Full Sim Experiments Faulty Motor

- variable step, auto, max=10, min=.01, tol=1e-4

```
warning('off', 'all');
motorRes = [.405 .4 .4 .4];
tic
sim('MavicProComplete_2018a');
```

```
Found algebraic loop containing:
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor4/throttle_fcn/Product2 (algebraic varia
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor4/throttle_fcn/Product
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor4/Sum1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor4/Divide1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor3/throttle_fcn/Product2
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor3/throttle_fcn/Product
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor3/Sum1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor3/Divide1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor2/throttle_fcn/Product2
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor2/throttle_fcn/Product
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor2/Sum1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor2/Divide1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/Switch (discontinuity)
MavicProComplete_2018a/Quadcopter/Powertrain/BuckConverter/Product
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/Divide
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/Product (algebraic variable)
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor1/throttle_fcn/Product2
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor1/throttle_fcn/Product
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor1/Sum1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/BLDC Motor1/Divide1
MavicProComplete_2018a/Quadcopter/Powertrain/motorGroup/Sum (algebraic variable)
```

```
toc
```

```
Elapsed time is 60.904654 seconds.
```

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

```
mission took: 149.7889seconds
```

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

```
rpm residual: 0.26809
```

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

```
cur residual: -0.023058
```

```
disp("final position: " + num2str(round(pos(end,1),1)) + "," + num2str(round(pos(end,2)
```
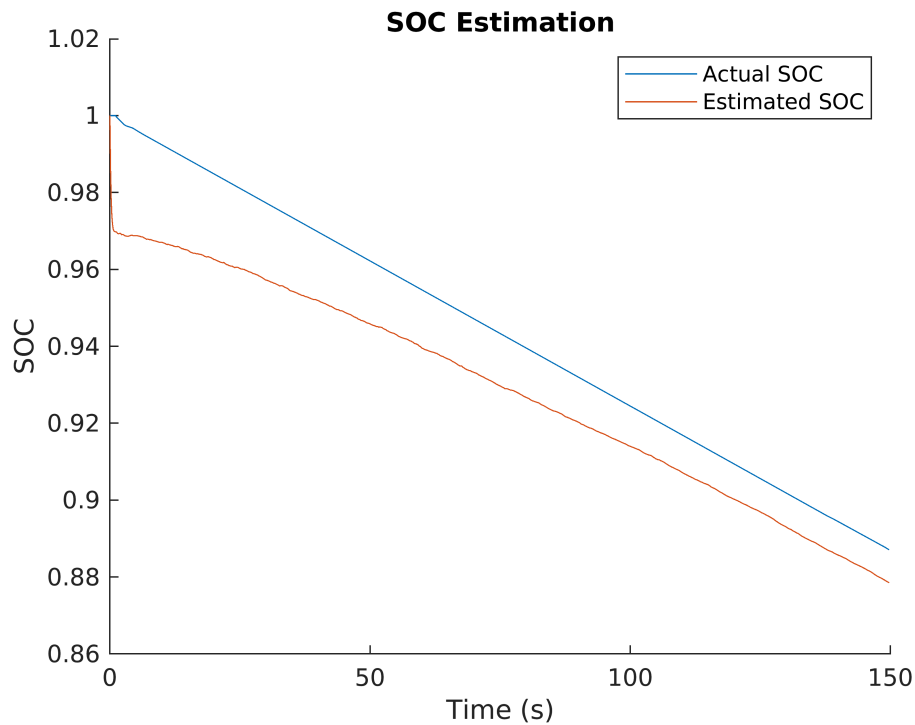
```
final position: 17.7,181.2
```

```
f1 = figure(1); clf;
hold on;
plot(soc.Time, soc.Data);
plot(soc_hat.Time, soc_hat.Data);
```

```matlab
title("SOC Estimation");
legend(["Actual SOC", "Estimated SOC"]);
ylabel("SOC");
xlabel("Time (s)");
hold off;
```



```matlab
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"]);
```
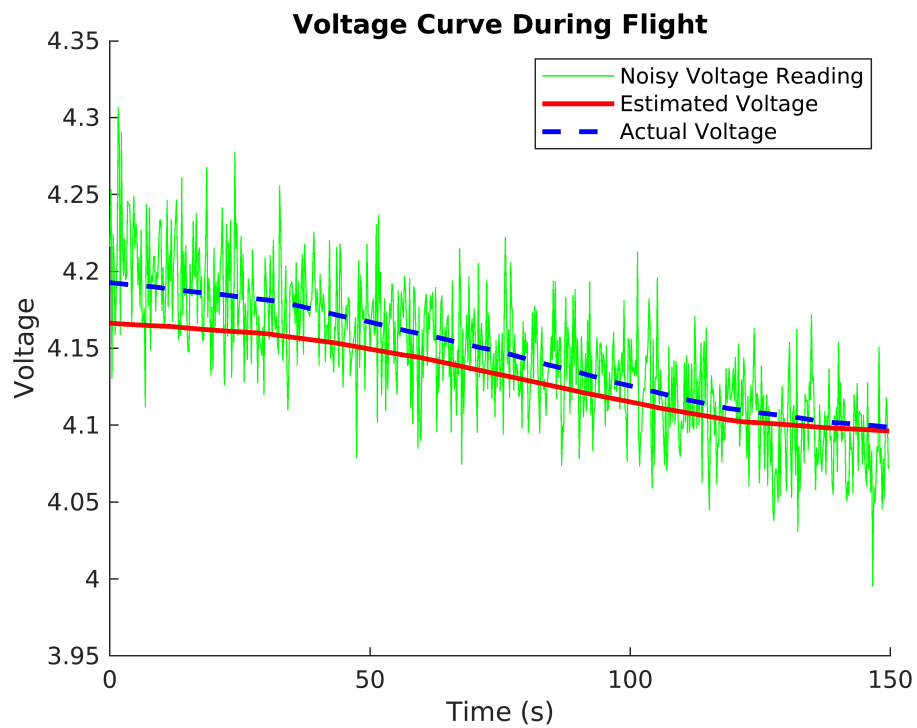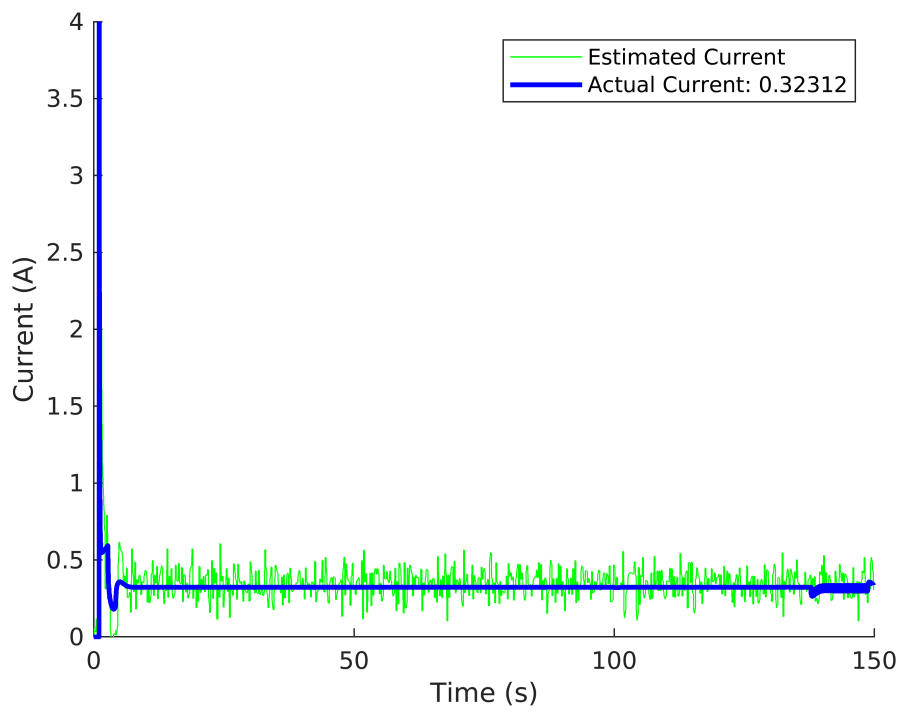
Voltage Curve During Flight


