

SELEX Sensors and Airborne Systems Streamlines FPGA Development with MathWorks and Xilinx Tools

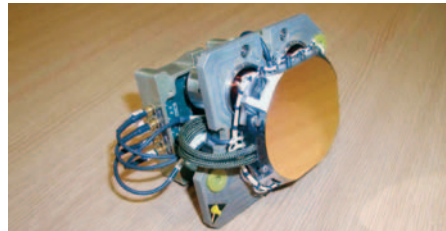
Traditionally, systems engineers at SELEX Sensors and Airborne Systems (SELEX S&AS), a Finmeccanica Company, have relied on a paper-based approach to communicate requirements to hardware engineers. However, the ambiguities of paper requirements often cause even the most highly skilled SELEX S&AS engineers in field programmable gate array (FPGA) development to misinterpret design specifications.

“Our standard route to an FPGA implementation included a paper-passing exercise between systems engineering and hardware engineers, who then had to interpret specifications before developing a system in VHDL,” Alasdair MacLean, lead hardware engineer at SELEX S&AS, explains. “There was a disconnect between the two groups, and we often had to correct misinterpretations.”

To improve the efficiency of their FPGA design process, SELEX S&AS applied MathWorks tools for Model-Based Design with Xilinx System Generator in a recent project for an airborne image acquisition and stabilization system. “With MathWorks tools and Xilinx System Generator, we maintain the same toolset from design to implementation—from the specification stage where the functionality is defined in the Simulink® model itself through to the implementation in the FPGA,” says MacLean.

THE CHALLENGE

The SELEX S&AS engineering team had several options for the airborne system project. Eddie Power, FPGA and ASIC design manager at SELEX S&AS, explains, “We had an existing analog prototype controller, but we felt we needed a nonlinear



Fine mirror mechanism.

response, which we could not achieve in an analog solution. A DSP-based software solution required us to use our traditional over-the-wall approach of communicating requirements between systems and hardware engineers. Moreover, there were worries that the timing of the DSP would not be fast enough to give the performance bandwidth we needed.”

The group decided to streamline its design and implementation process with a new approach. Power adds, “We needed to work in one environment, make changes easily as we moved into system integration, minimize obsolescence issues, and accurately predict how the system would behave once it was implemented.”

THE SOLUTION

Using MathWorks and Xilinx tools, SELEX S&AS engineers designed and implemented a digital controller for the airborne system using an integrated development environment.

“By creating and implementing an executable specification in Simulink, systems engineers no longer pass paper specifications to hardware engineers,” notes Power. “This approach results in better, faster communication between disciplines, reduces errors caused by misinterpretation of requirements, and cuts development time.”

THE CHALLENGE

To streamline the design and implementation of advanced FPGA systems

THE SOLUTION

Use MathWorks and Xilinx tools to specify, model, simulate, and synthesize FPGA systems

THE RESULTS

- Design iterations accelerated
- Hardware obsolescence issues minimized
- Continuous test and verification achieved



With MathWorks tools for Model-Based Design, we achieve analog speed without analog uncertainty, software capability without software overhead, and rapid prototypes without proprietary hardware.



Stephen Gifford, SELEX S&AS

Engineers first used Simulink to model the dynamics of the electromechanical hardware, including sensors, actuators, gimbals, and other elements. They then modeled and simulated the control system in Simulink to verify system performance and data precision.

“It would have been very difficult, if not impossible, to model and then hand code the entire system in VHDL,” MacLean notes. “Simulink gave us a big advantage by enabling us to model the controller and its environment quite accurately.”

SELEX S&AS translated the model into a fixed-point representation using Simulink Fixed Point. Once the design was tested, verified, and partitioned in Simulink, engineers then replaced the standard blocks with equivalent blocks from Xilinx System Generator for DSP.” During this conversion process, SELEX S&AS engineers ran simulations, ensuring that the functionality and performance had been retained.

Using Xilinx System Generator, the team automatically generated VHDL netlists for FPGA synthesis, targeting an off-the-shelf development card from Nallatech’s Xtreme DSP kit. They further tested the design by running hardware-in-the-loop simulations on the card with the simulation environment created in Simulink before proving the design on production hardware.

The control system is undergoing integration and testing with the complete airborne imaging system. SELEX S&AS is also using MathWorks and Xilinx tools to develop FPGA signal processing applications for image processing and radio frequency communications.

THE RESULTS

■ **Design iterations accelerated.** “With Simulink, we eliminated the intermediate specification production and interpretation stage, accelerated design iterations, and reduced integration time,” says MacLean. “Design iterations, which would typically take a day or more, were completed in less than one hour—from algorithm to board.”

■ **Hardware obsolescence issues minimized.** “Using Simulink and Xilinx System Generator, we raised the level of abstraction and reduced hardware obsolescence issues. We can retarget the same design to a different FPGA simply by changing a setting in the model,” says Power.

■ **Continuous test and verification achieved.** SELEX S&AS engineers used Simulink to accurately simulate and verify the system, significantly decreasing the team’s dependence on physical prototypes. “There was a direct correlation between simulation results in Simulink and real-world performance, which eliminated the disconnect between the model requirements and the implementation,” says MacLean. “What’s more, Xilinx System Generator lets us rapidly implement design changes if the requirements change.”

To learn more about SELEX S&AS, visit www.selex-sas.com

APPLICATION AREAS

- Aerospace and defense
- Model-Based Design
- Modeling and simulation

PRODUCTS USED

- Simulink
- Simulink Fixed Point
- Xilinx System Generator

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