USER STORY

Dutch Space Streamlines Development of Advanced Satellite System Simulators

THE CHALLENGE

To develop attitude and orbit control systems for European Space Agency initiatives

THE SOLUTION

Use MathWorks tools for Model-Based Design to streamline control system design and accelerate the development of accurate, real-time simulations

THE RESULTS

- Simplified formal review processes
- Increased code and component reuse
- Improved collaboration

As a participant in the European aerospace industry, Dutch Space has a proven track record of designing crucial systems and subsystems for many European Space Agency (ESA) initiatives. To achieve its string of successes and meet stringent deadlines, Dutch Space takes an agile, iterative approach to system development that promotes reuse.

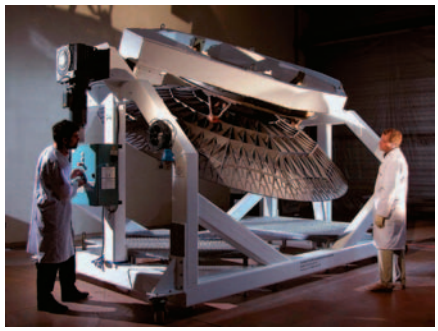
Engineers at Dutch Space rely on MathWorks tools for Model-Based Design to accelerate control systems and simulator development, increase model reuse, streamline formal review processes, and improve collaboration with other ESA contractors.

"On space projects, there is always time pressure," explains Erwin Mooij, senior functional specialist at Dutch Space. "MathWorks tools help us save time by enabling us to quickly modify our system models and extend our designs."

THE CHALLENGE

Dutch Space was contracted to design the attitude and orbital control system for Herschel/Planck, an ESA mission scheduled for launch in 2007 that will advance astronomical research. The project includes two satellites: Herschel, the largest space telescope ever launched, and Planck, a telescope for studying the origin and evolution of the universe.

To develop the system, engineers would need to integrate existing models of hardware components including sensors, such as star trackers and gyroscopes, as well as actuators for the thruster system. The on-board software receives input from the sensors and calculates the output needed to drive the thrust actuators.



Herschel space telescope.

Moreover, because the engineers would work with external contractors, Dutch Space would require a collaborative modeling and simulation environment for developing complex control systems and simulators in meeting tight time constraints imposed by ESA.

THE SOLUTION

The Dutch Space team used MathWorks tools for Model-Based Design to design the Herschel/Planck control system for the on-board software and to set up a simulation environment that facilitates reuse and rapid updates to subsystem models during the project.

"MATLAB®, Simulink®, and Real-Time Workshop® form a flexible and automated environment that enables rapid design changes," says Mooij. "Whenever we update our models, we always use Simulink. Even if you know C very well, Simulink is easier to use because it is at a higher level."

> *The simulation, postprocessing, and visualization capabilities of MATLAB and Simulink provide us with deeper insight and greater confidence in our design than we would have if we coded directly in C.*
>
> Erwin Mooij, Dutch Space

With little knowledge of the actual hardware performance, the engineers initially used functional C models of existing sensors to approximate the hardware. As more information became available, the team refined the control system design and added more complex sensor and actuator models to improve the accuracy of their simulations. Using Simulink S-functions, Dutch Space easily incorporated the C models for the space environment and flight mechanics.

Dutch Space engineers used the Control System Toolbox to further simplify the development of control algorithms and control system design.

After running simulations in Simulink to validate their system design, engineers used MATLAB to postprocess, plot, and visualize the results.

The team then integrated hardware elements in the simulations to test the communications interfaces and to assess performance.

Engineers used Real-Time Workshop to automatically generate C code from all their models. They then ran the code in EuroSim, a real-time simulation framework developed by Dutch Space for hardware-in-the-loop simulations. This environment served as a test bench for onboard software testing and to test failure and command scenarios for the hardware.

Mooij and his colleagues are reusing their Simulink models for additional projects, including ConeXpress, which will extend the life of fuel-depleted communication satellites by enabling spacecraft to dock with and take over the attitude and orbit control functions of the satellites.

THE RESULTS

- **Simplified formal review processes.** "The visualization, postprocessing, and performance calculation capabilities of MATLAB are very powerful," says Mooij. "It provides a very clean interface, plots, and results that help to streamline the preliminary design review and the critical design review for ESA."
- **Increased code and component reuse.** "Simulink helps us support our philosophy of reusing as much of our work as possible," reports Mooij. "For example, we incorporate our models for the space environment and satellite dynamics into many projects using Simulink."
- **Improved collaboration.** "We work with Spanish, German, and British contractors that all use MathWorks tools," explains Mooij. "With this common environment, we easily plug their models into our simulator for testing."

To learn more about Dutch Space, visit **www.dutchspace.nl**

APPLICATION AREAS

- Aerospace and defense
- Algorithm development
- Model-Based Design
- Simulation

PRODUCTS USED

- MATLAB
- Simulink
- Real-Time Workshop
- Control System Toolbox

www.mathworks.com

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