

# ME 8281 Term Project - Spring 2019

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April 9, 2019

## 1 Objective

The objective of the term project is to afford you an opportunity to investigate in depth the topics presented during the course in the context of applying it to a system. As such, the system should be relatively rich to allow you to explore several control design techniques covered in THIS course. The list of methods are:

1. Least squares estimation
2. Least norm control
3. Pole place approach to state-feedback and observer design
4. Internal model control, and temporal and angle-domain repetitive control
5. Linear quadratic control
6. Kalman Filtering
7. Feedback design based on affine parameterization / innovation feedback
8. Feedforward control using zero phase error tracking control (ZPET) or preview control
9. Dynamic programming
10. Input-shaping

In addition, the course covers several modeling and analysis concepts, including: Lagrangian dynamics, linear system response, stability, controllability/observability, uncertainty and system robustness.

## 2 Guidelines

- Your project should include, at the minimum, **three** items from the list above to a system.
- A key aspect of the project is that you can define suitable control problems that allow you to exercise these tools.
- Some approaches are rather simple so that there will not be too much scope of investigation. In that case, you should try more approaches.
- Accessment will be based upon how meaningfully (hopefully correct implementation is a given) you apply these tools and whether you have done an in-depth investigation of the method.

- You are welcome to work in teams of at most 2. However, working individually is also welcome.

The default system is that "Papi-Rubber" game<sup>1</sup>. I believe the game has plenty of opportunities to apply the design tools that we talk about in class. The basic aspect of the game is described in your homework 4. You can make up specifics of the game (e.g. how the aliens move, disturbances, etc.) or change something if you wish in order to make the control system more meaningful. Some examples include:

- Structured disturbance (e.g. periodic);
- Need to predict the desired trajectory
- Uncertain model
- Un-measured states
- Existence of some cost functions to be minimized
- Dealing with saturation or time-delay ....

If you wish to use a different system, please provide a 1-page proposal describing the system and why you think the system is rich enough for you to investigate the topics covered in this course. You are encouraged to discuss with me first. Making the course project related to your research is possible, but the investigation should be the application/furthering of the design methods developed in class rather than random topic from your research.

### 3 Final Project Report

The final report, due (tentatively) by the last day of finals week should include:

- System modeling and problem definition
- Design and analysis
- Extensive simulations
- Discussion of results

### 4 Timeline

- Please let me know (by email - by April 17) if you are working solo or in pairs.
- Email me - ASAP. if you wish to work on a non-Papi project. A 1 page description of the system and why you think this has scope is needed.
- Final report due (tentatively) by the last day of finals week
- Depending on progress, we may have project presentations during exam week (probably unlikely this semester) and optionally after the semester ends.

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<sup>1</sup>SunFlat <http://www.sunflat.net/iphone/app/papirubber/>