Sag Reflection
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Thanks to the SAG grants I have received, self-directed research has become a primary focus of my undergraduate education. This semester I participated in two SAG funded research projects: Amoebots, a project that aimed to develop a novel toroidal drive system and Mechanics of Origami Structures, where we attempted to design a glider using origami techniques. Each project taught me a significant lessons that will be invaluable as I continue performing research.

My work leading the Amoebots research project taught me about leadership and experimental design. When I first started the project I would describe my leadership style as that of a micromanaging supervisor. I felt I needed to control every aspect of the project in order for it to be successful. As a result, I gave my team members responsibility but not autonomy. My team members did important work such as running tests and designing components. However, I was the one who designed the tests and determined what components needed to be prototyped. As the semester progressed I gave my teammates more and more freedom, as well as open ended design problems. Instead of telling them how I thought we should design the torus, I asked them to do some research and come to me with a bill of materials. While I have made significant progress over the course of the semester, I still have a lot of room for improvement. My goal for next semester is to give my teammates enough autonomy that I could hypothetically leave the project and be confident that progress will still be made.

The most important thing I learned from the Amoebots project was how to design experiments. In the beginning of the semester my experiments were simple and could be considered crude. If I wanted to know the strength of a contractile actuator, I would simply hang mass off of the end until the actuator could no longer lift the mass. At the time, I believed that this would supply sufficient data. However, when I attempted to design new actuators, I found I did not have enough information to make an intelligent design decision. Eventually, I realized the error was in what questions my experiment was attempting to answer. I thought I wanted to know how strong an actuator was; however, I actually wanted to know the material properties of the wire that gave the actuator its strength. The former only tells me if this actuator is strong enough, while the latter tells me how to design future actuators. I learned a similar lesson on the Origami Glider project.

The Origami Glider research project taught me valuable lessons but did not accomplish what we hoped. Looking back, I believe the main issue that held us back was the failure to quickly determine 3D printing was not an effective way to make origami joints. Our experiments failed for the same reason the initial Amoebot experiments failed, they asked the wrong questions. We would ask “does this wing design work?” and when it failed we would design a new wing and ask the same question. We should have asked questions like “How stiff does a wing need to be in order to support the mass proposed?” and “What is the spring constant equivalence of the ninja flex?” Had we asked more of these types of questions in the beginning, we would have realized that we were on the wrong track sooner. Learning how to identity the right questions is probably the most important insight I gained from these experiences.