Integrated Spacecraft Autonomous Attitude Control (ISAAC)

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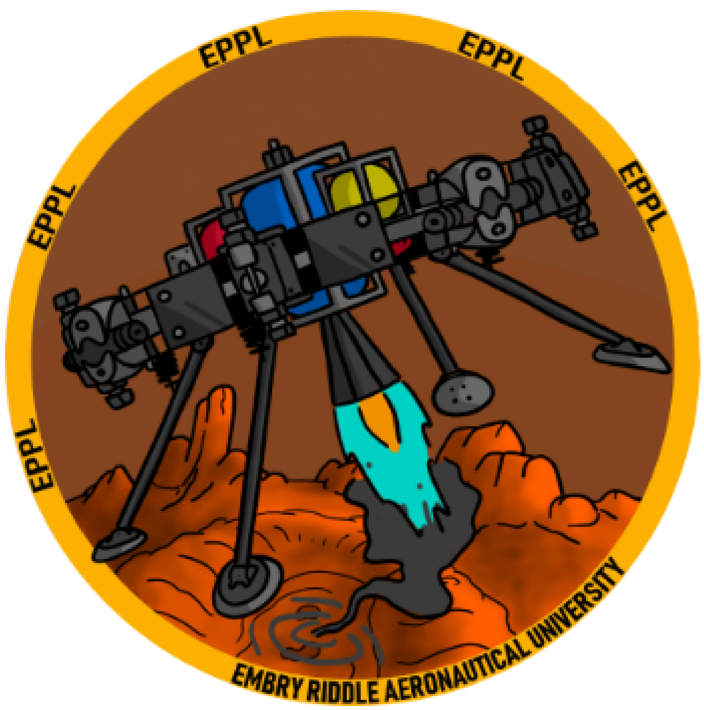
September 12, 2023



1 Abstract

ISAAC is a 3D-printed pneumatic spacecraft for attitude control development in a 3-axis gimbal ring. This allows for simulated free-space movement in a controlled test environment. The purpose of this open-sourced controller is to allow students, professors, and researchers to test and train their control algorithms on real hardware in real time. They will be able to apply the theory from the classroom to a physical system and visualize abstract math. The end goal is to have a website allowing anyone to upload their code (in Python) and watch it run via live stream. This will support researchers without access to developed hardware to be able to implement and test their algorithms in real time. Along with supporting undergraduate students interested in learning satellite attitude control and professors like Dr. Drakunov and Dr. MacKunis who can use it in their classes.

The spacecraft runs on a pneumatic system using the school's compressed air supply (Fig. 1). The compressed air being delivered is at ≈ 100 psi with an output equal to that. Thus the lines are not dangerously pressurized, giving a safe environment applicable for testing. As a further safety measure, the apparatus is stored inside a large test cell. This is because if anything backfires it is in a safe environment. The solenoids will stabilize the apparatus, using the compressed air as a means of propulsion. Though there are no tanks on the spacecraft, it will have a continuous supply of air flowing through the rings to the solenoids. This is doable since the 3D-printed rings will be hollow, allowing airflow while supplying it to the attitude controller.

The attitude controller will be integrated into ***easycontrols.org*** (Fig. 2) which will allow anyone on the internet to upload their python control algorithm and watch it run on hardware in real-time. The website has built-in functions, allowing the user to easily create their algorithm. This evaluates not only how well their control algorithm performs in a simulation, but additionally on hardware through a live stream. Developing this apparatus will not only enable us to continue research into attitude control algorithms beyond just the theory and simulations but additionally support others without the funding and means to develop hardware for testing.

2 Appendix

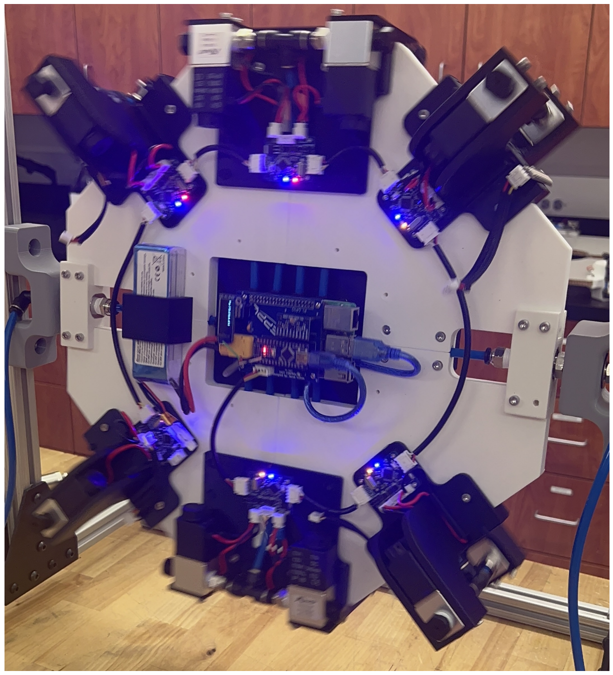


Figure 1: *1-D Version of 3D Printed ISAAC*

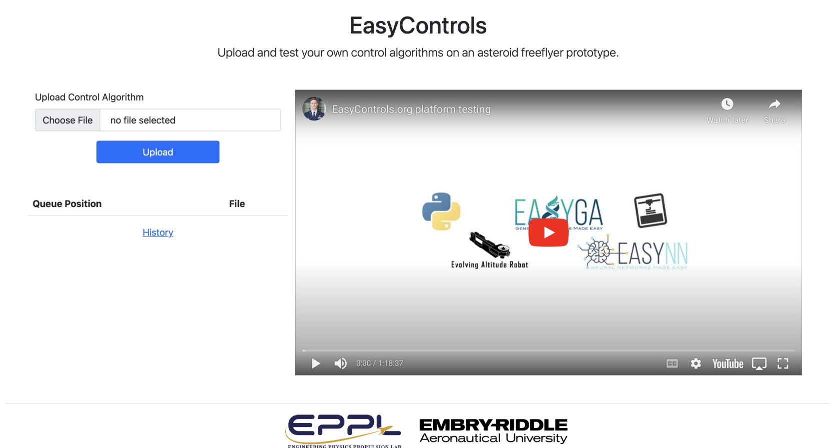


Figure 2: *Website* ***easycontrols.org*** *to Upload Code*