


```
ss_ro = 7860;
ss_Epsilon = 0.001;

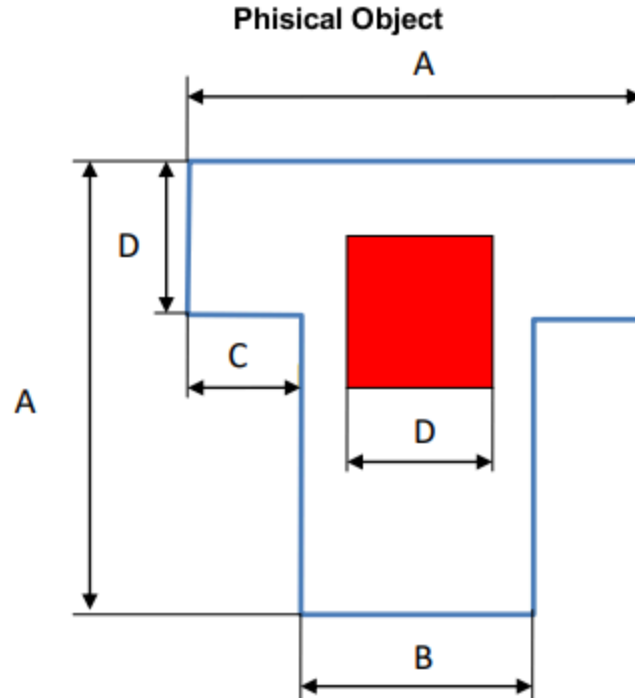
% Coper
cu_K = 401;
cu_Cw = 380;
cu_ro = 8920;
cu_Epsilon = 0.001;

% Aluminum
al_K = 237;
al_Cw = 900;
al_ro = 2700;
al_Epsilon = 0.001;

figure('name', 'Object', 'Position', [300 300 1200 500])
imshow("Przechwytywanie.PNG")
title("Phisical Object")

A = 0.3;
N = 0.2;
C = 0.05;
D = 0.1;
h = 0.005;
P = 100;

dt = 0.01;
sim_duration = 10000;
```



Running the simulation

```
% Stainless Steel
fprintf("steel...");
[ss_4x4_out, ss_4x4_H, ss_4x4_T_e, ss_max_4x4_dT] =
sim_board(matrix_4x4, sim_duration, ss_K, ss_Cw, ss_ro, A, D, h,
P, dt, ss_Epsilon, 0);
[ss_1x1_out, ss_1x1_H, ss_1x1_T_e, ss_max_1x1_dT] =
sim_board(matrix_1x1, sim_duration, ss_K, ss_Cw, ss_ro, A, D, h,
P, dt, ss_Epsilon, 0);
[ss_05x05_out, ss_05x05_H, ss_05x05_T_e, ss_max_05x05_dT] =
sim_board(matrix_05x05, sim_duration, ss_K, ss_Cw, ss_ro, A, D, h,
P, dt, ss_Epsilon, 0);
[ss_02x02_out, ss_02x02_H, ss_02x02_T_e, ss_max_02x02_dT] =
sim_board(matrix_02x02, sim_duration, ss_K, ss_Cw, ss_ro, A, D, h,
P, dt, ss_Epsilon, 0);
fprintf("done\n");

% Cooper
fprintf("cooper...");
[cu_4x4_out, cu_4x4_H, cu_4x4_T_e, cu_max_4x4_dT] =
sim_board(matrix_4x4, sim_duration, cu_K, cu_Cw, cu_ro, A, D, h,
P, dt, cu_Epsilon, 0);
```

```
[cu_1x1_out, cu_1x1_H, cu_1x1_T_e, cu_max_1x1_dT] =
    sim_board(matrix_1x1, sim_duration, cu_K, cu_Cw, cu_ro, A, D, h,
    P, dt, cu_Epsilon, 0);
[cu_05x05_out, cu_05x05_H, cu_05x05_T_e, cu_max_05x05_dT] =
    sim_board(matrix_05x05, sim_duration, cu_K, cu_Cw, cu_ro, A, D, h,
    P, dt, cu_Epsilon, 0);
[cu_02x02_out, cu_02x02_H, cu_02x02_T_e, cu_max_02x02_dT] =
    sim_board(matrix_02x02, sim_duration, cu_K, cu_Cw, cu_ro, A, D, h,
    P, dt/10, cu_Epsilon, 0);
fprintf("done\n");

% Aluminum
fprintf("aluminum...");
[al_4x4_out, al_4x4_H, al_4x4_T_e, al_max_4x4_dT] =
    sim_board(matrix_4x4, sim_duration, al_K, al_Cw, al_ro, A, D, h,
    P, dt, al_Epsilon, 0);
[al_1x1_out, al_1x1_H, al_1x1_T_e, al_max_1x1_dT] =
    sim_board(matrix_1x1, sim_duration, al_K, al_Cw, al_ro, A, D, h,
    P, dt, al_Epsilon, 0);
[al_05x05_out, al_05x05_H, al_05x05_T_e, al_max_05x05_dT] =
    sim_board(matrix_05x05, sim_duration, al_K, al_Cw, al_ro, A, D, h,
    P, dt, al_Epsilon, 0);
[al_02x02_out, al_02x02_H, al_02x02_T_e, al_max_02x02_dT] =
    sim_board(matrix_02x02, sim_duration, al_K, al_Cw, al_ro, A, D, h,
    P, dt/10, al_Epsilon, 0);
fprintf("done\n");

steel...done
cooper...done
aluminum...done
```

