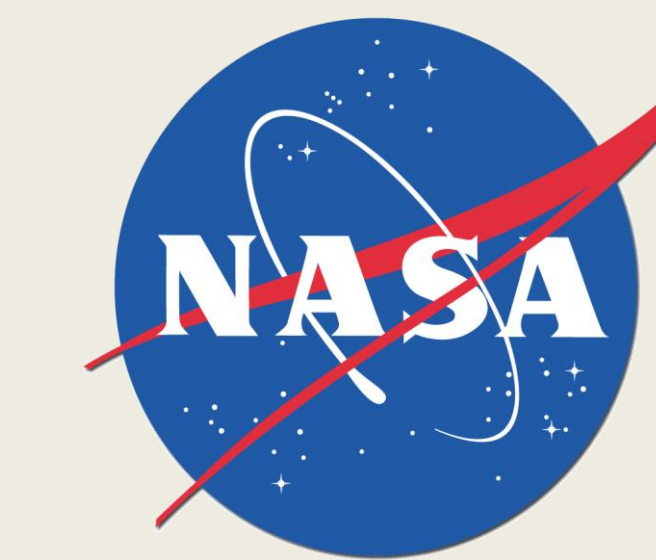




Supersonic Trajectory Optimization

For Minimum-Fuel Flights in Three Dimensions

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AFRC 530: Dynamics and Controls



Introduction

The supersonic trajectory optimization project was proposed as a stepping stone for future supersonic flight research. The ultimate goal of this project is to develop trajectories for test pilots to fly that minimize fuel consumption, allowing more sonic booms per test flight to be generated for data collection.

Test Platform Modeling

- The first test platform selected was the F-4H, as the data was easy to access. Using the aerodynamic and engine data from this aircraft, a model of the aircraft was created and used to test these programs.
- The next test model will be the F-18 Super Hornet. Data is more difficult to find for this platform, but it should be possible to build a rough model for the aircraft using data obtained from simulations.

Preliminary Results

Preliminary results have confirmed that the software and algorithms can produce trajectories that can optimize fuel use. Several flight paths with simple flight maneuvers have been successfully developed with these resources.

Acknowledgements

- Internship Coordinator – Lisa Illowsky
- Test Pilot – James Less
- Aerodynamics and Propulsion Branch Engineer – Jacob Ediger
- AFRC 530 Branch Chief – Oscar Murillo

