Full Sim Experiment - Nominal

```
motorRes = [.4 .4 .4 .4];
tic
sim('MavicProComplete_oct22');
```

```
Warning: When the Configuration Parameters->Diagnostics->Connectivity->"Bus signal treated as vector"
 diagnostic is set to "Error", the 'M-S-Function' block cannot accept a virtual bus signal. A virtual bus
 is connected to input port 5 of block 'MavicProComplete_oct22/Quadcopter/Airframe'. Consider converting
 the virtual bus into a vector using a Bus to Vector block at the input, or converting the virtual bus to
 a nonvirtual bus by inserting a Signal Conversion block at the input, with its "Output" option set to
 "Nonvirtual bus".
Warning: Unconnected output line found on 'MavicProComplete_oct22/Quadcopter/External Disturbances' (output
 port: 1)
Warning: If the inport 'MavicProComplete_oct22/MATLAB Function' of subsystem 'MavicProComplete_oct22/MATLAB
 Function' involves direct feedback, then an algebraic loop exists, which Simulink cannot remove. To avoid
 this warning, consider clearing the 'Minimize algebraic loop occurrences' parameter of the subsystem or set
 the Algebraic loop diagnostic to 'none' in the Diagnostics tab of the Configuration Parameters dialog.
Warning: If the inport 'MavicProComplete_oct22/MATLAB Function' of subsystem 'MavicProComplete_oct22/MATLAB
 Function' involves direct feedback, then an algebraic loop exists, which Simulink cannot remove. To avoid
 this warning, consider clearing the 'Minimize algebraic loop occurrences' parameter of the subsystem or set
 the Algebraic loop diagnostic to 'none' in the Diagnostics tab of the Configuration Parameters dialog.
Warning: Block diagram 'MavicProComplete_oct22' contains 1 algebraic loop(s). To see more details about the
 loops use the command Simulink.BlockDiagram.getAlgebraicLoops('MavicProComplete_oct22')  or the command line
 Simulink debugger by typing sldebug('MavicProComplete_oct22')  in the MATLAB command window. To eliminate
 this message, set Algebraic loop to "none".
Found algebraic loop containing:
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor4/throttle_fcn/Product2 (algebraic variable)
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor4/throttle_fcn/Product
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor4/Sum1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor4/Divide1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor3/throttle_fcn/Product2
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor3/throttle_fcn/Product
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor3/Sum1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor3/Divide1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor2/throttle_fcn/Product2
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor2/throttle_fcn/Product
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor2/Sum1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor2/Divide1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/Switch (discontinuity)
MavicProComplete_oct22/Quadcopter/Powertrain/BuckConverter/Product
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/Divide
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/Product (algebraic variable)
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor1/throttle_fcn/Product2
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor1/throttle_fcn/Product
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor1/Sum1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/BLDC Motor1/Divide1
MavicProComplete_oct22/Quadcopter/Powertrain/motorGroup/Sum (algebraic variable)
Warning: Discontinuities detected within algebraic loop(s), may have trouble solving
Warning: Solver is encountering difficulty in simulating model 'MavicProComplete_oct22' at time 0.02.
 Simulink will continue to simulate with warnings. Please check the model for errors.
Warning: Solver was unable to reduce the step size without violating minimum step size of 0.01 for 1
 consecutive times at time 0.02.  Solver will continue simulation with the step size restricted to 0.01 and
 using an effective relative error tolerance of 0.004214339201481494, which is greater than the specified
 relative error tolerance of 0.0001. This usually may be caused by the high stiffness of the system. Please
 check the system or increase the solver Number of consecutive min steps violation parameter.
```

```
toc
```

```
Elapsed time is 109.529290 seconds.
