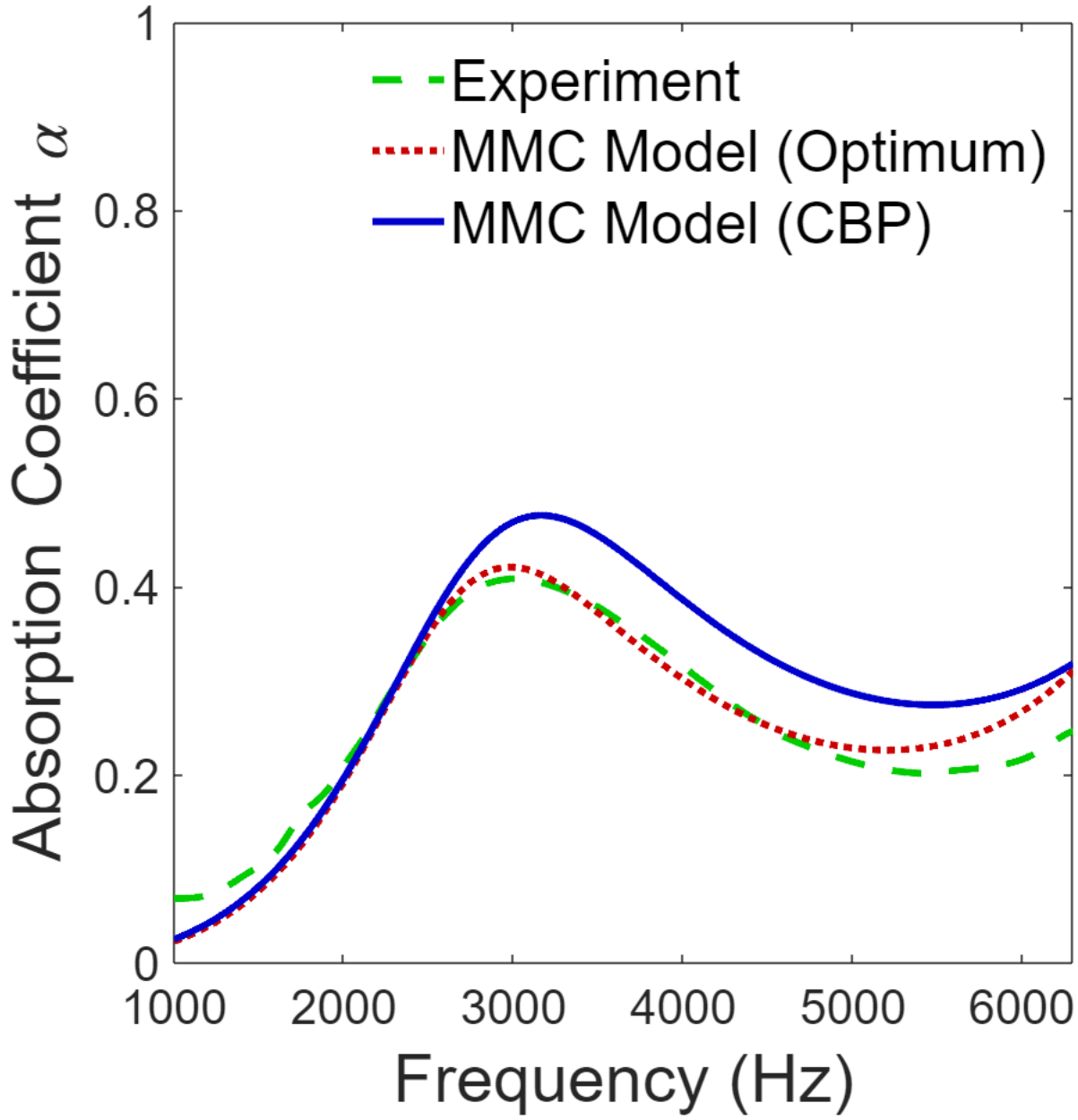
```
sample =
Lattice containing:
Number:        1
Lattice Layer containing:
Number:        1
Name:        BCC
Cell Length:    6.00000
Rel Density:    0.40000
Strut Length:    5.19615
Strut Width:    1.92101
Cross Section:    Circular
# layers:    4
```

```
calcTMM(sample);
calcSAC(sample);
```

```
clc; clear all; close all;
load('Lattice SAC.mat');
load('Lattice Data.mat');
load('MMC_errors.mat');
