SATELLITEWARE

A Colorado Company Accelerates Satellite Development and Deployment

When Advanced Solutions, Inc. (ASI) launched in 1995, its founders were looking for a change from their jobs with large aerospace contractors. But they also didn't want to follow the same path as other startups in the same industry.

"A lot of small aerospace companies are body shops for the primes," said John Cuseo, ASI's cofounder, president, and CEO. While "body shops" provide talent and expertise to larger contractors and "can make a living that way, you're not creating a product that can revolutionize anything," Cuseo said.

At the same time, the satellite industry itself was changing, with growing military and commercial demand for smaller, more agile hardware than the

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car-sized satellites of the past. “They want to design them quickly, build them quickly, and get them in orbit quickly,” Cuseo said.

The transition in the satellite industry represented an opportunity. Over the next two-plus decades, ASI developed modular, flexible flight software and design tools that evolved with the increasing demands of smaller, more autonomous satellites. Today, software that began development at the turn of the century through an Air Force SBIR contract is powering more than 25 military and commercial satellites currently in orbit—with more on the way.

“We wanted to create products that changed the industry,” Cuseo said. “That’s why we started in the SBIR program.”

ASI first received an SBIR contract from the U.S. Air Force to create a completely new type of flight software for satellites—a modular system that would be readily adaptable for different hardware and missions. That initial work, awarded as a Phase I SBIR in 2001, resulted in a software framework that would ultimately be developed into ASI’s commercially available flight software, known today as Modular/Autonomous/eXtendible Flight Software, or MAX Flight Software.

The SBIR resulted in the creation of what company founders called the On-Board Dynamic Simulation System, or ODySSy. ODySSy is built into the MAX Flight Software and allows the satellite to respond to simulation stimuli in a ground-test environment with no external ground-test equipment. This dramatically simplifies satellite integration and testing, resulting in significant cost and time savings.

While it would be several years before the technology would take flight, the simulation software had immediate implications for integrating and testing the complex systems and structures that must come together during assembly of even the simplest of satellites. “It can test itself in real mission scenarios as if everything is hooked up,” Cuseo said. “It has a full environmental simulation so it thinks it’s flying in orbit. As you start integration, the computing environment transitions to the real flight processor and you start hooking up flight hardware, like reaction wheels and sensors. It knows what’s connected and what’s not, and it will configure the simulation accordingly.” This kind of simulation eliminates the need for complex pieces of hardware used to connect simulated interfaces to satellites during the assembly process. “We are all about approaching problems in a different way, streamlining the path to get on orbit,” Cuseo said.

Following a second Phase II SBIR contract, the ODySSy software was placed on-board the Air Force Research Laboratory’s TacSAT-2 mission, which launched successfully in 2005.

Having been part of a successful space mission through its SBIR work with the Air Force, ASI found further opportunities in the rapidly growing commercial space field. It won a seat at the table on the ORBCOMM Generation II project, a constellation of 18 commercial communication satellites developed by Sierra Nevada Corporation. The ODySSy software developed through the SBIR was critical in the assembly, integration, and testing of the satellites, 18 of which were ultimately launched by 2015.

The trend towards building clusters of small, low-cost satellites has since proliferated in both the

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Photo Courtesy ASI

John Cuseo

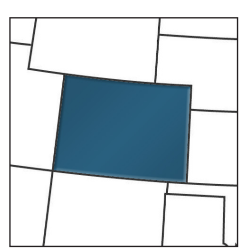
military and commercial space, providing redundancy and resiliency as well as accelerating deployment and capabilities. When a group of small satellites are being built simultaneously, there's often not enough rack space or time to test them all in an expeditious manner. ASI's simulation capabilities have proven crucial to overcoming that logistical bottleneck. "It enables these satellites to be built quickly in mass quantities," Cuseo said.

Moreover, the MAX Flight Software is able to help solve another problem that comes with deploying a constellation of satellites at once—keeping them from running into each other.

That's a job that, until now, has largely been overseen by earthbound operators and systems. The sheer number of small satellites, however, makes on-board systems capable of making decisions without waiting for direction from the ground all the more important. "Putting up a small satellite that can track any other object is going to be very important in the future," Cuseo said.

With its fully developed suite of software, ASI's work now spans the full satellite lifecycle—from design and construction to testing, launch, and ongoing mission control.

In 2010, ASI moved to a 15,000 square foot facility. The new space included dedicated space for spacecraft and avionics assembly. The move also brought it closer to the FalconSAT small satellite engineering program, which is operated by the U.S. Air Force Academy in partnership with AFRL as a testbed for new technologies. Another SBIR contract supported ASI's work with the Academy, and FalconSAT-5 launched at the end of 2010 with its software on-board. ASI software also powers FalconSAT-6, launched in late 2018, and a planned FalconSAT-8 mission.



ASI's MAX Flight Software has now matured to the point where it can be installed on any satellite hardware. Cuseo calls it "the first flight software in the world that can be considered a commercial off-the-shelf product because of how flexible it is."

Earlier in 2018, MAX and ODySSy were on board the first of what will eventually be 30 commercial imaging satellites launched by Astro Digital. These Landmapper CORVUS satellites were developed and tested using another ASI tool, STK SOLIS (Spacecraft Object Library in STK), created through a partnership with Analytical Graphics, Inc., a leading developer in the aerospace field. This tool allowed Astro Digital to configure targeting plans and testing prior to launch. More than 75 other domestic and international companies, universities, government agencies and the Department of Defense have since purchased the product.

"We're now exposed to 95 percent of the aerospace community," Cuseo said, including most of the major prime contractors that he and ASI's other founders once worked for.

With its fully developed suite of software, ASI's work now spans the full satellite lifecycle—from design and construction to testing, launch, and ongoing mission control. With a staff of 40 engineers, total revenues have increased more than six-fold since 2001.

Cuseo now also sees new opportunities closer to the ground, including software that controls launch vehicles, entry vehicles, and unmanned aerial vehicles (UAVs). ASI is currently working with DARPA to get a small, highly autonomous prototype of a self-directed UAV off the ground.

"There are so many exciting uses for this software, and it's starting to really take off," said Cuseo.

Advanced Solutions, Inc.

Modernization Priority: Space

Littleton, CO • SBIR contract: F29601-02-C-0098 • Agency: Air Force • Topic: AF01-019, Low-Cost/Robust Nanosatellite Spacecraft for Distributed, Communicated Systems Constellations

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