```

```
disp("mission took: " + num2str(tout(end)) + "seconds");
```

```
mission took: 501.4408seconds
```

```
disp("rpm residual: " + num2str(mean(rpm_res/100)));
```

```
rpm residual: 0.24276
```

```
disp("cur residual: " + num2str(mean(i_res)));
```

```
cur residual: -0.02031
```

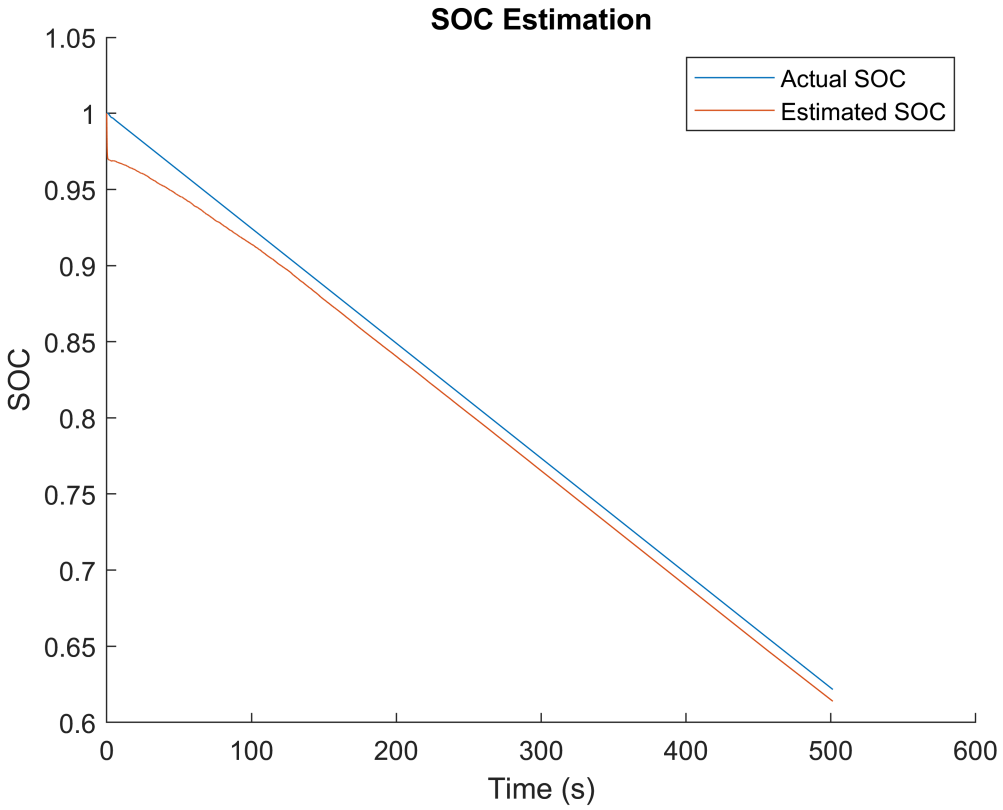
```
disp("final position: " + num2str(round(pos(end,1),1)) + "," + num2str(round(pos(end,2),1)));
```

```
final position: 0.1,2415.5
```

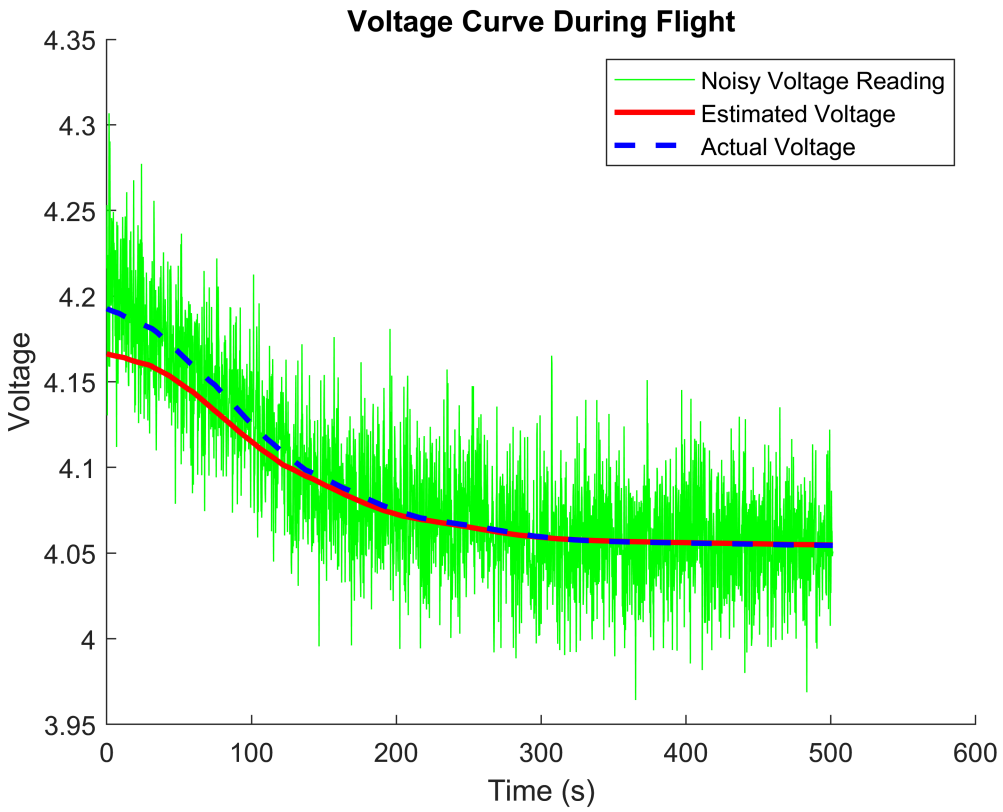
```
disp("soc: " + num2str(soc.Data(end)));
```

```
soc: 0.62163
```

