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# ECE 486

Quadcopter Modeling and Simulation

Acknowledgement: C. Carlson, R. Halverson, and R. Caverly provided the data collected from the Parrot Mambo during hover.

## Vehicle Parameters

```
m = 65e-3;      % Mass, kg
g = 9.81;       % Gravitational constant, m/s^2
kT = [];        % Thrust coefficient, N
umax = 500;     % Maximum thrust input command.
```

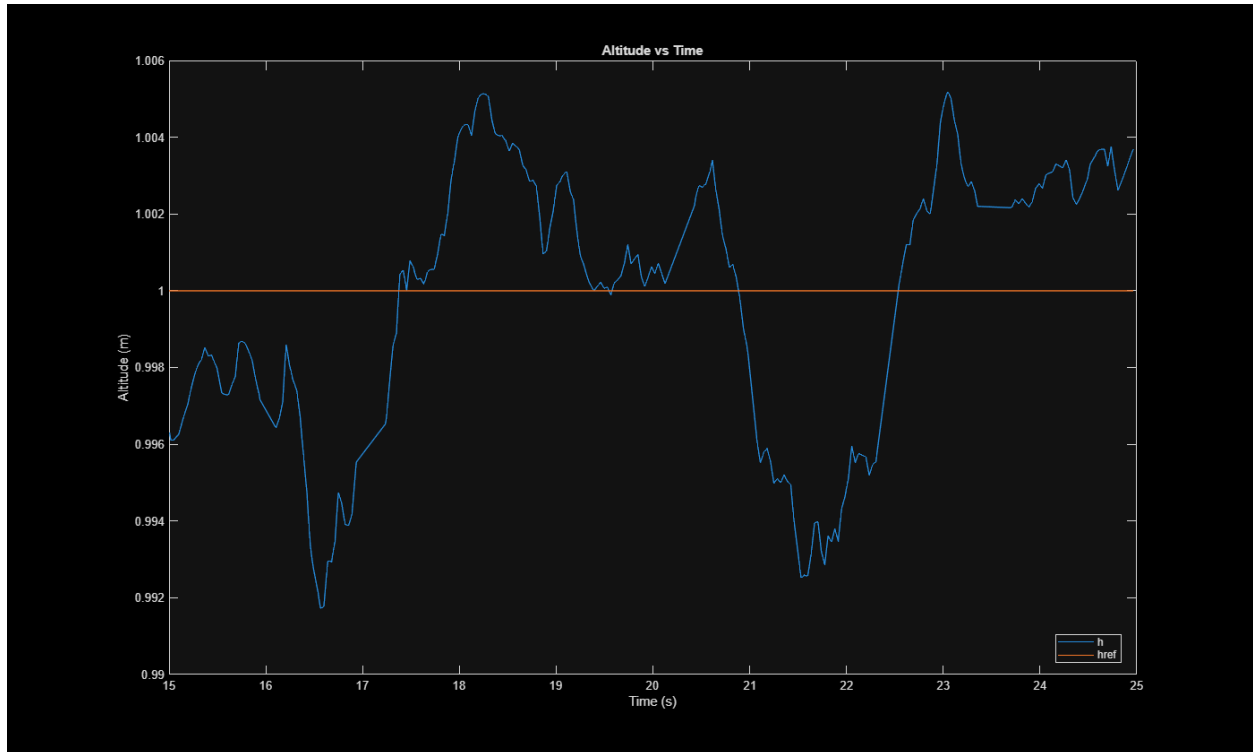
## Load hover data

```
load('MamboData');
```

## Part A

Plot altitude and desired altitude vs. time Add labels to the horizontal and vertical axes of your plot.

```
figure (1);
plot(t, h);
hold on;
plot(t, href);
legend('h', 'href', 'Location', 'best');
xlabel('Time (s)');
ylabel('Altitude (m)');
title('Altitude vs Time');
hold off;
```



## Part B

```

u_mat = [u1; u2; u3; u4];
u_average_per_motor = mean(u_mat);
kT = m*g/4/u_average_per_motor;
a_max = (4*kT*umax - m*g)/m;

fprintf('Estimated kT = %.6e N per unit command\n', kT);
fprintf('Average motor command during hover (per motor) = %.3f\n',
u_average_per_motor);
fprintf('Maximum upward acceleration with u_max = %.1f is a_max = %.3f m/
s^2\n', umax, a_max);

```

```

Estimated kT = 5.275977e-04 N per unit command
Average motor command during hover (per motor) = 302.148
Maximum upward acceleration with u_max = 500.0 is a_max = 6.424 m/s^2

```

## Part C

Simulate system with constant motor command to maintain hover. Plot altitude vs. time. Again, add labels to the horizontal and vertical axes of your plot.

