Spring 2019, EE 386 – 01
"Introduction to Control and Robotic System"

Mini-project. Due to February 6, 2019

1. Give the formulation of the pitch-plane rocket stabilization problem.
2. Present a functional diagram of rocket angle-of-attack control system.
3 Present math model derivation and linearization. Stability analysis of uncompensated angle-of attack dynamics.
4. Assume $a_1 = 5, b_1 = 14$. Given performance specifications: settling time $t_s \le 1.5\,\sec$, and maximum overshoot/undershoot $\le 4.3\%$ (for PD controller only).
   .4.1. PD controller design based on performance specifications.
   4.2. PID controller design based on performance specifications.
5. Simulations. Present simulation (math-flow) diagrams. The plots should be reasonably scaled. ***Your name must be*** on all simulation plots.
   Initial conditions: $\alpha(0) = 0.1\,rad$, $\dot{\alpha}(0) = 0.5\,rad/\sec$
   The constrains $\left|\alpha(t)\right| \le \dfrac{\pi}{6}$, $\left|\delta(t)\right| \le \dfrac{\pi}{6}$ are to be enforced.
   Use saturation block for $\delta(t)$ while implementing the controller in Simulink.
   5.1 Simulate the uncompensated plant for $\delta(t) \equiv 0$, $w(t) \equiv 0$. Plot $\alpha(t)$. Comment the results of the simulations.
   5.2 Simmulate control system with PD controller assuming $w(t) \equiv 0$. Plot $\alpha(t), \delta(t)$. Comment the results of the simulations.
   5.3 Simmulate control system with PD controller assuming $w(t) = 3.5 \cdot 1(t-4)$. Plot $\alpha(t), \delta(t), w(t)$. Comment the results of the simulations.
   5.4 Simmulate control system with PID controller assuming $w(t) = 3.5 \cdot 1(t-4)$. Plot $\alpha(t), \delta(t), w(t)$. Comment the results of the simulations.
6. Conclusions. Compare the performances of both controllers. Emphasise the advatages and the disadvantages.

Hint. Use the class notes and the text book.

A report structure (not more than 15 pages):

1. Cover page
2. Introduction (what the problem is about, why it makes sense, why it is important and the ways to solution)
3. Mathematical modeling and problem formulation
4. The PD and PID controller design.
5. Simulations
6. Conclusions.