ME 586: Biology-Inspired Robotics

University of Washington, Winter 2020

Instructor: Prof. Sawyer B. Fuller

term project overview (v.1)

Overview   The overall theme is to craft projects like the NSF: in addition to proposing projects, researchers will peer-review other projects. Teams (self-selected, we will have an in-class to help you find a team), will submit and present a research proposal (in the form of a poster) to the class that is related to biology-inspired robotics. The idea is to give you practice at the art of finding research funding. At the end of the quarter, you will change roles and assume the duties of the funding agency and decide which proposal merits funding. In our case, it will be by giving you enough money to buy the first coffee that will get the project started!

As part of your project, you are expected to perform initial research related to your proposal, because all good proposals contain initial results. These will be in simulation, or on a robot platform. Results will take the form of a few figures in your proposal. Think of this as a sort of advanced problem set, equal in work to 2-3 regular problem sets, but where you assign the problems based on your interest and curiosity.

Topic area   Topic ideas are provided in a separate handout, "topic areas" available on the course website.

Poster format and contents   The main criteria is taken verbatim from the NDSEG fellowship application:

> A reader should be convinced that your project will make an important contribution and the proposal be a persuasive argument for why your project/proposed training deserves to be funded.[1]

The exact size of the poster can vary, but aim for a size ranging 24–42 inches wide by 24–36 inches tall. Either print on multiple letter-sized paper, or use the ME poster printer (to be determined).

Below is a suggested outline for the sections of your poster, which must be included in almost any good proposal.

1. **Summary** ($\approx$150 words). A short summary of your proposal, which describes the main problem and includes a shortened version of the remaining sections below.

2. **Introduction and Technical Need**. Bullet points that describe to the reader your particular area, and its relation to other investigations. For example, if your topic is ball catching, you might summarize the physics of a ball in flight and catching, and then describe (and give citations for) previous suggestions for how it is done or learned by humans. Here you will state what is not yet known, and describe who or what would benefit from a better understanding.

3. **Research Objectives.** Answer what the main scientific challenges you would like to address are, given in one of the research objective formats described below.

4. **Preliminary work**. Describe the work you have done this term so that you can use it as a springboard to highlight what still needs to be done. For example, you could say that you have laid the groundwork by implementing a simulation of a ball-intercepting feedback law that shows that a simple servo-feedback controller exhibits characteristics similar to human ball catching, and that you will use this to find out

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[1] **http://www.ndsegfellowships.org/application**

what parameters are most important to match human behavior. Here you would include figures that explain any apparatus and data you have collected.

5. **Research Plan.** Describe the series of steps you will perform, and discuss possible expected results. How will you measure progress? Here, you will include a description of the milestones during the course of the research, which for this proposal is a 3-year Ph.D. Include a Gantt chart (google it) to show milestones. Example tasks might be recruiting test subjects, constructing an apparatus, or performing data analysis. It is understood in a research proposal that these plans are not rigid, but represent a best-guess and will change as research progresses.

Initial results To strengthen your proposal in the area of "why do you think you will be successful," you will perform initial work to show the promise of your proposed research. The idea is that this initial work will be the starting point of a more comprehensive investigation that would likely involve physical robots or biological research subjects.

The topic will be of your own choosing in the general area of biology-inspired robotics (which can realistically include all of robotics). The suggested approach will be to get your initial results in simulation, but physical robotic implementations (such as on a platform you have access to such as lego mindstorms, robot arms, etc.) are also acceptable so long as the primary component is not hardware development.

Grading The most important criteria are that your proposal follow the three "C's": Clear, Coherent, and Complete. The first means it is clear to the reader what you are trying to do; the second is that there be a main theme that is reflected throughout the document, and the third is that it persuasively answer as many of the Heilmeier Catechism's questions as possible. More important than strong "initial results" from this quarter is a clear articulation of how these results will lead into a more in-depth plan of research with clear goals, though strong initial results can help.

Below is the rubric we will use to evaluate proposals on a scale of 1 (poor), 2 (fair), 3 (good), 4 (very good), to 5 (excellent). Note: these review rating numbers are the convention commonly used in proposal evaluation but are not equivalent to your grade for the assignment. The instructor will consider these peer review recommendations but will make the final, curved determination of grades.

An evaluation consists of

1. A sentence or two summarizing the objective of the proposal

2. A list of (+)*strengths* and (-)*weaknesses* in the following areas:

   (a) **Intellectual merit:** the potential to advance knowledge in science or engineering.
   (b) **Broader impacts:** the potential benefit to society. Examples include improving the environment, providing opportunities to underrepresented groups, improving education, and improving research infrastructure.
   (c) **Chances of success:** has the proposer demonstrated that there is a good chance that the proposed research will produce the desired knowledge? Strength of initial results can indicate future promise.

3. A final rating and summary sentence or two that provides justification.

Timeline

- In the middle of the quarter, each team will submit a <1 page "letter of intent" that describes the general area you would like to explore and one or two steps you will perform toward collecting the initial results for your proposal.

- During the second-to-last class session, your team will present a poster explaining your proposal in the ME lobby, including a short (5-10 minute) presentation to the class at your poster, along with accompanying video or demo if applicable.

- On the last day of class, you will perform a peer review of a small number (~3) of other posters from the class. Then the votes will be tabulated and we will find out which proposals will receive funding.

You will submit written work on Canvas. Deadlines for these and presentations are listed there.