Embedded Real-Time Systems (AME 3623)
Homework 5

March 29, 2006

This homework assignment is due on Tuesday, March 4th at 5:00pm. Your work may be handed in electronically (use the **Homework 5** digital dropbox on D2L) or in hardcopy form (in person or to my office).

This assignment must be done individually: do not share/discuss your answers with others or look at the answers of others.

Question 1

Helicopter dynamics in general are quite complicated (and hence, so is control). However, in certain regions of the helicopter state space (as described by variables including Cartesian and rotational position/velocity, and position and velocity of the main rotor), the helicopter behaves in a linear fashion. Three such regions are hovering, fast forward flight, and hovering upside down. This linear property makes it easy to design a feedback controller that maintains the helicopter within the corresponding region (we have one such controller for each region). But – to move between these regions requires the helicopter to pass through very non-linear (and unstable) regions of space. One strategy is to command the helicopter in a ballistic manner (without the use of feedback) so as to move as quickly through the non-linear region and arrive at a linear one (for example, hard pitch forward to quickly transition from hover to fast forward flight, where the "fast forward flight" controller can take over).

Assume that your controller has access to sensory data that includes pitch angle and forward velocity. In addition, assume that a significant change in pitch angle (e.g., by 180 degrees) requires the helicopter to be moving laterally by $.5m/s$). Design a FSM that, on command from a ground station, will bring your helicopter from hover to hovering upside down. Once in this state, on a second command, the FSM will bring the helicopter back to the hover state.

1. (5 pts) What are the states?

2. (5 pts) What are the events?

3. (10 pts) What are the outputs?

4. (10 pts) Show the state transition diagram.

Question 2

How much time did you spend on this assignment?