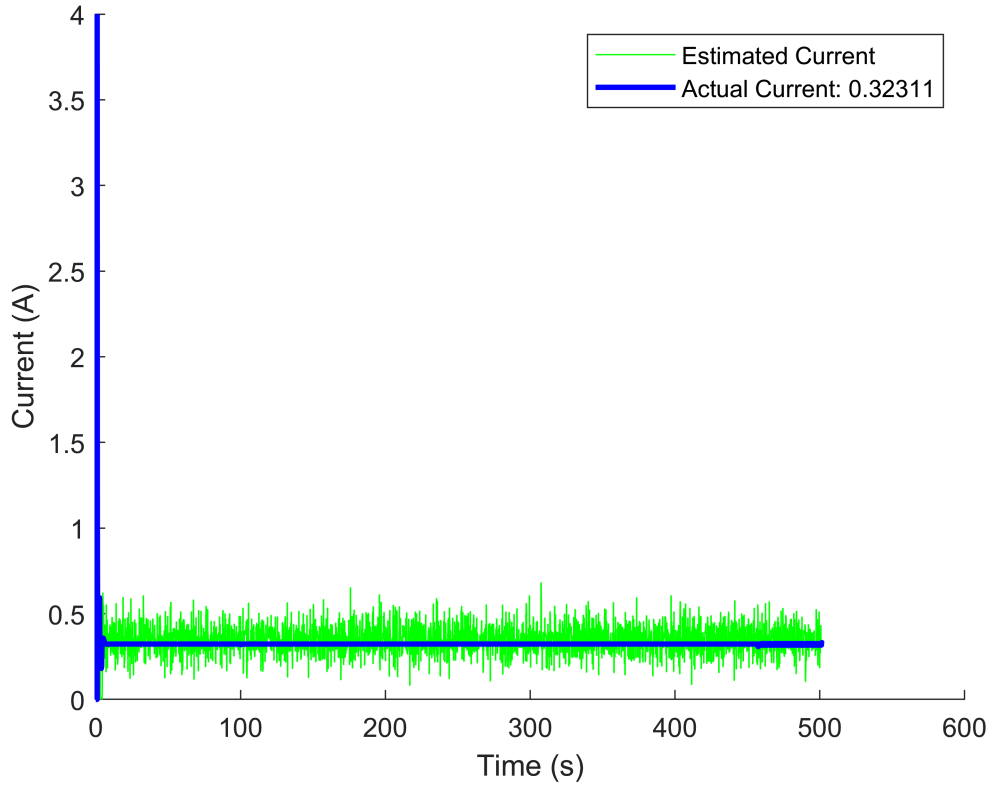
```
f1 = figure(1); clf;
hold on;
plot(soc.Time, soc.Data);
plot(soc_hat.Time, soc_hat.Data);
title("SOC Estimation");
legend(["Actual SOC", "Estimated SOC"]);
ylabel("SOC");
xlabel("Time (s)");
hold off;
```



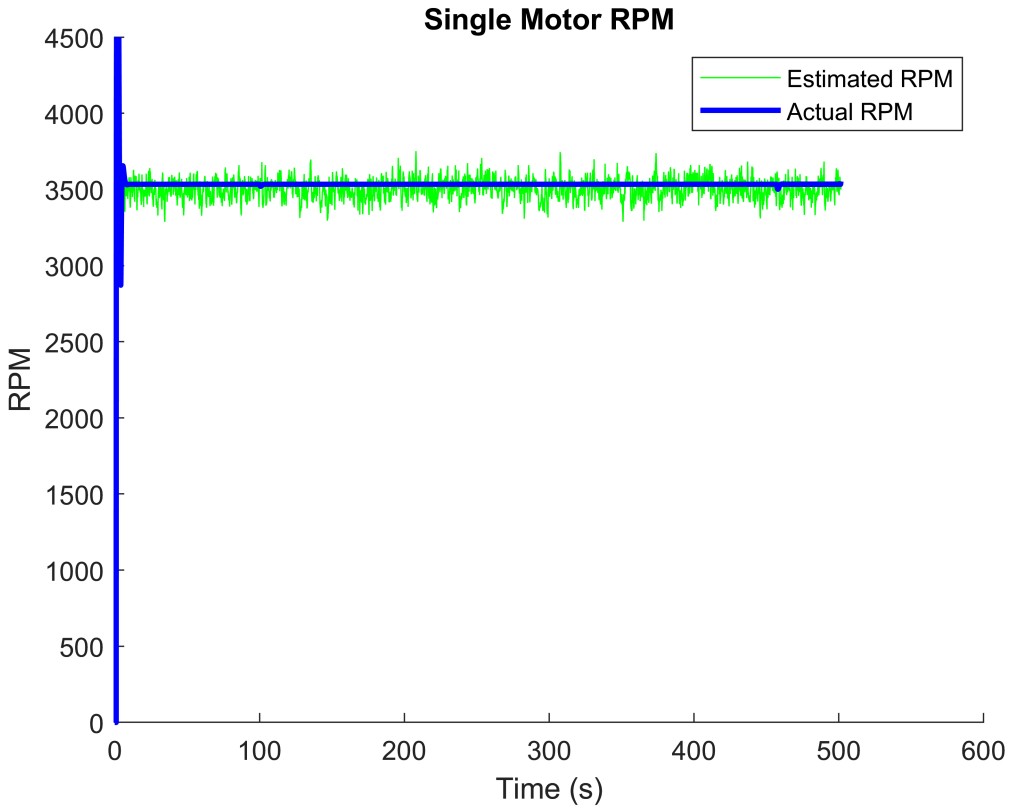

```
f2 = figure(2); clf;
hold on;
plot(noisy_v.Time, noisy_v.Data, 'g');
plot(v_batt_hat.Time, smoothdata(v_batt_hat.Data, 'movmean', 500), 'r', 'linewidth', 2);
plot(v_batt.Time, smoothdata(v_batt.Data, 'movmean', 500), 'b--', 'linewidth', 2);
hold off;
title("Voltage Curve During Flight");
xlabel("Time (s)");
