Product Specification & Project Plan

EML 4551C – Senior Design – Fall 2011

Team # 6

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Project Sponsor

Harris Corporation

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Introduction

The Harris Corporation has recently introduced a new, premature design for a large, solid, collapsible reflector with autonomous capabilities. Our group will be working alongside group five to create a scaled down working prototype of this system. Though the idea behind the mechanical design of the system has already been introduced, our groups are responsible for finalizing the method in which the individual components come together, as well as coming up with the component specifications as they must be scalable to the larger ideal reflector intended for use by the Harris Corporation. The final goal for both groups is to first finalize and then materialize the initial design for the reflector system and successfully demonstrate its mechanical capabilities of autonomously transferring from a stowed to a defined, deployed configuration.

Description of Criteria

- **Client Needs**
  - Panels are flush when deployed
    - The seam between panels has a minimal gap in the plane of the panels, and all panels should be the same height relative to each other.
  - Reliable Deployment
    - The panels must not catch on each other, the locking mechanism/s must successfully engage such that the prototype deploys autonomously and without adjustment with a reliability of 99.9% or higher.
  - Panels Remain in Place
    - Once the panels are fully deployed in the final product, the reflector will need to remain in operation for 15-30 years with zero maintenance. The latching mechanism should keep the panels in alignment by remaining latched while undergoing the forces commonly experienced by such reflector antennae.
  - Space Deployable
    - Space based applications require certain restrictions on usable materials and equipment. For instance, only certain motors have been demonstrated to operate in zero-G, and all materials may be exposed to high levels of radiation.
  - Bi-Directional
    - The deployment path taken by the panels must consist of a primary rotational stage, and secondary linear stage. Thus, the panels will first be aligned radially, and then vertically. The client has requested a functional prototype that demonstrates this motion.

- ## Engineering Specifications
    - Panel-panel locking mechanism: This component connects the edges of the panels aligning them radially and vertically.
        - Mechanism Type
            - Method of connecting panels, such as magnetic or mechanical
        - Mechanism Implementation
            - Describes the repetition of the mechanism, including number of connections per panel, spacing between connections, and position along panel edge.
        - Mechanism Interface
            - The manner of incorporating the panel-panel locking mechanism into each panel.
    - Panel-hub connection
        - The structural connection between each panel and the hub.

- ## Quality-Function Chart

		Engineering Specifications				
		Mechanism Type	Mechanism Implementation	Mechanism Interface	Hub Connection	Panel Material
Client Need	Panels are Flush when deployed	x	x		x	
	Reliable Deployment	x	x			
	Panels remain in place	x	x	x	x	
	Space Deployable	x				OS
	Bi-Directional deployment					x
	Teamwork				x	x

Key: x: Strongly Impacts Decisions _: Does not impact Decision OS: Out of scope for prototype

The figure above expresses the main focus of the project which is to design the type, orientation and interface for the interlocking mechanism.

Selection of the panel material will only be made for the prototype, and will therefore have slightly different requirements than a commercial application. Special hazards and restrictions for materials for space based applications may not be considered (e.g. the prototype will not be designed for exposure to radiation.)

Design of the hub connection that structurally incorporates each panel into the reflector assembly, and selection of the prototype panel material will require significant teamwork with the sister team.

Budget

There is an allotted $2,500 worth of funding for this project. Though the ideal reflector consists of graphite skin panels with honeycomb cores, the cost of such materials would surpass our budget. For that reason, along with others, our overall goal is to show the mechanical capabilities of the system, rather than to design and construct an actual reflector capable of focusing electromagnetic energy that can withstand high levels of radiation. This gives leeway in our budget, as material selection for the panels is not confined to only those that are realistic for a reflector with intended use in space. Thus, we can choose a material with similar properties to the ideal material, but only a fraction of the cost to ensure we stay within our budget. Another portion of the budget will go towards the design used for the interlocking of the panels, whether it is by magnets, additional material, or other means. The bulk of the remainder of the budget must be set aside for the testing of the prototype. When the time for experimentation of the system comes, as any problems arise the necessary alterations to the design must take place. For that reason we must be sure to have enough funding left over for any additional materials that must be purchased. Additional expenses may include travelling to the Harris Corporation in Melbourne, Florida, for a better understanding of solid reflectors, in which case the budget can cover these expenditures as well.

Project Planning

Tasks	**Start Date**	**Duration (days)**	**End Date**
Team Meeting/Code of Conduct	9/15/2011	7	9/22/2011
Meeting with Sponsor	10/6/2011	1	10/6/2011
Needs Assessment/Project Scope	9/20/2011	16	10/6/2011
Product Specifications/Project Plan	10/4/2011	9	10/13/2011
Concept Generation/Selection	10/18/2011	9	10/27/2011
Interim Design Review	11/1/2011	16	11/17/2011
Final Design Package	11/29/2011	9	12/8/2011
Cost Analysis	12/5/2011	3	12/8/2011
Order Materials	12/8/2011	8	12/16/2011
Research	9/20/2011	87	12/16/2011
Teamwork	9/15/2011	92	12/16/2011

Sponsor Video Meetings

- Every other Friday, starting October 14, 2011.

Gantt Chart