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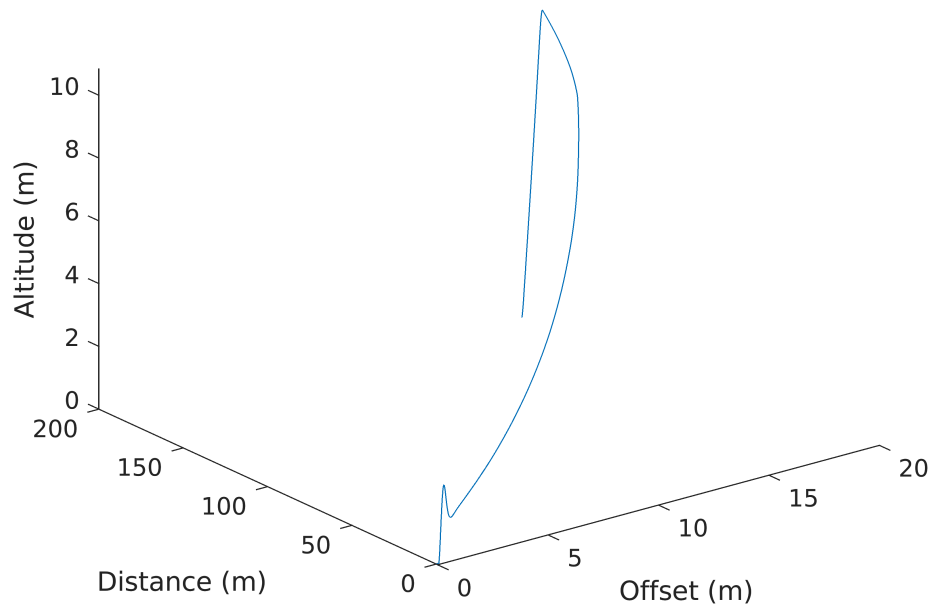
```matlab
f4 = figure(4); clf;
hold on;
plot(rpm_hat.Time, rpm_hat.Data, 'g');
plot(rpm.Time, rpm.Data, 'b', 'linewidth', 2);
hold off;
xlabel("Time (s)");
ylabel("RPM");
title("Single Motor RPM");
legend(["Estimated RPM", "Actual RPM"]);
```
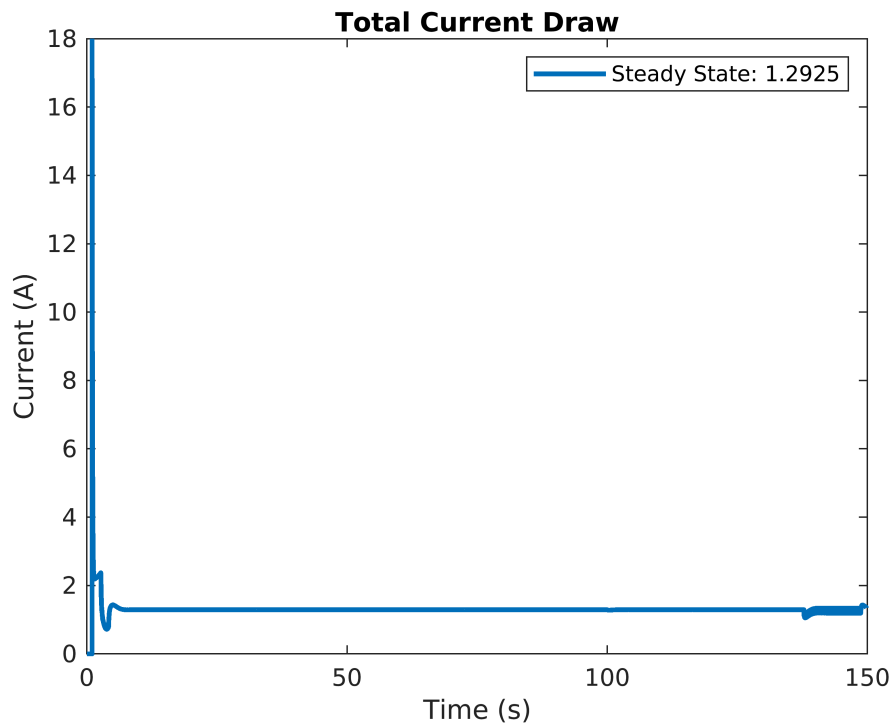