ylabel("Voltage");
legend(["Noisy Voltage Reading", "Estimated Voltage", "Actual Voltage"]);
```



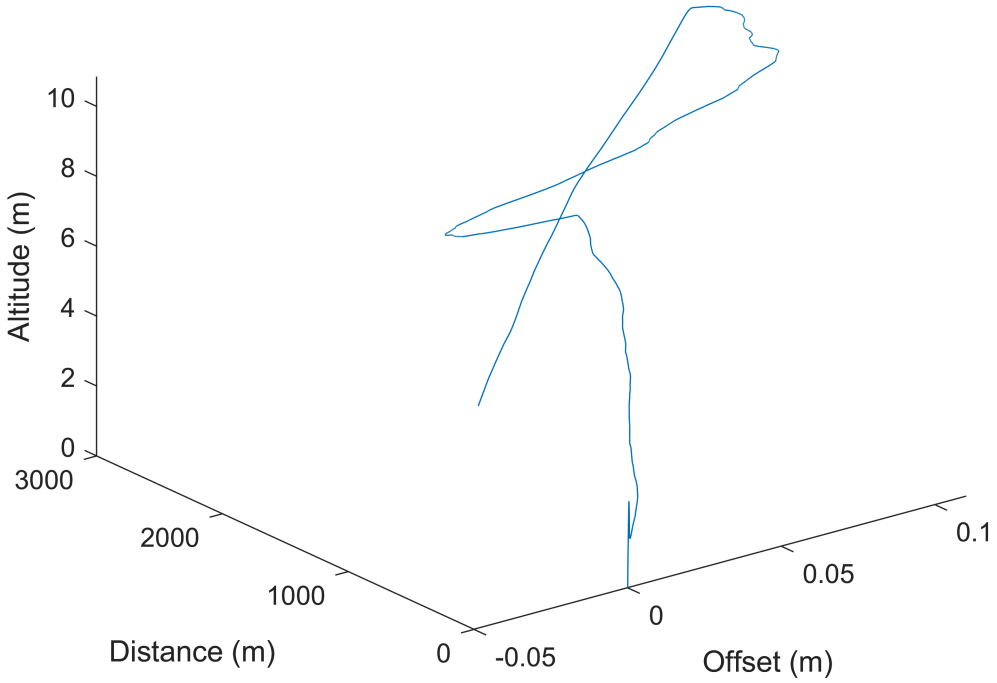

```
i_hatData = i_hat.Data(1,:);
f3 = figure(3); clf;
hold on;
plot(i_hat.Time, i_hatData, 'g');
plot(i_mot.Time, i_mot.Data, 'b', 'linewidth', 2);
hold off;
% title("Single Motor Current Draw");
xlabel("Time (s)");
ylabel("Current (A)");
legend(["Estimated Current", "Actual Current: " + num2str(i_mot.Data(1000))]);
ylim([0 4]);
```



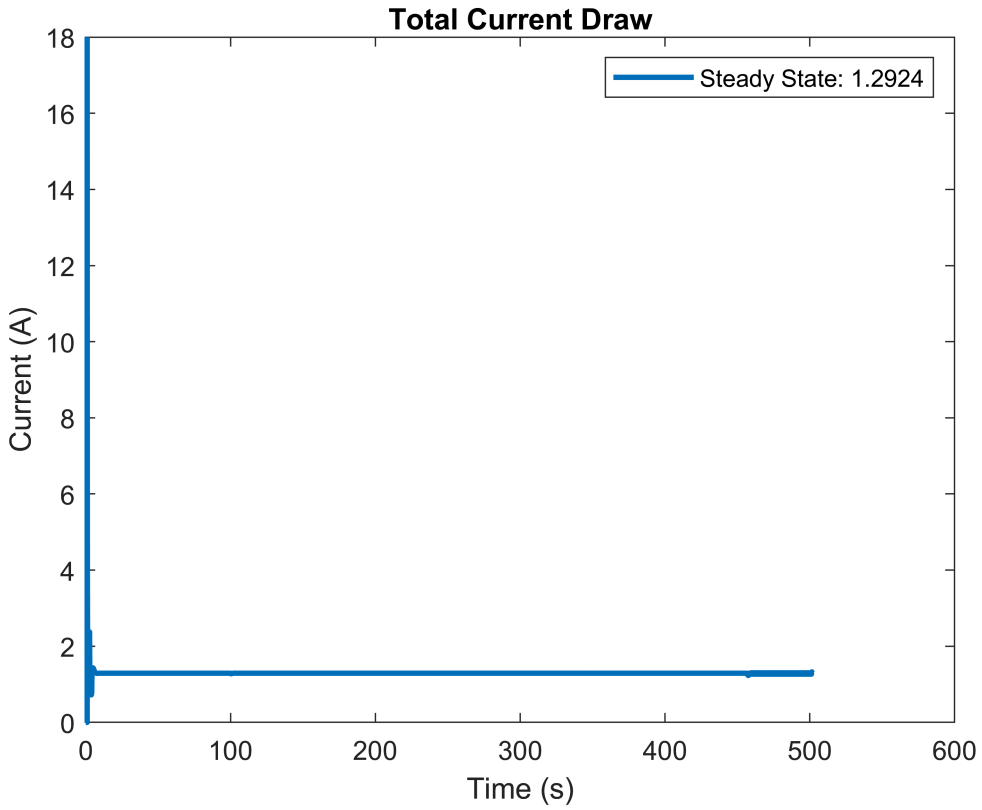

```
f4 = figure(4); clf;
hold on;
plot(rpm_hat.Time, rpm_hat.Data, 'g');
