

Marshall Problem/Project Statement - Student Design Topic

Problem/Project Title: _____ Correlated Electromagnetic Levitation Actuator (CELA)

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Indicate which discipline(s) is/are most appropriate to work on this problem (e.g., aerospace, mechanical, electrical, chemical, industrial, civil, computer, physics, materials, test, nuclear, earth science, other)

_____ Mechanical and Electrical Engineering

Marshall Problem Statement

Background: The big picture with references to previous work (Why would a design student be excited about this work?)

CELA is an advancement in the state of the art electromagnetic reaction-sphere-based spacecraft attitude control systems. Reaction spheres described in the prior art rely on permanent magnets, hysteresis motors, piezoelectric and ultrasonic effects, and electromagnetic induction as their primary actuating principle. These systems have various pitfalls with respect to system friction and vibration, complex sensing systems, and insufficient performance. In demonstrating a novel frictionless reaction sphere, students will utilize polymagnet programmable correlated electromagnet technology in an agile development scheme to achieve omnidirectional rotation control. Students will have the opportunity to demonstrate multiple facets of electrical engineering product design including electromagnetics, control algorithm design, embedded software, circuit and PCB design. In addition the design group will create 3D models to be used for manufacturing prototype hardware.

Recent/on-going research on the problem (What resources, if any, are available to the student design team, such as equipment, software, facility utilization)

Students will have access to the current research papers the CELA team has so far. They will need to use their own source for 3D printing and conducting the tests. They will have access to mentors on project management as well as test-driven development.

Details of the problem; design constraints, requirements (if any), outcome expected. One semester Student Design course lasts 15 weeks; two semester course lasts 30 weeks. (What do you expect the student design team to accomplish?)

Students will attend weekly working meetings with the CELA team at NASA MSFC. They will be responsible for the prototype development. This includes weekly testing (and test reports for each week/test). The team will work within CELA's nominal schedule based on Test-Driven Development and Agile Management. At the start of each week/test, the student team will begin by writing the initial test report, which will include the setup, the objectives for that test, the Key Performance Parameters to be tested/evaluated, assumptions, and any input. The student team will be responsible for determining the Key Performance Parameters, with oversight/input from the CELA team. At the end of each test, they will complete the Test Report for that test, including pictures of the setup, and pictures/data of the results, as well as any references/sources used. The test will include (but are not limited to) printing/assembling 3D models, developing controls algorithms, and testing correlated magnetic patterns.

Student Design Project Rules:

1. Weekly telecons will be scheduled to maintain proper progress and prevent dead-end ventures.
2. Deliverable(s) required (e.g., one semester course – a written final report; two semester course – written final report and a prototype/model (if practical))