Single Motor RPM
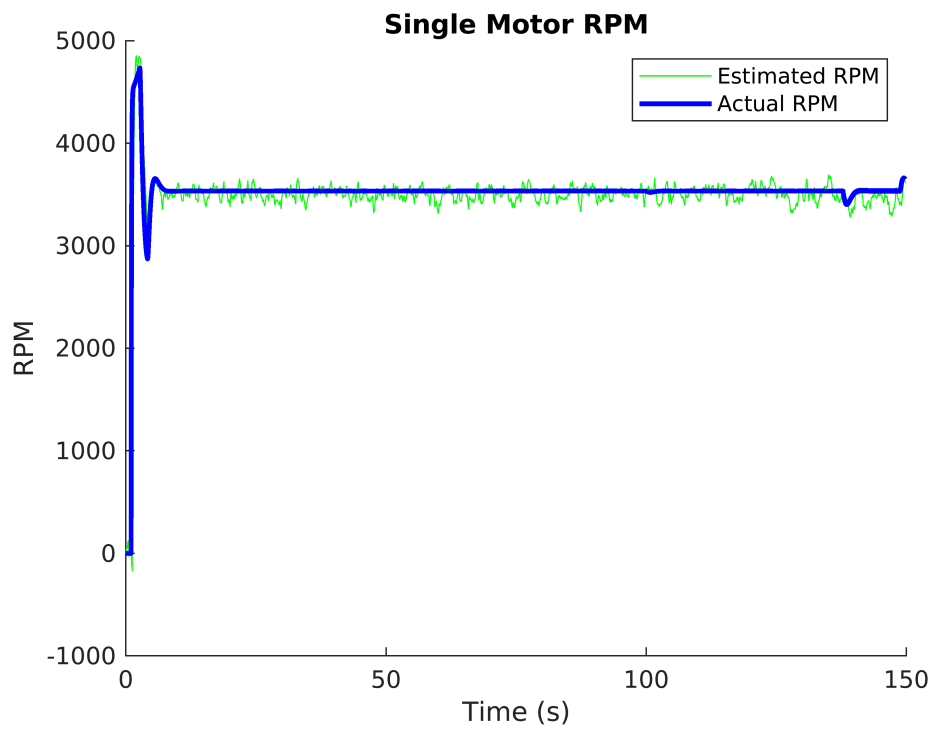

```
f5 = figure(5); clf;
plot3(pos(:,1), pos(:,2), pos(:,3));
%xlim([-1 1]);
xlabel("Offset (m)");
ylabel("Distance (m)");
zlabel("Altitude (m)");
title("UAV Trajectory");
```
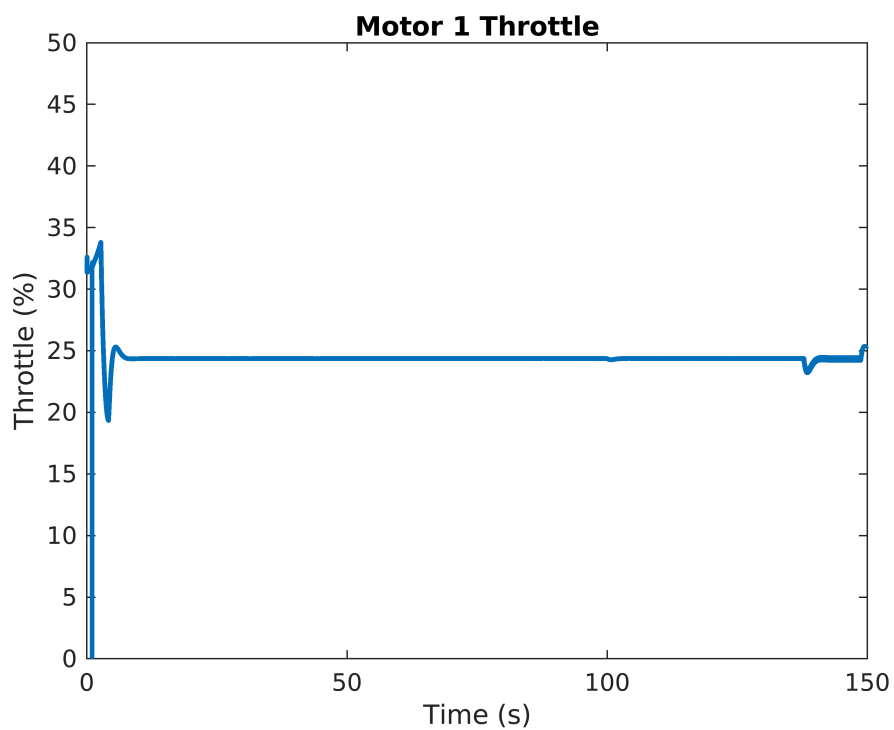
UAV Trajectory


```matlab
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))]);
```