load('Experiment Unit Cell Layers.mat');
```

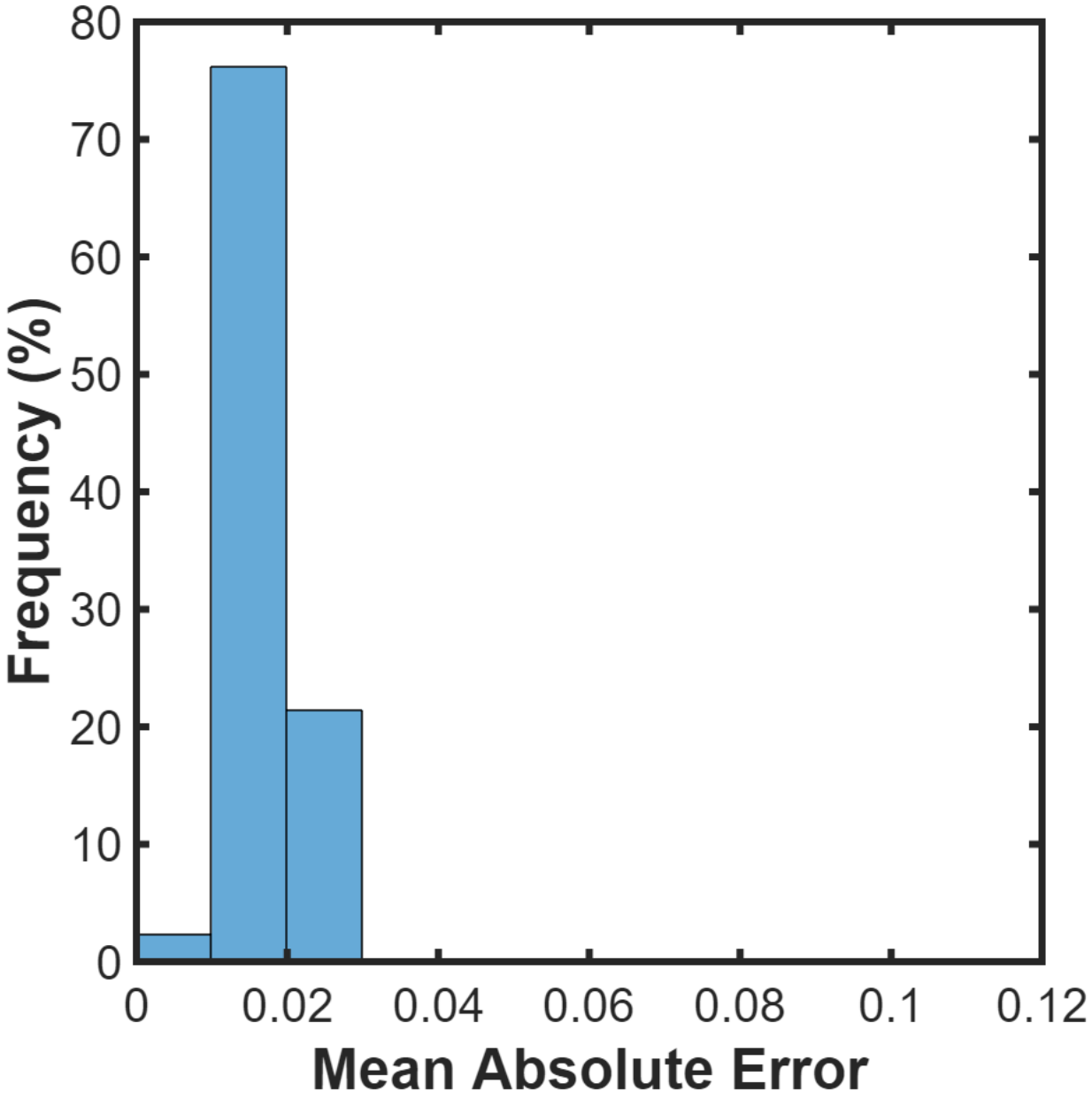
```
figure('Position', [100 100 660 660]);
color = [0 0.8 0;0.8 0 0;0 0 0.8;0.8 0.6 0];
line_style = ["--" ":" "-" "-."];
marker = ['o','+','x','s'];

for idx_case = 1:length(labels)
    f = freq(:,idx_case);
    alpha_expt = SAC_expt(:,idx_case);
    label = labels(idx_case);

    plot(freq(:,idx_case),SAC_expt(:,idx_case),'DisplayName','Experiment', ...
