6dof Monte Carlo: Stochastic Wind Simulation 12-20-21

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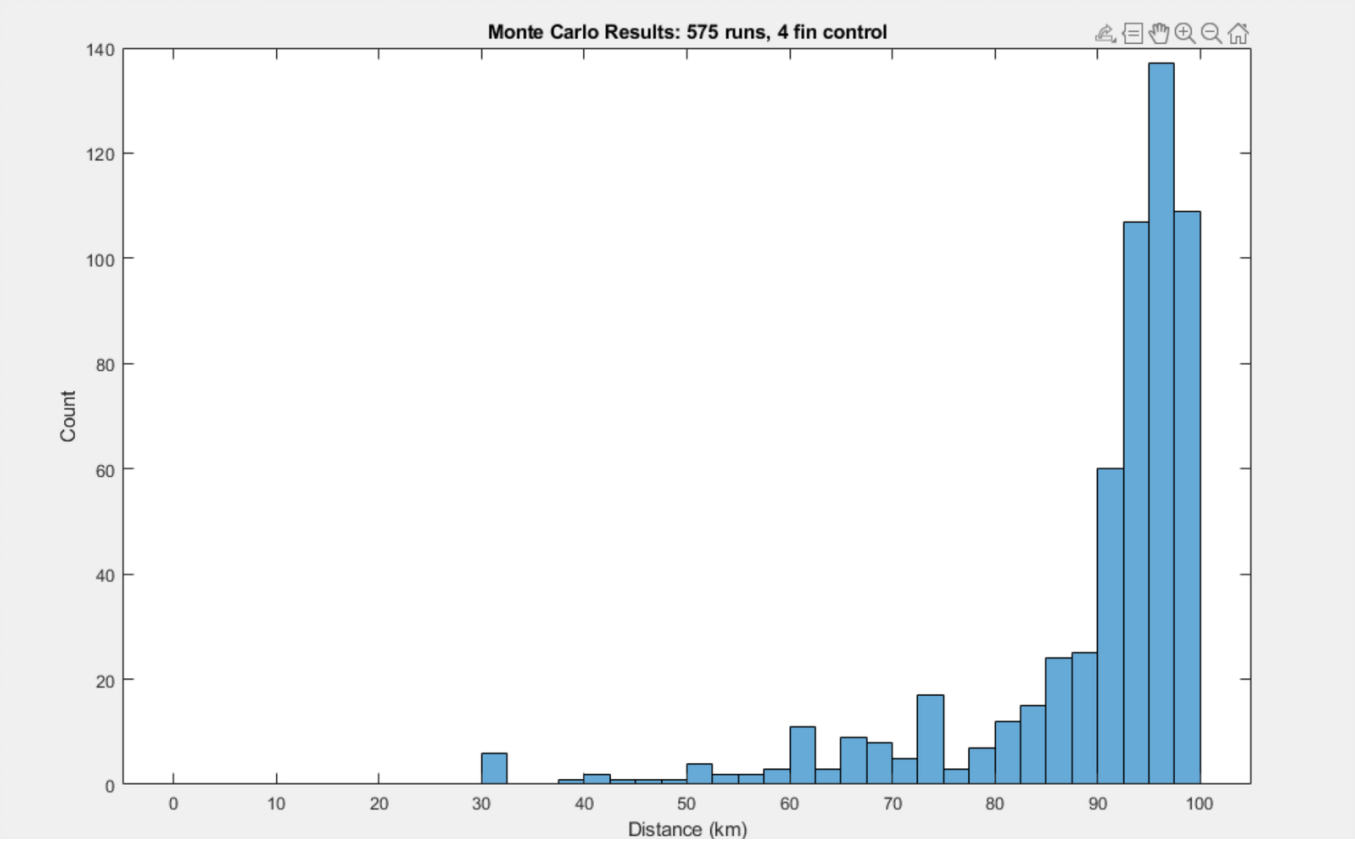
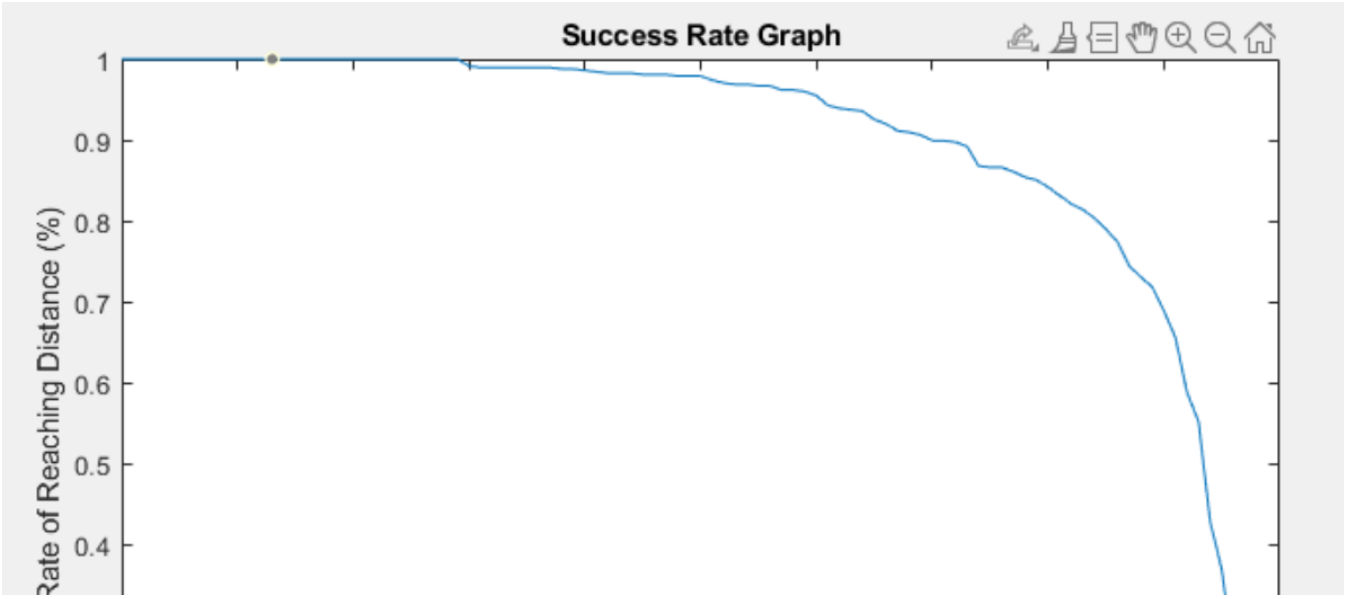
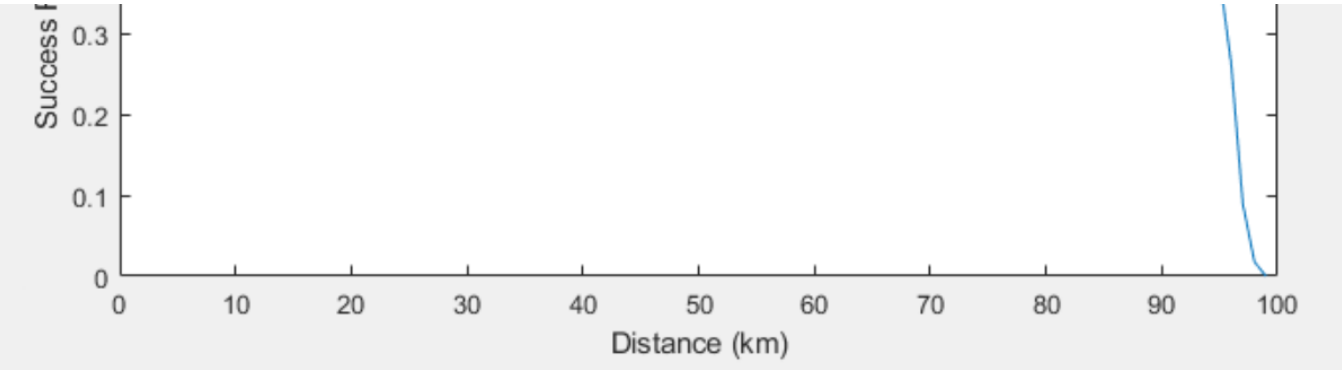
We performed a Monte Carlo Simulation using the Stochastic Wind Simulation on December 20th, 2021. The Stochastic Wind Simulation works by randomizing the speeds of wind and consequently, forces exerted on the rocket. This Monte Carlo involved running the 6dof 4 fin control MATLAB simulation 575 times and recording the results of these simulations. The purpose of this simulation was to determine the distribution of apogees achieved by the rocket and the probability of reaching the desired apogee. The graphs of the results are detailed below. The median km achieved was 94.554 while the mean was 89.433.







