Case Study: **Fokker Space**

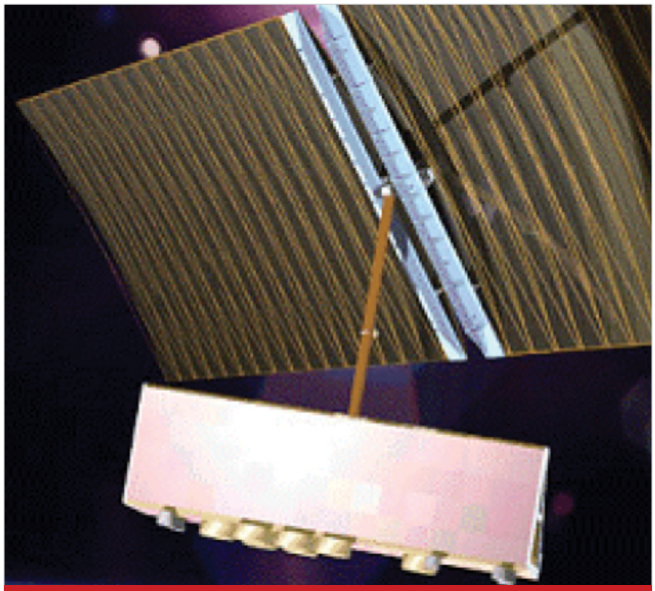
Meeting the Challenge: Engineering for a New Class of Satellite

Overview

The trend towards smaller satellites is reaching maturity in the spacecraft industry. Designs with a low volume and mass significantly reduce costs by enabling more economical launch vehicles and/or multiple payloads per launch. This can bring down the cost of a satellite from $10,000 per pound for a single satellite launched via heavy rockets to below $3,000 per pound with this new approach. To achieve this more compact and lower weight satellite, each system has to be reviewed for possible reduction in volume and mass.

The subject of this case study was an effort undertaken within Fokker Space to lower the volume and mass of solar panel array designs. This culminated in the Curwin solar panel array concept which used a curved arrangement of solar panels (like a tape measure) instead of a separate backbone structure to reduce both volume and mass while retaining the required stiffness and high frequency response.

The difficulty and high cost of replicating on-orbit conditions during deployment on the ground resulted in a high reliance on simulation. MSC Software's multibody program Adams was chosen to analyze and simulate the solar array deployment in on-orbit conditions.



By utilizing Adams, Fokker was able to explore and simulate a deployment mechanism to achieve their goal of proper deployment.

"The use of virtual prototypes becomes necessary to support the design of new space applications. Zero gravity measurements could become practically impossible, making the use of dynamic simulations a necessary part of the product design."

Challenge

The goals for the simulation of the deployment were:

- Determine the important factors in a successful deployment
- Evaluate the initial design of the solar panel array
- Validate design changes to meet the requirements of a successful deployment
- Final validation of a design that resulted in a controlled and reliable deployment

Solution

MSC Software's Adams was chosen to analyze the multibody dynamic process during the deployment. In the past, Adams has been successfully used within the spacecraft industry to model solar panel deployment.

Using Adams, the following conclusions regarding the simulation of the Curwin solar panel array were found:

- A proper primary deployment of the folded panels was critical to the secondary deployment that resulted in curved panels.
- Using virtual prototyping, the critical parameters were identified and their impact on the design evaluated.
- Careful consideration of the level of detail needed can result in a highly efficient yet accurate solution process.
- A successful final design was found by using the information obtained from the simulation.

Results/Benefits

The resulting simulation process using Adams models took under 2 minutes each to analyze in order to explore and obtain a final design.

Figure 1 shown below is a snapshot of 6 points in time during which deployment showed an initial design without control motion, representing a hazard both to the array and the spacecraft itself.

Figure 2 shows a snapshot of 6 points of time of the final design, exhibiting a controlled deployment that correctly approached the final straight shape necessary for the secondary deployment to achieve the desired curved shape.

By utilizing Adams, Fokker was able to explore and simulate a deployment mechanism to achieve their goal of proper deployment. As the demand to reduce volume and mass continues to grow in the satellite industry, the MSC solution demonstrated here can be expanded further to incorporate a larger range of flexibility and detailed physics using MSC Nastran and Marc in cooperation with Adams.

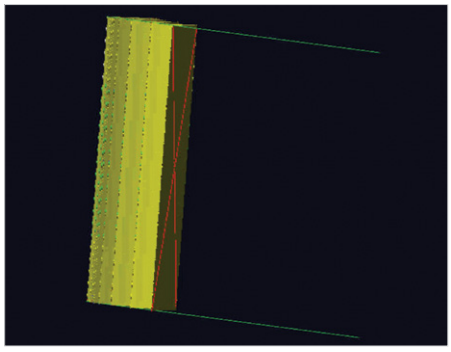
Key Highlights:

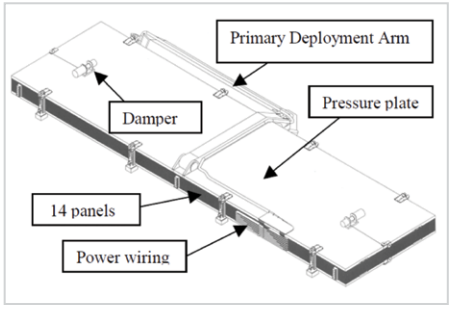
Product: Adams

Industry: Aerospace

Benefits:

- Lower volume and mass of solar panel array design
- Reduce costs from $10,000 per pound for a single satellite launched via heavy rockets to below $3,000 with new approach
- Realistic simulation to replicate on-orbit conditions during deployment





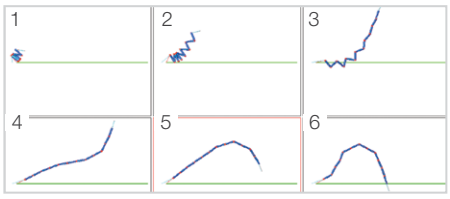


Fig.1: *Green line is desired final shape after primary deployment*

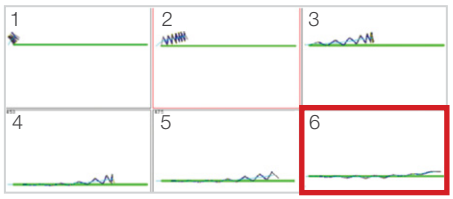


Fig.2: **Minimal distortion & deviation from a straight line.** *Green line is desired final shape after primary deployment*

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