Two-Step Hub Mechanism for Solid Reflector Deployment

Product Specifications and Schedule

EML 4551C – Senior Design – Fall 2011 Deliverable #3

Team # 5

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Reviewed by Advisor:

Introduction:

The goal of this project is to design the hub deployment mechanism for a solid reflector that proves its functionality. Harris Corporation has provided a very basic, preliminary design for the hub that we are to update and edit as we see fit. Pro/ENGINEER CAD drawings of this beginning design have been created so that our team can produce a 3-D dynamic simulation of the prototype hub mechanism.

Product Specifications:

A rough design has already been put together for a two-step hub mechanism for solid reflector deployment. This project focuses on proving this concept. The product to be produced is a working scale prototype along with a full kinematic and dynamic analysis of the mechanism. The prototype should be able to deploy a segmented solid reflector with a 4 foot aperture diameter. The hub must be able to first rotate to spread out all segments of the reflector. Once this first step is complete it will collapse to lock all panels together. When fully deployed the panels need to be aligned accurately. The hub must be properly designed so that it can accomplish its required motions without binding or other malfunctions. The hub will be comprised of a series of concentric rings that will facilitate this motion. For a reflector that goes into orbit, there is no fixing it if it jams. It has to work the first time, every time. The weight of the panels will also be a factor in the design. It must be strong enough to support the reflector panels and interlock mechanisms and withstand any inertial forces that it may experience.

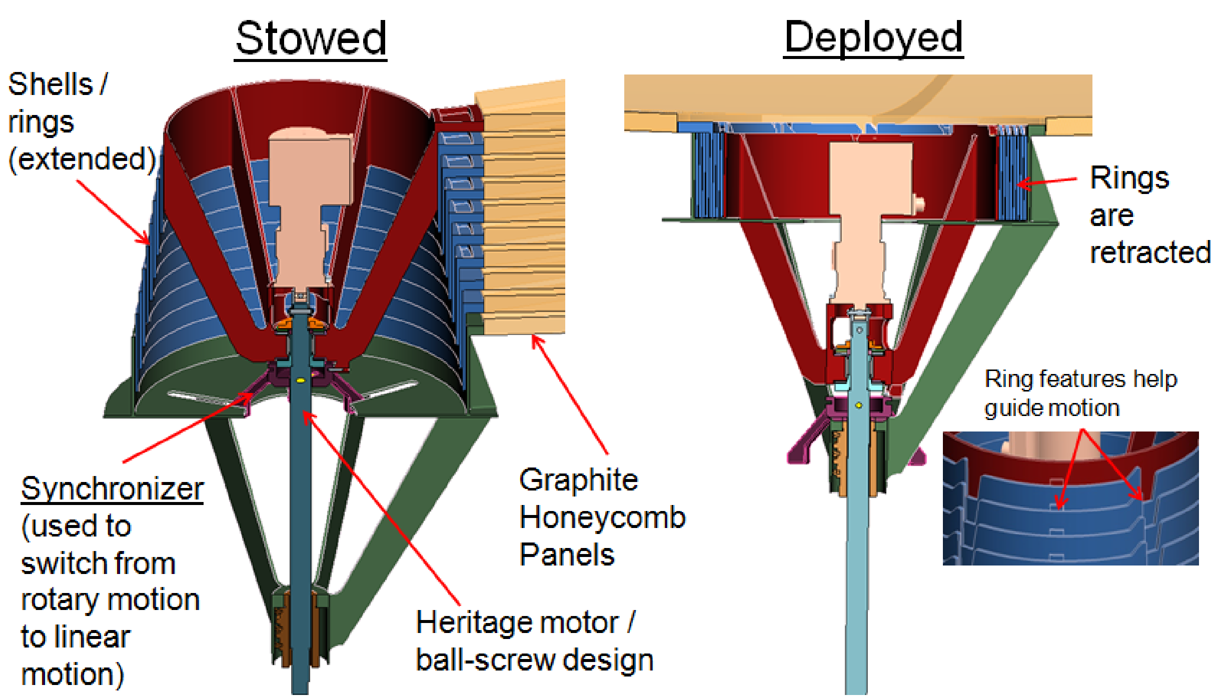

Figure 1: Potential Hub Embodiment

Budget:

Harris Corporation has set a $2,500 budget for this project. They will provide funding and support for our group to develop a CAD model, dynamic simulation and a scaled-down working prototype of the hub assembly in order to demonstrate its function. Apart from the motor, the primary costs involved with this project will be raw materials. Very few off-the-shelf components can be used in its construction. Most of the mechanism will have to be custom machined. The concentric rings may require high tolerances and /or special alloys, both of which can further increase the cost of the prototype.

Constraints:

After talking with our sponsor, Gustavo Toledo, many of the constraints originally set in place have been nullified. Nonetheless, there are still several constraints that need to be considered while constructing the hub deployment mechanism. In no particular order, below is a summary of such constraints:

a) There is a $2,500 budget
b) The hub should be constructed mainly of concentric rings each having a panel mounted to it
c) Materials for the prototype are important but have not been specified. These are the things that need to be considered:
    a. Some materials cannot take the extreme temperatures imposed in outer space
    b. Some materials degrade after repetitious movements
    c. Some materials are not strong enough to uphold the heavy panels
d) This hub deployment mechanism should be designed so that it can be used in space and on the ground for the purposes of communication

QFD		Engineering Specifications				
		Material Strength	Motor/Driver Setup	Panel Interface	Motion Syncronization	Retraction Method
Customer Needs	Maintain Panel Alignment			X		X
	Rotate the Panels into Position	X	X	X	X	X
	Retract the Panels into Same Surface Plane		X			X
	Contain Redundancies	X	X			X
	Reliable	X	X		X	X

An X in the box denotes there is a relationship between the customer needs and the engineering specifications for our team. The main customer need is that the panels are rotated into position. This is seen in the fact that all of our engineering specifications relate to that need. Also, it is seen that our engineering specification of a working retraction method plays a role in all of the customer needs.

Project Schedule

Task Name	Start Date	Completion Date	Duration (Days)		September, 2011	October, 2011	November, 2011	December, 2011	January, 2012	February, 2011	March, 2011	April, 2011
Kick-off Meeting	9/1/2011	9/30/2011	30									
CAD	10/1/2011	11/30/2011	61									
Simulation	11/1/2011	12/31/2011	61									
CML	12/1/2011	1/31/2012	62									
Order Supplies	12/1/2011	1/31/2012	62									
Build	1/1/2012	3/31/2012	91									
Test	3/1/2012	4/19/2012	61									
Reports	9/1/2011	4/19/2012	243									
Final Presentation	4/1/2012	4/27/2012	27									