Acquired Data

```
figure('name', 'Resolution Matrices', 'Position', [300 300 1200 500])
subplot(3,4,1)
imagesc(ss_4x4_out);
title("Stainless Steel 40 mm x 40 mm")
subplot(3,4,2)
imagesc(ss_1x1_out);
title("Stainless Steel 10 mm x 10 mm")
subplot(3,4,3)
imagesc(ss_05x05_out);
title("Stainless Steel 5 mm x 5 mm")
subplot(3,4,4)
imagesc(ss_02x02_out);
title("Stainless Steel 2 mm x 2 mm")

subplot(3,4,5)
imagesc(ss_4x4_out);
title("Cooper 40 mm x 40 mm")
subplot(3,4,6)
imagesc(cu_1x1_out);
title("Cooper 10 mm x 10 mm")
```

```
subplot(3,4,7)
imagesc(cu_05x05_out);
title("Cooper 5 mm x 5 mm")
subplot(3,4,8)
imagesc(cu_02x02_out);
title("Cooper 2 mm x 2 mm")

subplot(3,4,9)
imagesc(al_4x4_out);
title("Aluminum 40 mm x 40 mm")
subplot(3,4,10)
imagesc(al_1x1_out);
title("Aluminum 10 mm x 10 mm")
subplot(3,4,11)
imagesc(al_05x05_out);
title("Aluminum 5 mm x 5 mm")
subplot(3,4,12)
imagesc(al_02x02_out);
title("Aluminum 2 mm x 2 mm")

T_e_data = [
    ss_4x4_T_e    cu_4x4_T_e    al_4x4_T_e;
    ss_1x1_T_e    cu_1x1_T_e    al_1x1_T_e;
    ss_05x05_T_e  cu_05x05_T_e  al_05x05_T_e;
    ss_02x02_T_e  cu_02x02_T_e  al_02x02_T_e;
];

H_data = [
    ss_4x4_H    cu_4x4_H    al_4x4_H;
    ss_1x1_H    cu_1x1_H    al_1x1_H;
    ss_05x05_H  cu_05x05_H  al_05x05_H;
    ss_02x02_H  cu_02x02_H  al_02x02_H;
];

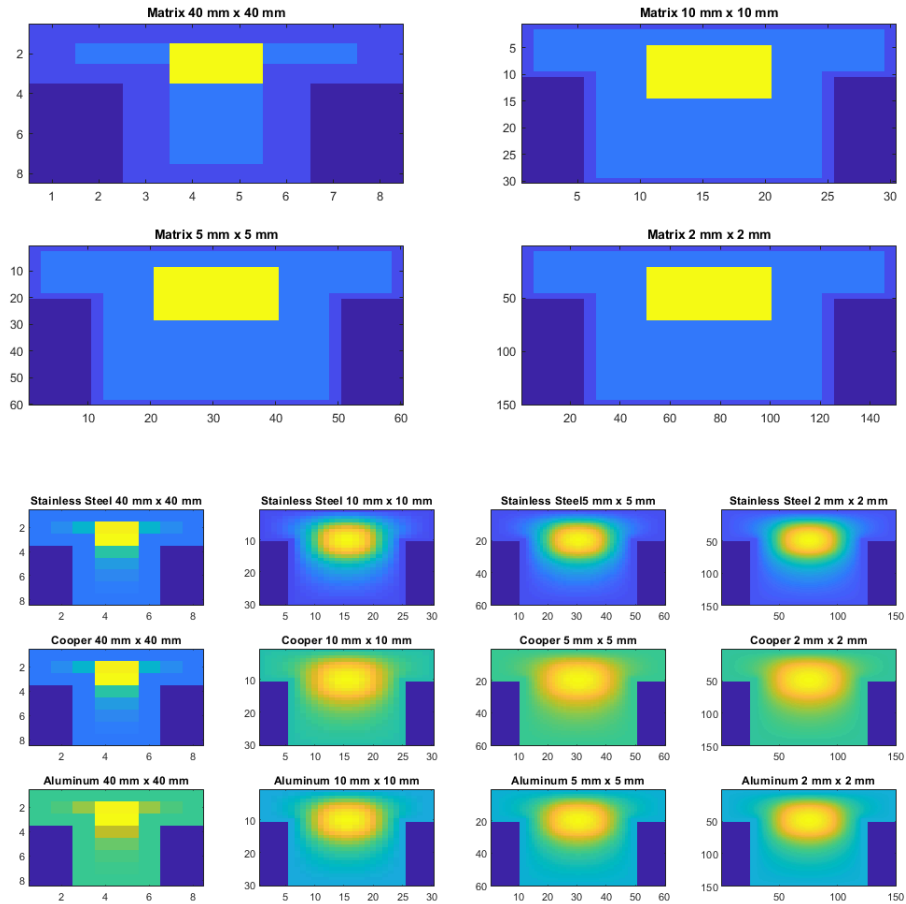
figure('name', 'Simulation Data', 'Position', [300 300 1200 500])
subplot(1,2,1)
bar(T_e_data, 0.5)
ax = gca;
%ax.XTickLabel = {'SS','Cu', 'Al'};
ax.XTickLabel = {'40','10', '5', '2'};
