Inertia Identification

Brian Bingham[1]

I. Summary

The general model we are using for surge and yaw is

$$m\dot{y} + k_1 y + k_2 y^2 = F$$

where $y(t)$ is the forward speed or yaw rate, m is the inertia, k_1 is the linear drag term, k_2 is the quadratic term, and F is the constant thrust or torque. If we assume $k_1 = 0$, so there is only quadratic drag, the solution to the differential equation takes the form

$$y(t) = y_{ss} \tanh\left(y_{ss}\frac{k_1}{m}t\right)$$

where y_{ss} is the steady state velocity. We know the drag coefficeint, k_1, from the steady-state experiment results, so there are two unknown parameters, the total inertia (m) and the steady-state velocity (y_{ss}).

Experimentally we measured step response in surge and yaw. The result is data for each step response experiment. We can use MATLAB to fit a curve of the form above to the data, which results in something like...

[1] Brian Bingham is with the Department of Mechanical and Aerospace Engineering, Naval Postgraduate School, Monterey, CA 93950, USA. bbingham@nps.edu

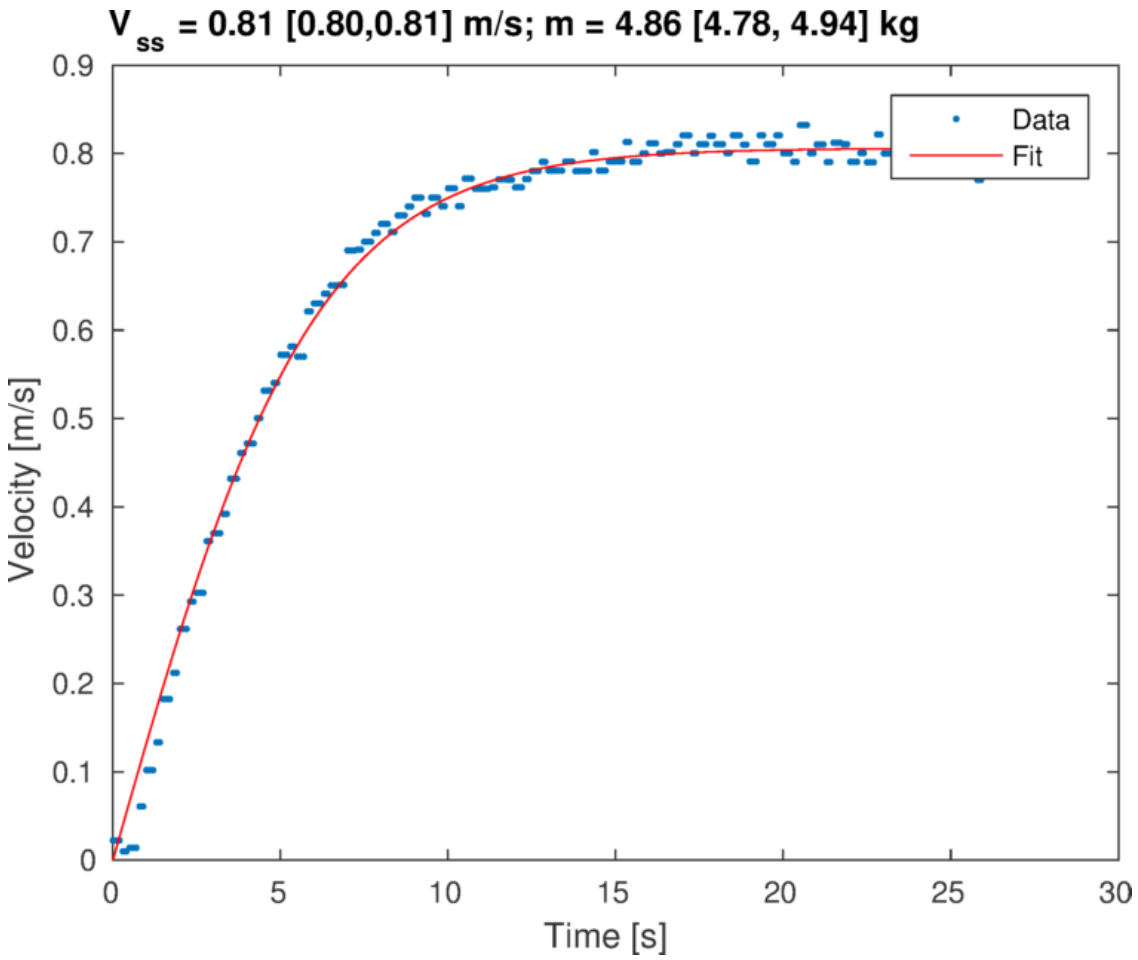

Fig. 1. Results from curve fit. Parameter values are given as final value and 9% confidence bounds.