plot(rpm.Time, rpm.Data, 'b', 'linewidth', 2);
hold off;
xlabel("Time (s)");
ylabel("RPM");
ylim([0 4500]);
title("Single Motor RPM");
legend(["Estimated RPM", "Actual RPM"]);
```



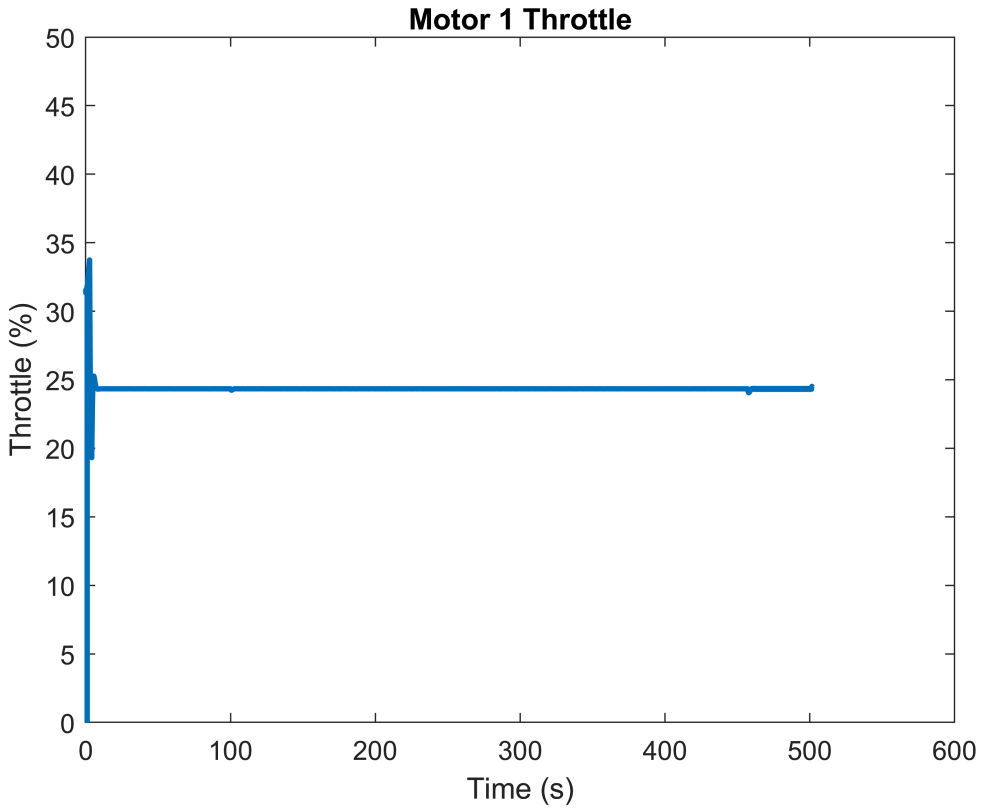

```
f5 = figure(5); clf;
plot3(pos(:,1), pos(:,2), pos(:,3));
%xlim([-1 1]);
xlabel("Offset (m)");
ylabel("Distance (m)");
zlabel("Altitude (m)");
title("UAV Trajectory");
```



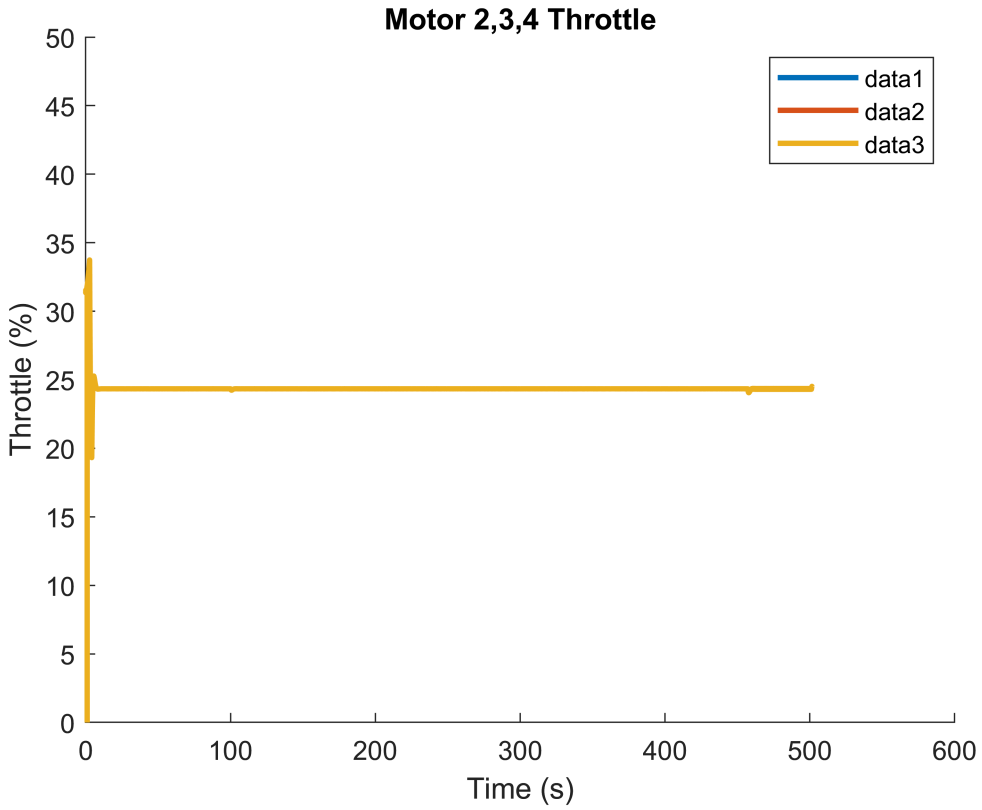

```
f6 = figure(6); clf;
plot(i_batt.Time, i_batt.Data, 'linewidth', 2);
title("Total Current Draw");
xlabel("Time (s)");
ylim([0 18]);