        'Color',color(1,:),'LineStyle',line_style(1),'LineWidth',3);
    hold on;

    idx_cell = case_idx(idx_case,2);
    idx_length = case_idx(idx_case,3);
    idx_density = case_idx(idx_case,4);
    N_layer = 24/cell_length(idx_length);

    % From optimization.
    str_length =
strut_length(length(rel_density)*(idx_length-1)+idx_density,idx_cell)*1e-3 *
length_corr_best(idx_cell,1);
    str_width =
strut_width(length(rel_density)*(idx_length-1)+idx_density,idx_cell)*1e-3 *
width_corr_best(idx_cell,1);
    N_layer = 24/cell_length(idx_length);
    delta_1 = delta_1_best(length(rel_density)*(idx_length-1)+idx_density,idx_cell);
    delta_2 = delta_2_best(length(rel_density)*(idx_length-1)+idx_density,idx_cell);

    alpha_MMC = MMC_strut(str_length,str_width,N_layer,delta_1,delta_2,f);
    plot(freq(:,idx_case),alpha_MMC,'DisplayName','MMC Model (Optimum)', ...
        'Color',color(2,:),'LineStyle',line_style(2),'LineWidth',3);
    hold on;
    error_MMC_optimum(length(rel_density)*(idx_length-1)+idx_density,idx_cell) =
mean(abs(alpha_expt-alpha_MMC));

    % From CBP ML Models.
    sample = Lattice('Circle',freq(:,idx_case));
    insertLayer(sample,ExptCases{idx_case},1);
    calcTMM(sample);
    calcSAC(sample);
    plotSAC(sample);
    error_MMC_CBP(length(rel_density)*(idx_length-1)+idx_density,idx_cell) =
mean(abs(sample.SAC-alpha_MMC));

    hold on;

    ax = gca;
    ax.FontSize = 20;
```

```
    ax.XLim = [1000 6300];
    ax.YLim = [0 1];
    ax.XTick = 1000:1000:6300;
    ax.YTick = 0:0.2:1.0;
    ax.XLabel.String = "Frequency (Hz)";
    ax.YLabel.String = "Absorption Coefficient \alpha";
    ax.XLabel.FontSize = 28;