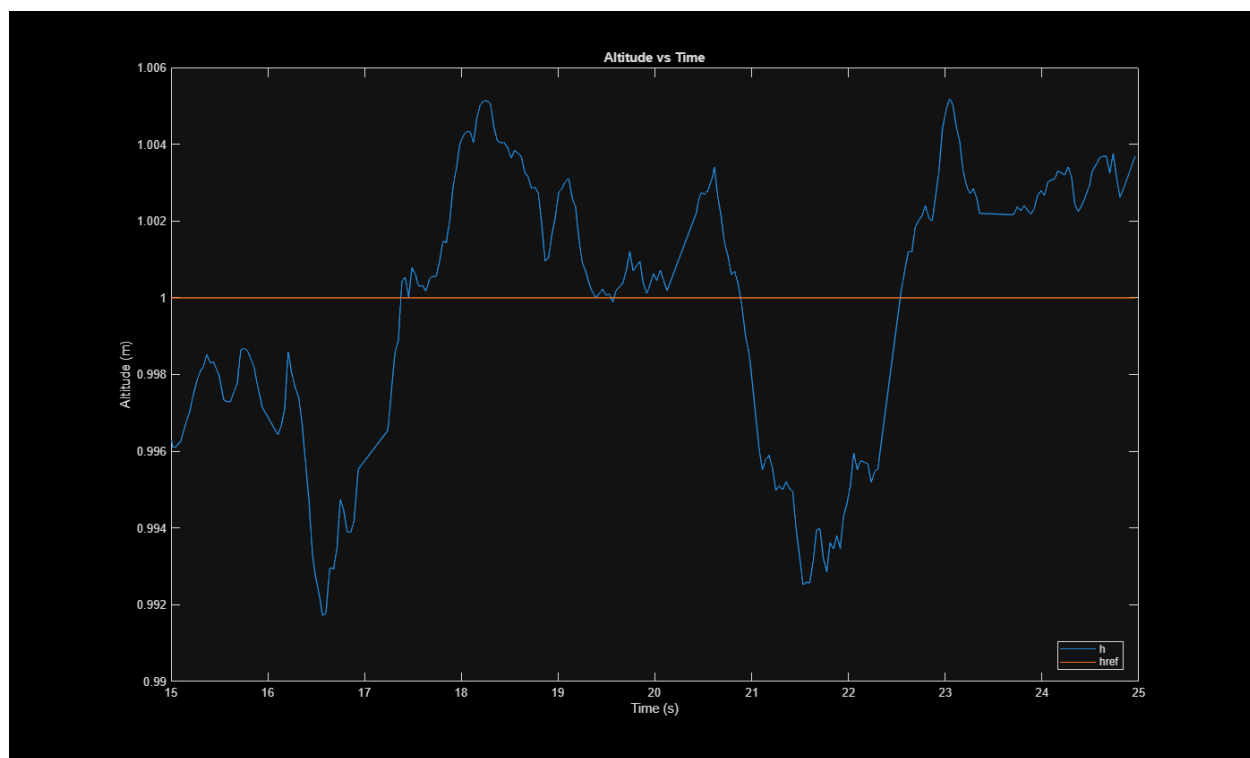
```

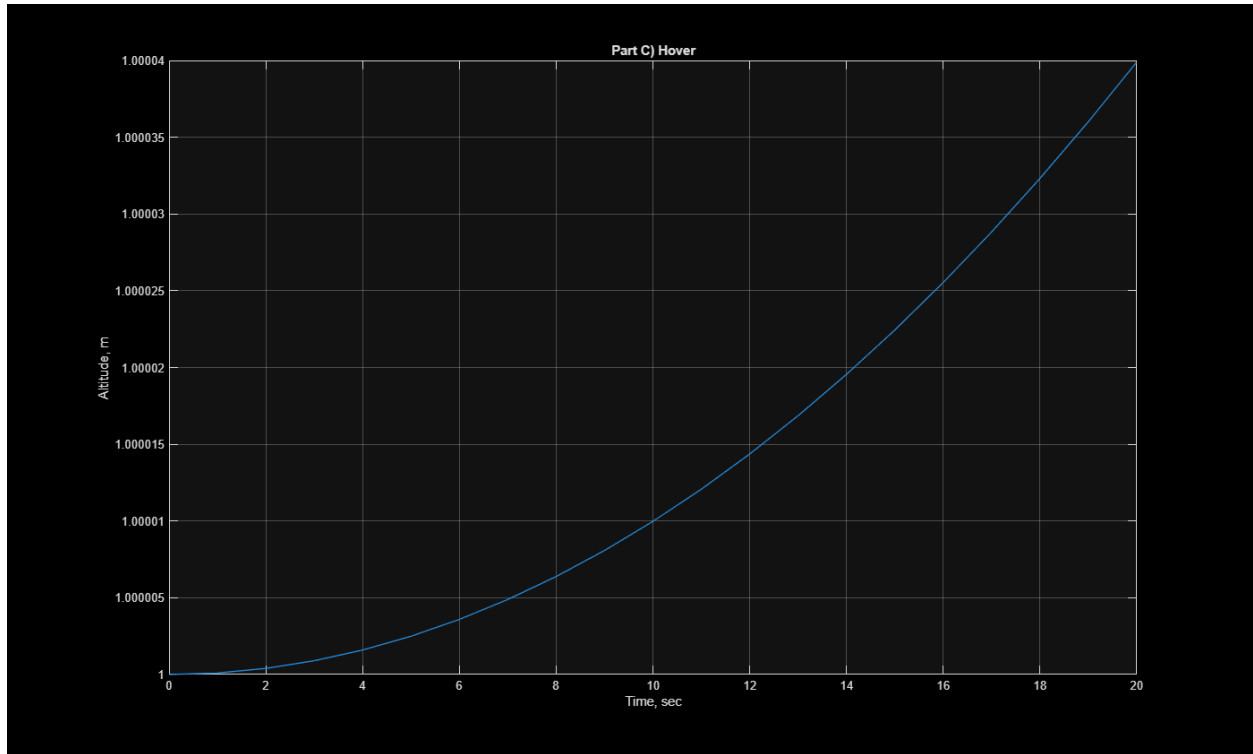
h0 = 1;           % Initial altitude, m
hdot0 = 0;        % Initial altitude velocity, m/s
u = (m*g)/(4*kT); % Throttle command, unitless
Tf = 20;          % Final simulation time, sec

assignin('base', 'm', m);

