

## Using a Medium-Lift Launch Vehicle for a Moon Orbiter



### Product

Chandrayaan 1

### Business

Indian Space Research Organization develops and delivers application specific satellite products and tools for broadcasts, communications, weather forecasts, disaster management tools etc.

### Project Overview

System modeling project evaluated system reliability, failure analysis, performance estimation of the flight control and avionics, and bottleneck detection in message handling between software tasks.

### Team background

System engineers, Hardware and Software designers, and FPGA teams.

### Challenges

- Moon Lander must use existing technology with minimal upgrade and new algorithms.
- Short project schedule, \$76M budget and limited physical testing.
- The response time for an event-activated task must be less than 20ms.
- Power consumed by the entire spacecraft must be less than 80% of the battery capacity.
- Maintain performance-level during failure of hardware, network and data error.
- To determine the system responses for 115 combinations of failures.

### Results

- Integrated model of both existing and new technology in VisualSim.
- Designed moon orbiter electronics to meet reliability, performance and power requirements.
- Detected multiple points of possible failures and were fixed.
- Identification of instruments and flight controls that failed to meet the timing deadlines.
- Using VisualSim simulation model to size the computer, 1553B Bus and redundancy design.

### VisualSim solution

- Using the VisualSim library of Computer, Resource, 1553B and C-API.
- Model constructed in about 6 weeks and simulated for multiple days of orbiting.
- Reports on latency, Quality-of-Service, buffer occupancy, and data loss were generated.
- Visualsim fault analysis included loss of hardware, network link damage, and loss of handshakes between software and incorrect data values from sensors and other nodes.