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E3.series®

Zuken's software solution for electrical wiring, control systems and fluid engineering.

Stone Aerospace saves 12 weeks in cabling design by implementing a digital design process

STONE AEROSPACE

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John Harman, Electrical Engineer, Stone Aerospace

Stone Aerospace saves 12 weeks in cabling design by implementing a digital design process

Stone Aerospace faced the pressure of a tight schedule in designing a one-of-a-kind underwater autonomous vehicle (AUV) capable of traveling 15km under the Antarctic ice shelf. The AUV acts as a testing ground to validate an aircraft-mounted radar system that will be used in a space mission. The time needed to design the wiring harness for the AUV was reduced by around 12 weeks and $20,000 was saved by using E³.series to automate many aspects of the design process, while integrating the logical and physical design on a single platform.

The search for life in space

Scientists believe that underneath the icy surface of Europa, one of Jupiter's moons, is a vast ocean thought to be the most likely location for finding life in our solar system. The National Aeronautics and Space Administration (NASA) plans to orbit a spacecraft around Jupiter to conduct a detailed examination of Europa, and find if there is truth in these claims of extraterrestrial life.

Stone Aerospace is a partner in NASA's Europa Clipper mission concept. This includes a radar among its instrumentation that will penetrate Europa's frozen crust and map the thickness of the ice shell. The company's ARTEMIS AUV is designed to use the closest conditions on earth to Jupiter – deep under the Antarctic ice – to test the space-bound radar by flying gridded surveys over the Antarctic ice shelf. It is also designed to serve as a prototype of a AUV that could be deployed on a future mission to Europa.

ARTEMIS will enter the water through a hole bored in the Antarctic ice and then travel along the path flown by the aircraft and measure the depth of the ice from below so that the airborne instruments can be calibrated. The AUV will carry a range of sensitive instruments to measure aspects such as temperature, depth and water current velocities, and to identify microbiological communities.

Cable design challenges

The long range and number of instruments on the ARTEMIS created enormous design challenges. The coefficient of drag has to be low in order to achieve the AUV's range, so the craft is shaped like a torpedo. The control system, batteries, propulsion system and instruments are enclosed in 12 pressure vessels on the craft. Each pressure vessel has complex internal connections as well as connections to other pressure vessels. The AUV requires approximately 100 cables, each of which is custom-built with around a six-month lead time.

The science payload of the previous generation Stone Aerospace AUV

Results

- Elimination of $20,000 in cable rework and expedited delivery costs
- Design cycle reduction by 12 weeks
- Ability to view the electrical and physical design of the entire craft in a single hierarchical view
- Effective design team collaboration created common nomenclature improving quality and cutting errors
- Automated checks ensured correct connector selections.

Stone Aerospace is a Texas-based company dedicated to the exploration and commercialization of the frontiers we know of and the discovery of the ones yet to come. They develop the tools needed to explore the frontier, to survive and work in it, to characterize it, and to exploit it. At the heart of the company are seasoned expeditionary scientists and explorers who have used the equipment they design in demanding environments - and best-of-class engineers and coders. Stone Aerospace is novel, lean, fast moving and cutting-edge.

E³.series is Zuken's software solution for electrical wiring, control systems and fluid engineering.

E³.series from Zuken is a Windows-based, scalable, easy-to-learn system for the design of wiring and control systems, hydraulics and pneumatics. The out-of-the-box solution includes E³.schematic (for circuit and fluid diagrams), E³.cable (for advanced electrical and fluid design), E³.panel (for cabinet and panel layout), and E³.formboard (for 1:1 wiring harness manufacturing drawings). Integrated with MCAD, E³.series is a complete design engineering solution from concept through physical realization and manufacturing output.

In the past, Stone Aerospace engineers designed the AUV's cables by capturing information for each cable in a spreadsheet and producing schematics using a drawing program. But this method had a lot of limitations, including time-consuming spreadsheet maintenance and schematics production. There was also no way of ensuring they were up-to-date and consistent. Considerable time had to be spent on consistency checks and, even then, errors often went undetected until the craft was tested during the assembly process.

The company recently implemented Zuken's E³.series software which manages both logical and physical wiring harness design and ensures the consistency of the entire project without manual effort. "E³.series enables us to see the electrical and physical design of the entire craft in hierarchical fashion," said John Harman, Electrical Engineer for Stone Aerospace. "We can go down the hierarchy to look into detail at the battery pod or up the hierarchy to see how the battery pod connects to the thrusters and control system. Our entire engineering team works with the same model, which helps keep everyone on the same page."

Stone Aerospace defined a common library of parts, most of them simply copied from previous projects, and engineers working on the project drew from this library to save time and ensure consistency. The software reduced the time to design the cables and greatly reduced errors by, for example, ensuring that the connectors mated with each other, that there were enough pins to handle each wire in the assembly, and that the right penetrators were used.

Controlling nomenclature

The company also used E³.series to control the nomenclature of the project. For example, the AUV has many RS232 communications lines, with the master for each line having an Rx and Tx port and the slave also having an Rx and Tx. The Tx on the master connects to the Rx on the slave and vice versa. The software automatically produces master out/slave in and slave out/master respectively on the two lines. "When we used manual methods, each engineer used their own terminology and this sometimes resulted in errors," Harman said. "With E³.series the entire project looks as though it were designed by a single person even though even though it was actually created by a distributed design team."

"There's no doubt in my mind that if we had used our previous design methods we would have run into many problems where the design did not exactly match the bill of materials," Harman said. "This would have required cables to be sent back for rework which would have involved considerable additional expenses and set the schedule back," Harman added.

"With our new automated approach we got the design right the first time and did not have redo a single cable," he concluded. "We estimate that we saved about $20,000 in cable rework and expedited delivery costs. We also achieved substantial productivity gains because engineers had a very clear picture of what one another were doing and because of the automated checks performed by the software. When we design ARTEMIS' successor, it will be easy to repurpose the libraries and nomenclature as well as the design itself, which will provide additional efficiencies."

Assembly of latest generation ARTEMIS AUV