```

```
assignin('base','g',g);  
assignin('base','kT',kT);  
assignin('base','u',u);  
assignin('base','h0',h0);  
assignin('base','hdot0',hdot0);  
  
sim('QuadcopterSim',[0 Tf]);  
  
figure(2);  
plot(tsim,h);  
xlabel('Time, sec');  
ylabel('Altitude, m');  
title('Part C) Hover');  
grid on;
```





## Part D

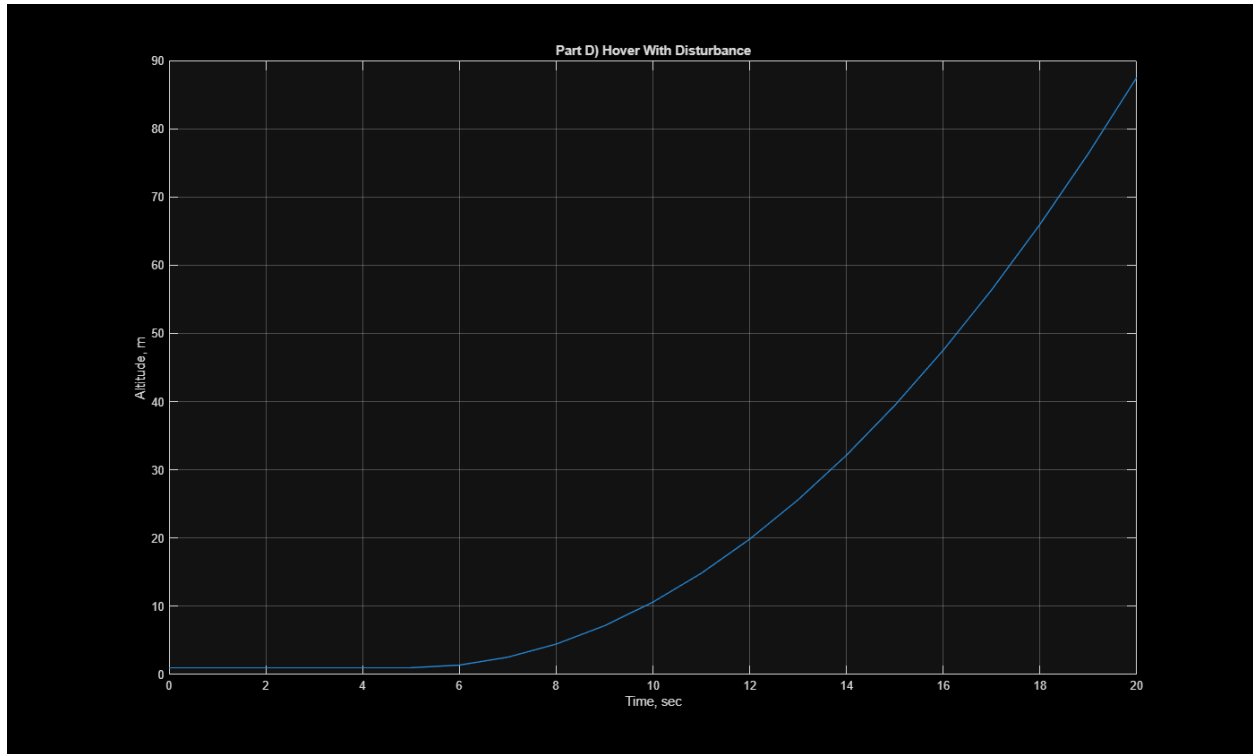
Modify Simulink diagram to include disturbance. Simulate and plot altitude vs. time.

```
h0 = 1;           % Initial altitude, m
hdot0 = 0;        % Initial altitude velocity, m/s
u = (m*g)/(4*kT); % Throttle command, unitless
Tf = 20;          % Final simulation time, sec

assignin('base','m',m);
assignin('base','g',g);
assignin('base','kT',kT);
assignin('base','u',u);
assignin('base','h0',h0);
assignin('base','hdot0',hdot0);

sim('QuadcopterSimPartD',[0 Tf]);

figure(3);
plot(tsim,h);
xlabel('Time, sec');
ylabel('Altitude, m');
title('Part D) Hover With Disturbance');
grid on;
```



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