

# Marshall Problem Statement / Senior Design Topic

Problem Title: Electric Sail Propulsion System Deployer Mechanism

MSFC Mentor Name and Organization: Michael Tinker (ES10)

Mentor's Contact Information: Mike.Tinker@nasa.gov, 256.544.4973

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 and Aerospace

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## Marshall Problem Statement

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

The Electric Sail (E-Sail) propulsion system utilizes positively charged thin wires that extend outward from a spacecraft. A high voltage power supply biases the wires such that ions are repelled and electrons are collected, producing thrust significantly exceeding that possible from any other realizable near-to-mid-term propulsion system. This activity would focus on a key element of the E-Sail propulsion system, the Tether Deployment System (TDS), and will help assess the feasibility of this cutting edge advanced propulsion concept.

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

MSFC is currently engaged in maturing and assessing the feasibility of the concept through an FY16-17 NASA Innovative Advanced Concepts (NIAC) Phase II and internal research and development funding. Prior work in the area of tether deployment systems has been performed by companies such as Tethers Unlimited (a partner on the project) but known issues exist with the current concept of operations and alternatives are desired. The partnering organization will have access to MSFC facilities, notably the Flight Robotics Lab, for testing the concept and for collaboration with subsystem experts.

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?)

This activity is focused around the design, development, test, and evaluation of a tether deployment system (TDS) for the E-Sail concept. Requirements for the tether and TDS stem from an FY16 Advanced Concepts Office (ACO) study of a 12U CubeSat E-Sail implementation. The deployer mechanism must be designed, fabricated, assembled, and tested over the course of this activity. Single-tether and multiple-tether configurations could be developed and tested, depending on the consensus of the university/NASA teams. The E-sail concept consists of many wires/tethers to produce desired thrust levels, and ultimately multiple-tether deployers must be developed. Test results should then be correlated to dynamic models to predict the 0-G response of the flight system and aid in the derivation of guidance and control requirements on the spacecraft.