Marshall Problem Statement / Senior Design Topic

Problem Title: Articulated deployment plate for small satellite solar array

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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, Electrical, Computer

Marshall Problem Statement

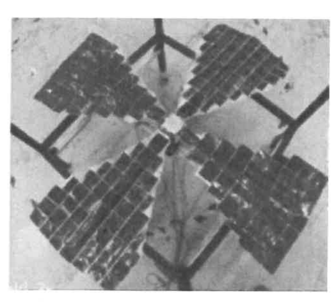
Background: The big picture with references to previous work (Why would a senior design student be excited about this work?)

Small satellites, such as CubeSats, are advantageous tools for space exploration. Their small size takes advantage of advanced microchips and other miniaturized components, enabling powerful spacecraft in a low volume, low mass, and low cost [especially for launch] form factor. However, their biggest advantage is also their biggest weakness. Because of their small size, power generation remains a large challenge. Though powerful, miniaturized computers, cameras, etc. are readily available, generating enough power to operate them is difficult. To solve this problem, NASA is developing a small satellite solar array – ~1/2 this thickness of a human hair – which can stow into a small volume for launch and deploy into a large area on orbit. In order to point this array at the sun, an articulated deployment plate is needed.

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

Solar array hardware samples are available to be sent to the team.

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



The solar array depicted on the right is planar version of the NASA LISA-T small satellite technology. The host CubeSat is located in the center, with 4x triangular panels extending out each side to form the array. For launch, the panels are stowed on top of the CubeSat and subsequently deployed once in orbit. To generate power the panels must be point at the sun. In the configuration shown, the panels are hard mounted to the CubeSat, forcing the entire spacecraft to be pointed. In some cases, however, it will be desirable to point the array at the sun and the spacecraft (or more appropriately, a science payload on the spacecraft) in a different direction. To solve this, the senior design team much create a deployment plate that can be extended away from the host CubeSat and subsequently articulated.

There are two components to the project. Minimum success criteria and stretch goals are defined for each.

1. Central deployment: push 550g mass (solar array + deployment plate) away from the spacecraft.

   Success threshold – can deploy stowed (folded) array mass 0-1m (total distance simply determined/altered by boom length), remotely activated.

   Stretch goal – can deploy and retract unfolded array 0-1m programmable on the fly, remotely activated.

2. Articulation: once deployed, can point the plate and unfolded array at a target.

   Success threshold – can send signal from control computer to point plate better than ±45° in single (x or y) axis

   Goal -- can send signal from control computer to point plate better than ±45° in x and y axis

   Stretch goal – can automatically point plate better than ±45° in x and y axis with input from a sensor (e.g. a light sensor which seeks to point the array at a bright light).

Senior 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))