Total Current Draw


```
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()
```
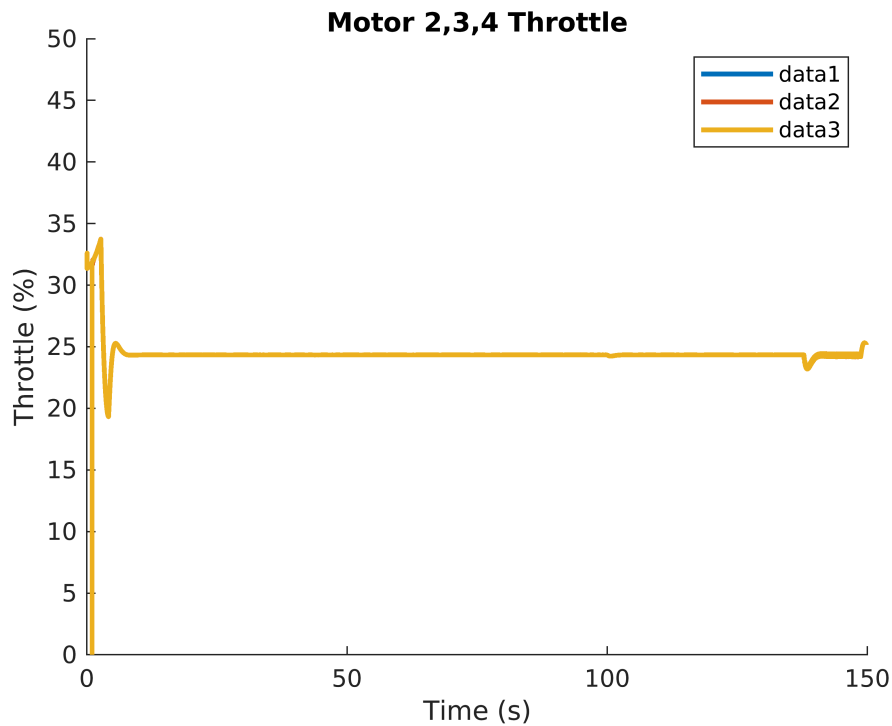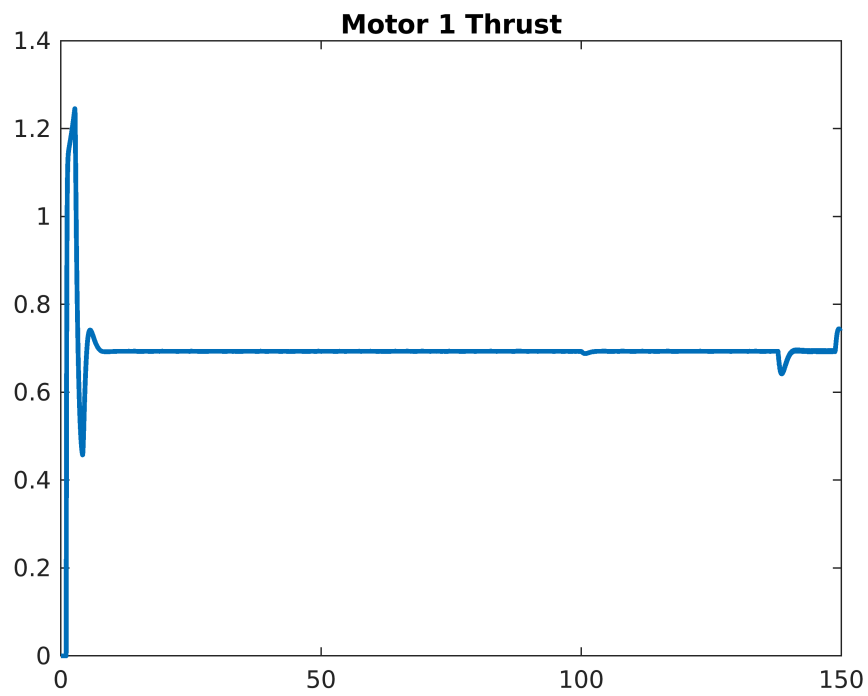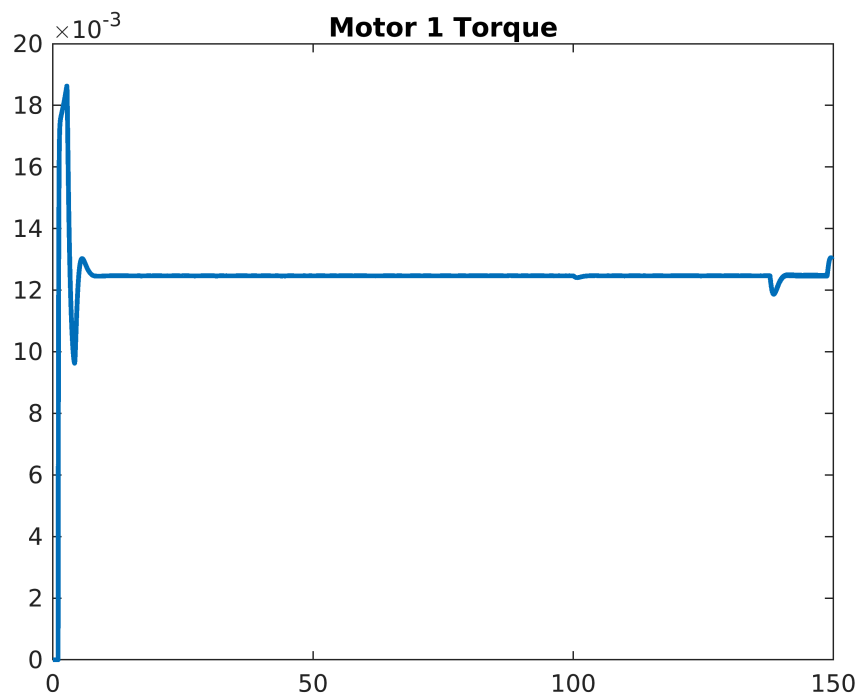


```
f9 = figure(9); clf;
plot(th_mot.Time, th_mot.Data, 'linew', 2);
title("Motor 1 Thrust");
```