    ax.YLabel.FontSize = 28;
    legend('Location','northeast','NumColumns',1);
    legend('FontSize',24);
    legend('boxoff');

    print(strcat('MMC-',label,'.tif'),'-dtiff','-r500');
    hold off;

    removeLayer(sample,1);
end
```

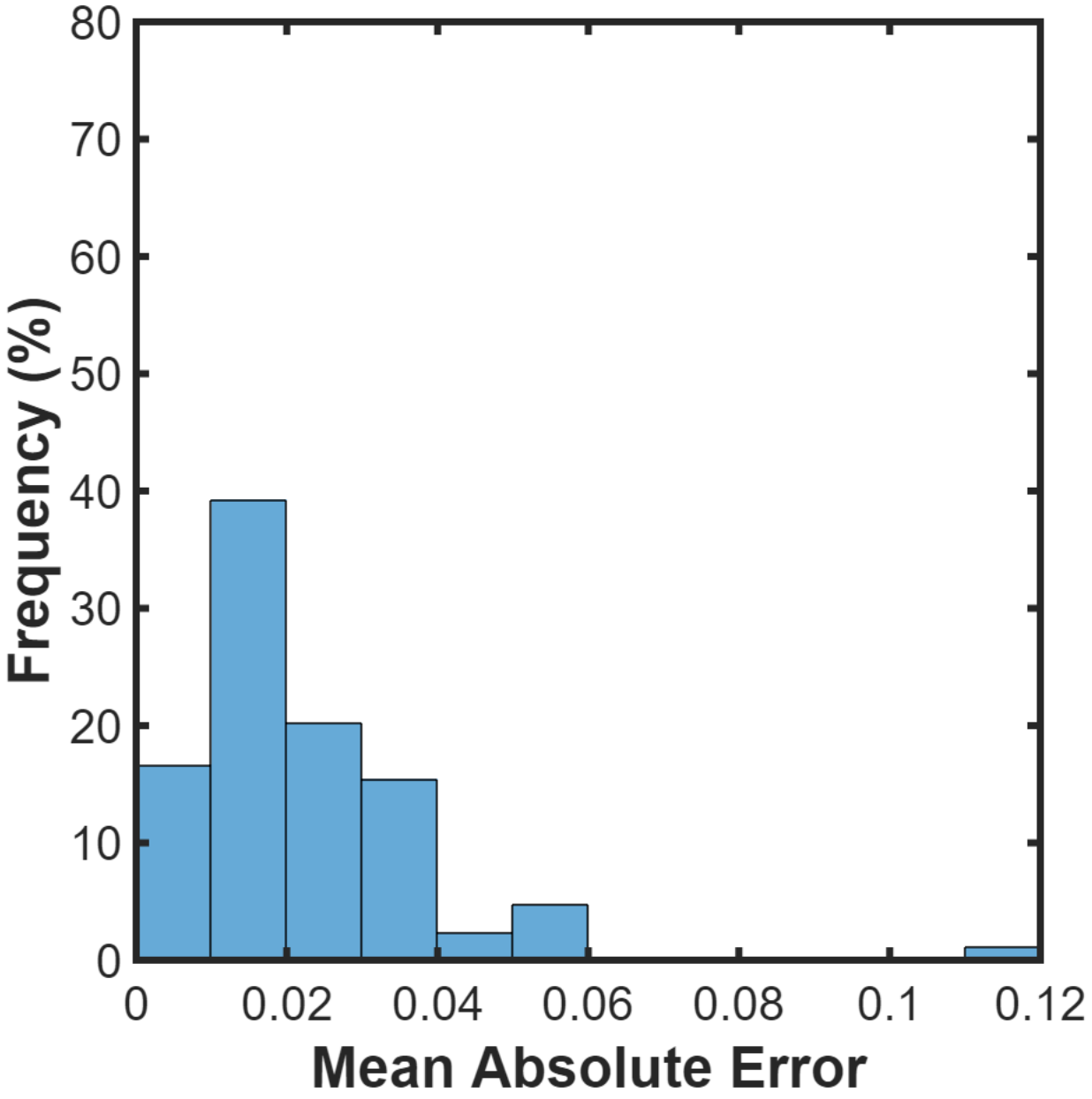



```
% Plot of Errors
figure('Position', [100 100 660 660]);
x_pdf = [0:1:12]./100;
histogram(reshape(error_MMC_optimum,[],1),x_pdf,'Normalization','pdf');
hold on;

ax = gca;
ax.FontSize = 20;
ax.XLim = [0 12]./100;
ax.XTick = [0:2:12]./100;
ax.YLim = [0 80];
ax.YTick = 0:10:80;
```

```
ax.XLabel.String = "Mean Absolute Error";
ax.YLabel.String = "Frequency (%)";
ax.XLabel.FontSize = 24;
ax.YLabel.FontSize = 24;
ax.XLabel.FontWeight = 'bold';
ax.YLabel.FontWeight = 'bold';
ax.Box = 'on';
ax.LineWidth = 3;

% Saves graph as .png file. Open them up to see.
print("error_MMC_optimum.tif",'-dtiff','-r500');
hold off;
```



```
%pause;

figure('Position', [100 100 660 660]);
x_pdf = [0:1:12]./100;
histogram(reshape(error_MMC_CBP,[],1),x_pdf,'Normalization','pdf');
hold on;

ax = gca;
ax.FontSize = 20;
ax.XLim = [0 12]./100;
ax.XTick = [0:2:12]./100;
ax.YLim = [0 80];
ax.YTick = 0:10:80;
ax.XLabel.String = "Mean Absolute Error";
ax.YLabel.String = "Frequency (%)";
ax.XLabel.FontSize = 24;
ax.YLabel.FontSize = 24;
ax.XLabel.FontWeight = 'bold';
ax.YLabel.FontWeight = 'bold';
ax.Box = 'on';
ax.LineWidth = 3;

% Saves graph as .png file. Open them up to see.
print("error_MMC_CBP.tif",'-dtiff','-r500');
hold off;
```




```
% Create LatticeLibrary
clc; clear all; close all;
LatticeLib.createLib();
```

```
Lattice Library created successfully.
```