```
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```

part 3

```
clc;
clear;
close all;

%load system model
load('mathModel.mat');

%check thm 8.5
[num, den] = ss2tf(A,B,C,D);
zeros = roots(num);
% its controllable because no zeros at s = 0

%find K matrix
syms ka k1 k2
%char eqn desired: s^3+12s^2+48s+64
K = [k1 k2];
A_rt = [[A+B*K B*ka];[-C 0]];
charEqn = charpoly(A_rt);

eqn1 = 12 == charEqn(2);
eqn2 = 48 == charEqn(3);
eqn3 = 64 == charEqn(4);

[meatMat,potatoesMat] = equationsToMatrix([eqn1, eqn2, eqn3], [k1, k2,
 ka]);
K = double(linsolve(meatMat, potatoesMat));

K_rt = K(1:2).';
ka = K(end);

% model
encGain = 2*pi /4096;

rtSim = sim('part3model.slx');

Ts = findSettlingTime(rtSim.tout, rtSim.pos)

RMSE = findRMSE(rtSim.tout, rtSim.pos, 1)

%plot
figure();
hold on;
plot(rtSim.tout, rtSim.pos, 'DisplayName', 'System Output');
plot(Ts, rtSim.pos(find(rtSim.tout ==
 Ts)), 'ro', 'DisplayName', 'Settling Time = 1.65 [s]');
```

```matlab
title('Robust Tracking with Disturbance Rejection');
xlabel('Time, t[s]');
ylabel('Position, \theta[rad]');
grid();
legend('Location', 'southeast');

%save vars
A_rt_doub = [[A+B*K_rt B*ka];[-C 0]];
save('robust.mat', 'A_rt', 'A_rt_doub', 'encGain');

% commentary
comments = ['The difference between the full state and robust
 controllers' ...
    'was %.3f percent increase. The difference between the RMSE was
 %.3f ' ...
    'percent increase'];
fprintf(comments, 31.496, 40.496);
```
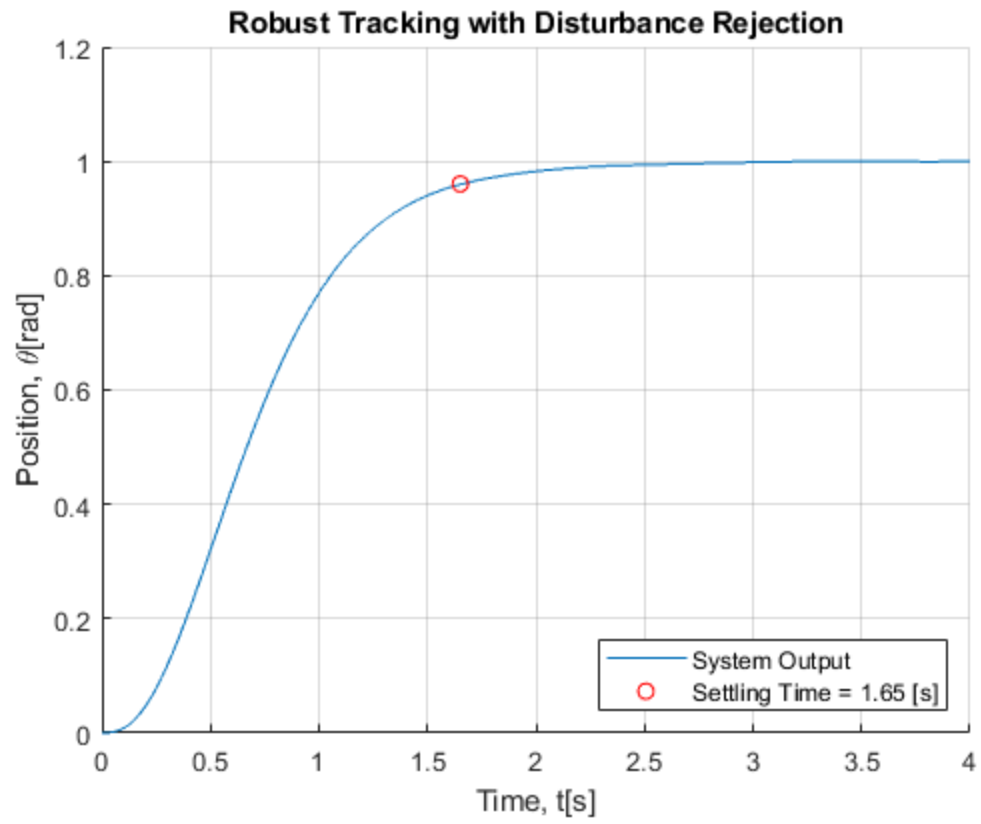
Ts =

   1.6510

RMSE =

   0.0121

*The difference between the full state and robust controllerswas 31.496
 percent increase. The difference between the RMSE was 40.496 percent
 increase*

Published with MATLAB® R2019b