Motor 1 Thrust

```
f10 = figure(10); clf;
plot(tq_mot.Time, tq_mot.Data, 'linew', 2);
title("Motor 1 Torque");
```


Motor 1 Torque
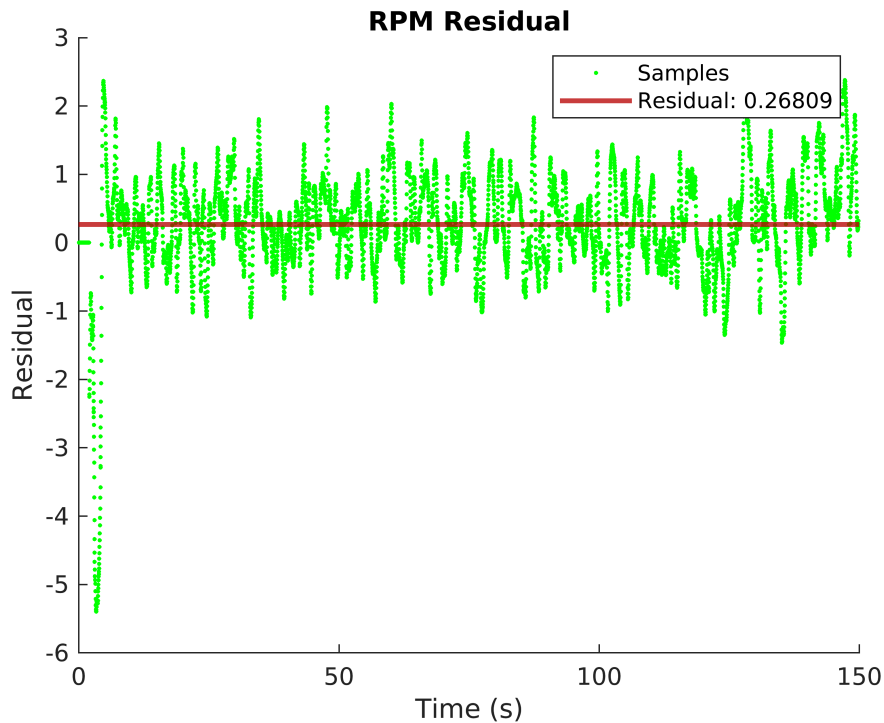
```
rpm_resa = rpm_res.Data(:,1:4500);
```

```
f10 = figure(10); clf;
hold on;
plot(rpm_res/100, 'g.');
yline(mean(rpm_res/100), 'r', 'linew', 2);
hold off;
title("RPM Residual");
ylabel("Residual");
xlabel("Time (s)");
legend(["Samples", "Residual: " + num2str(mean(rpm_res/100))]);
```



```
f11 = figure(11); clf;
hold on;
plot(i_res, 'g.');
yline(mean(i_res), 'r', 'linew', 2);
hold off;
title("Current Residual");
ylabel("Residual");
xlabel("Time (s)");
legend(["Samples", "Residual: " + num2str(mean(i_res))]);
```

Current Residual

Legend:
- Samples
- Residual: -0.023058

Y-axis: Residual
X-axis: Time (s)