

Project Year

2016-2017

Project Title

An Interactive Visual Reference for Control Systems

Project Team

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Audience

This project is designed as an interactive visual supplement to the concepts being taught to biomedical engineering students (primarily sophomores) enrolled in *Systems and Controls*. It is also intended as a review and reference for students taking upper level courses in which control systems are applied.

Pedagogical Challenge

Systems and Controls offers a one-semester introduction to design and analysis of linear systems, which are often applied in biomedical research to model biological systems. Because the course introduces such a large amount of information in a short time, concepts are often limited to calculations using pencil and paper and are distanced from real-life examples and potential applications. As a result, the course can be daunting for visual and hands-on learners.

Concepts learned in *Systems and Controls* also appear in upper level courses in the biomedical engineering curriculum, including *Systems Bioengineering II* and *Systems Pharmacology*. However, they are often not reviewed before being applied in assignments and labs. Thus, the relevance to real-life applications may be difficult to understand initially, making it harder to learn new material.

Solution

The development of a series of interactive online applets is proposed to help students visualize the *Systems and Controls* material. These applets will cover both theoretical concepts (such as Fourier transforms and block diagrams) and incorporate models of real-life systems (such as the baroreceptor reflex or neural networks). They will be developed and tested over the upcoming summer and fall semesters and be available to the rising sophomore class by the time they begin the course in the spring. The goal is offer a visual and interactive resource that will help *Systems and Controls* students better understand the potential applications of what they are learning without adding to an already heavy workload, and to help other students review these concepts so they can apply them more broadly in upper level courses.

Assessment Strategy

The effectiveness of the resource will be evaluated primarily through feedback from students. An anonymous form will be available to *Systems and Controls* students throughout the semester on which they can indicate if and how the applets helped them understand a concept or complete an assignment.

All students who used the applets will be asked to fill out an end-of-semester survey. This survey will collect feedback on how easy the applets were to learn and use, and whether having a visual representation of the concepts aided with their understanding.

Instructors of *Systems and Controls* and other courses that apply these concepts will also provide feedback on the project by assessing if students appear to have a better understanding of the concepts covered. This can be determined by exam and homework statistics, and through communication with students in lectures and during recitation sessions.

Faculty Proposal

As the instructors of *Systems and Controls*, we frequently hear from students that they don't see the uses for control theory and control design in biomedical engineering. This is primarily due to the constraints of having only six weeks to teach the basic materials for classical control design. We think that this could be addressed with the addition of applets. These could teach concepts in the context of specific biomedical engineering applications including controlling seizures with electrical stimulation, regulating medically induced coma with automated titration of anesthesia, understanding the motor control system, etc. For each application, the applets can emphasize the basic components of the control system: the model of the system, i.e., the representation that makes sense for the system, the approach to the control design, the design itself, and results.

In addition, a Blackboard site will be set up for the course to track how often students access the applets. The site will include an anonymous end-of-semester survey asking for feedback.

Completed Project

The applet can be found in the repository here: https://bitbucket.org/etian1/controls_simulation