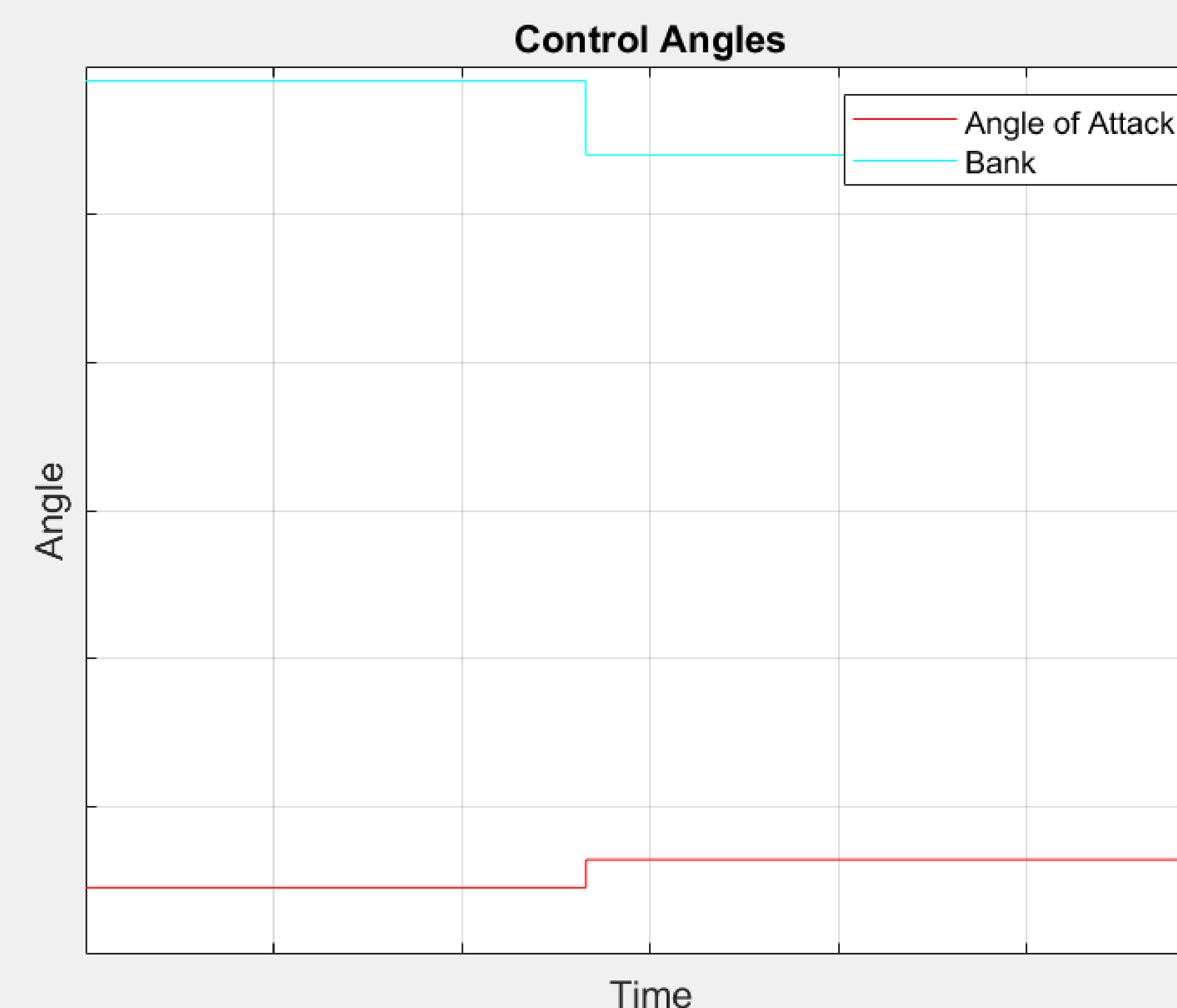
Project Pathway

An extremely simple problem was first solved for to test the effectiveness of available resources, especially POST2. Using the available data from the F-4H to build a model, a scenario where the aircraft completed a simple climb from one specified altitude to another was used as to frame the problem. Three trajectories were solved for this. In the first trajectory, the aircraft only had to achieve the target condition, without regard to time or fuel. The other trajectories achieved the same target conditions, but also optimized themselves with regards to time and fuel respectively.

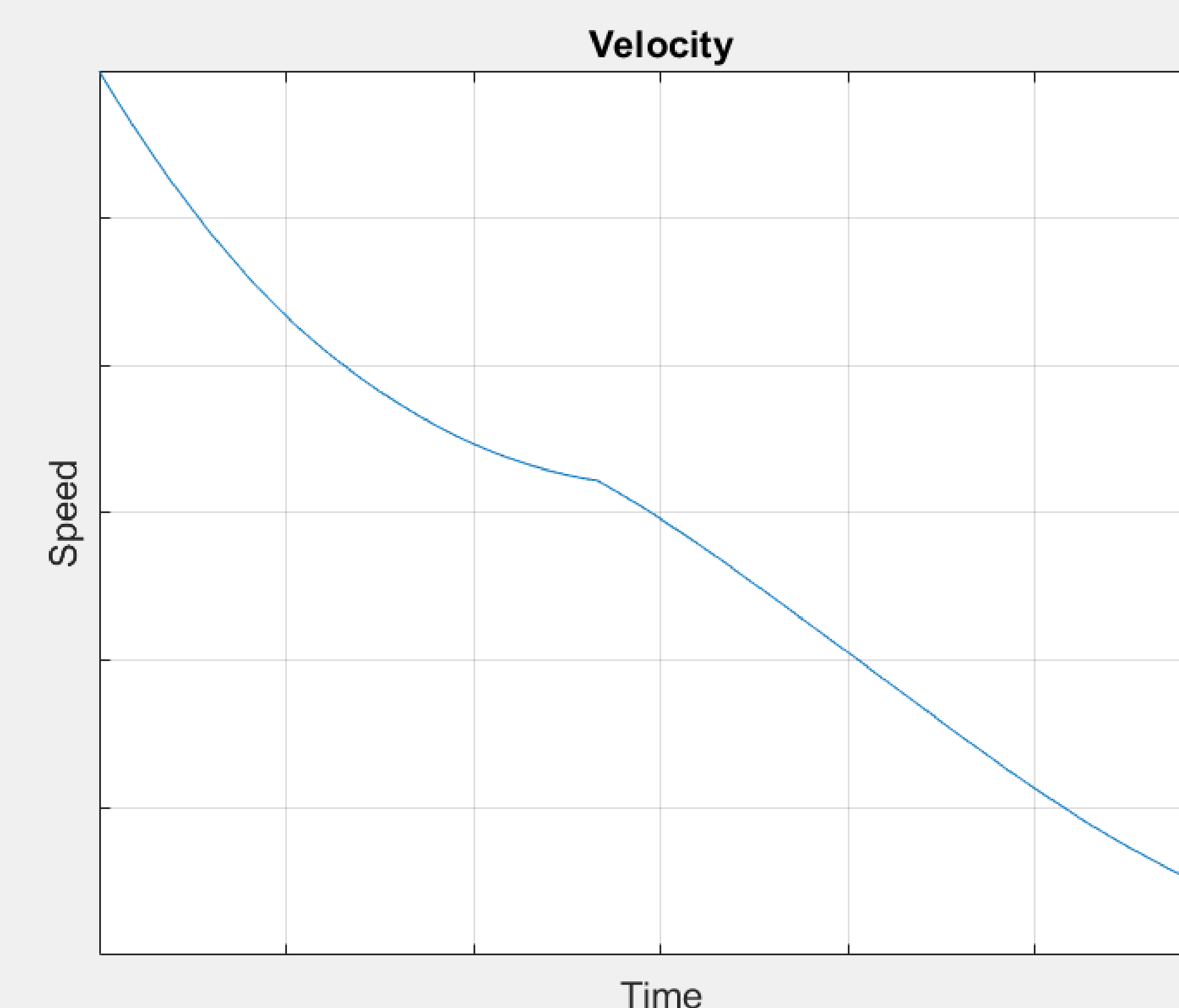
Afterwards, more complicated trajectories with maneuvers that are more difficult to implement were tested, with their flight paths computed via an algorithm. The goal of this series of problems was to sequentially build up to more and more complex targeting conditions while narrowing down areas where potential problems could occur. The below plots described a trajectory without optimization where the target condition was to make reach two target positions in sequence.

Following the competition of all problems with the F-4H model, the next step would be to recalculate each problem with an F-18 model. This model will be developed by obtaining the necessary data from flight data accrued via simulations.

Control Angles



Aircraft Speed



Calculated Trajectory