%xlabel('Plate Material')
xlabel('Model Resolution [mm]')
ylabel('Final Temperature [K]')
title("Temperature")
legend('Stainless Steel','Coper', 'Aluminum', 'Location', 'east')

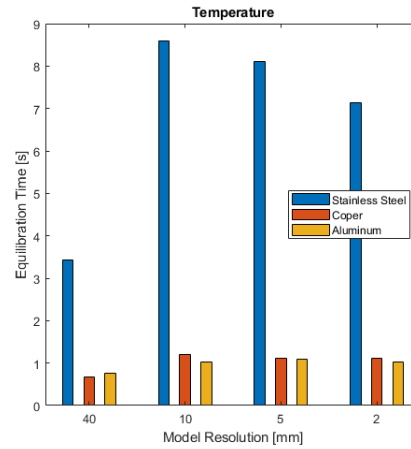
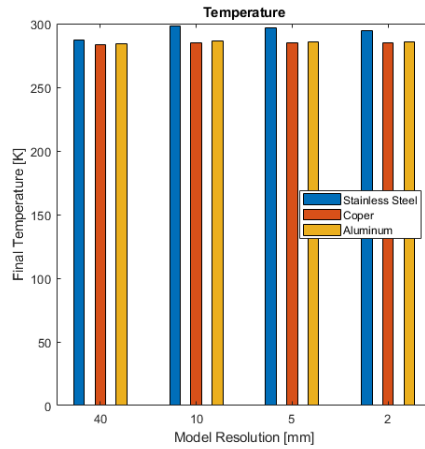
subplot(1,2,2)
bar(H_data.*dt, 0.5)
ax = gca;
%ax.XTickLabel = {'SS','Cu', 'Al'};
ax.XTickLabel = {'40','10', '5', '2'};
%xlabel('Plate Material')
xlabel('Model Resolution [mm]')
```

```
ylabel('Equilibration Time [s]')
title("Temperature")
legend('Stainless Steel','Coper', 'Aluminum', 'Location', 'east')

figure('name', 'Table', 'Position', [300 300 300 100])
resolution = {'40 mm'; '10 mm'; '5 mm'; '2 mm'};
Stainless_Steel =
    [T_e_data(1,1);T_e_data(2,1);T_e_data(3,1);T_e_data(4,1)];
Coper = [T_e_data(1,2);T_e_data(2,2);T_e_data(3,2);T_e_data(4,2)];
Aluminum = [T_e_data(1,3);T_e_data(2,3);T_e_data(3,3);T_e_data(4,3)];
T = table(Stainless_Steel,Coper,Aluminum,'RowNames',resolution);

uitable('Data',T{:,:}, 'ColumnName',T.Properties.VariableNames,...
        'RowName',T.Properties.RowNames,'Units', 'Normalized', 'Position',
        [0, 0, 1, 1]);
```





	Stainless_Steel	Coper	Aluminum
40 mm	286.8484	283.5595	283.9460
10 mm	297.9243	285.0850	286.5514
5 mm	296.7268	284.6650	285.9292
2 mm	294.3228	284.7398	286.0091

Summary

With that we can observe, that the minimum resolution right for the simulation was the 1 mm x 1 mm. Any better resolution yealds the same information about the equilibrium temperature of the plate

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