ylabel("Current (A)");
legend(["Steady State: " + num2str(i_batt.Data(1000))]);
```



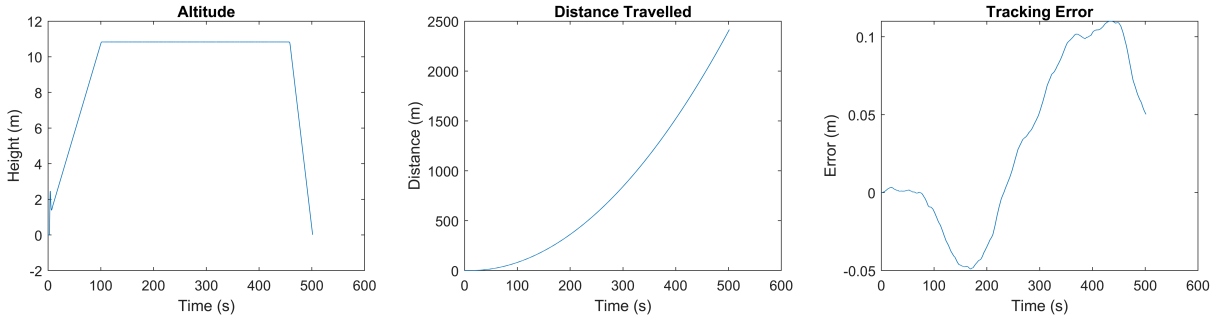

```
f7 = figure(7); clf;
plot(m1_throttle.Time, m1_throttle.Data, 'linewidth', 2);
title("Motor 1 Throttle");
xlabel("Time (s)");
ylabel("Throttle (%)");
ylim([0 50]);
```




```
f8 = figure(8); clf;
hold on;
plot(m2_throttle.Time, m2_throttle.Data, 'linewidth', 2);
plot(m3_throttle.Time, m3_throttle.Data, 'linewidth', 2);
plot(m4_throttle.Time, m4_throttle.Data, 'linewidth', 2);
hold off;
title("Motor 2,3,4 Throttle");
xlabel("Time (s)");
ylabel("Throttle (%)");
ylim([0 50]);
legend()
```




```
f9 = figure(9); clf;
f9.Position = [0 0 1400 300];
subplot(131);
plot(tout, pos(:,3));
title("Altitude");
xlabel("Time (s)");
ylabel("Height (m)");
subplot(132);
plot(tout, pos(:,2));
title("Distance Travelled");
xlabel("Time (s)");
ylabel("Distance (m)");
subplot(133);
plot(tout, pos(:,1));
title("Tracking Error");
xlabel("Time (s)");
ylabel("Error (m)");
```




```
f10 = figure(10); clf;
plot(power.Time, power.Data, 'linew', 2);
title("Power Consumption During Flight");
xlabel("Time (s)");
ylabel("Power Consumption (w)");
ylim([0 50]);
```