The script/code used is featured below

Monte Carlo Simulation:

This script will run the simulation for the amount of times specified by the for loop, saving the workspace variables as a .mat file each time.

```
clc
proj = openProject("GNC.prj");
for a=0:3000
    run('initialize.m');
%    proj = openProject("GNC.prj");
    sim('six_dof');

    runIDs = Simulink.sdi.getAllRunIDs;
    runID = runIDs(end);
    dataset = Simulink.sdi.exportRun(runID);

    filename = sprintf('output3/run%d.mat', a);
    fprintf("%s\n",string(filename))
    save(string(filename),'dataset');

    fprintf("COMPLETE %d\n",a);
end
```

Data Cleaning:

This script parses through the runs and saves the apogee of each run into output.mat

```
size = 575;
array = zeros(1,size);
for a = 1:size
    filename = sprintf('output3/run%d.mat',a);
    load(filename);
    data = dataset{8}.Values.Data;
%     t = dataset{8}.Values.Time;
    y = data(:,1);
    array(a) = max(y);
    save('output.mat','array');
    sprintf('%d',a)
end
```

Histogram:

This script creates a histogram of the results with bin sizes of 2.5 km, starting from 0 to 100.

```
load('output.mat')

histogram(array/1000,0:2.5:100)
xlabel("Distance (km)")
ylabel('Count')
title("Monte Carlo Results: 575 runs, 4 fin control")
```

Percentage Graph:

This script creates a percentage graph of the results.

```
size = 100
arr = zeros(1,size)
for i=1:size
    arr(i) = sum(array > 100000/size*i)/length(array)
end

plot((0:10/size:9.99)*10,arr)
xlabel("Distance (km)")
ylabel('Success Rate of Reaching Distance (%)')
title("Success Rate Graph")
```

The results of the simulation look promising, as this was run on a simulation with a mass over the budget. Despite this, the rocket was able to achieve an apogee of 90km around 70% of the time.