



SUCCESS STORY

Robots Aiding the Raptor to Fly to Combat Readiness Faster

AUTOMATED AIRCRAFT INLET COATING

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SBIR COMPANY NAME: AEROBOTICS INC

TECHNICAL PROJECT OFFICE: AFRL/
RXME

SPONSORING ORGANIZATION: AFRL

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THE BASICS

- Automated tech that refurbishes inlet ducts faster than doing so manually
- 33% faster, requiring 80% fewer man hours
- Speedy combat readiness and better performance signature against radar



THE AIR FORCE HAS A ROBOTIC SYSTEM CAPABLE OF RESTORING THE SPECIAL COATINGS ON AN F-22'S AIR INLET DUCTS MORE QUICKLY AND CHEAPLY THAN DOING SO BY HAND.

With support from the Air Force Small Business Innovation Research/Small Business Technology Transfer Program, Alabama-based Aerobotix Inc. developed an automated technology that refurbishes inlet ducts faster than doing so manually.

On average, the manual coating process took 36 calendar days. With robotic coating technology, that process shrank to an average of 24 calendar days--an improvement of 12 days-- and required 80 percent fewer man hours.

Aerobotix worked on the project with engineers from the Air Force Research Laboratory and the Air Force Life Cycle Management Center's F-22 System Program Offices at Wright Patterson AFB and Hill AFB.

The ability to refinish engine inlet ducts quickly means the F-22 can be refurbished and returned to service rapidly. This supports combat readiness and gives the aircraft a better performance signature against radar. On jet aircraft, inlets ensure smooth airflow into engines in spite of air whipping at the ducts from multiple directions.

Aerobotix has secured millions in Air Force contracts for the system. This has helped accelerate the company's growth, allowing it to double its staff, revenue, and physical space.

The company's expansion, along with \$11.3 million in Phase III contracts with the Air Force, represent critical-success benchmarks for SBIR companies.

The company says it also has secured \$1.4 million in add-on projects and has quoted another \$640,000 in work. Furthermore, the Air Force is investigating the possible use of the Aerobotix system on other jet fighters and missile systems.

BEHIND THE TECHNOLOGY

The F-22, a fifth-generation advanced tactical fighter jet, first entered production in 2005. A stealth aircraft outfitted with integrated avionics, it can cruise at supersonic speeds (greater than 1.5 Mach) without using afterburners.

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But this high-performance craft still requires regular maintenance, including re-applying the special coatings on its inlet ducts.

Coating jet-engine inlets manually requires hundreds of hours of sanding, painting, and other tasks—all performed in confined spaces. Maintainers toggled in protective suits, hoods, and respirators must crawl on their hands and knees or lay on their back inside the inlet ducts to re-coat them.

Under these conditions, it can be nearly impossible for maintainers to manually apply the coatings at consistent speeds and thicknesses. Moreover, the physical demands of performing this work by hand can take a physical toll on Airmen, resulting in shoulder injuries.

Aerobotix's system uses two robots working at the forward and aft ends of the ducts to sand and spray-coat them.

The system slashes the time required to coat the inlets from more than 1,630 hours to 320 hours.

Additionally, the robots can apply more coating before the material's pot life expires, drastically reducing coatings waste due to expired material. These highly engineered coatings can be expensive—on the order of \$1,000 per gallon—and efficient use can save approximately \$40,000 per aircraft, officials said.

Aerobotix specializes in providing turn-key robotic systems for aerospace, military, NASA, and general industrial applications. It also provides a range of solutions for robotic and automated coating needs. The company says it collaborated with industry leaders in spray gun technology, carbon-fiber tube manufacturing, and software developers to create this automated solution.

A multi-axis robot manufactured by Fanuc Robotics is at the system's core. However, the design also incorporates commercial-off-the-shelf components as well as parts designed and built by Aerobotix.

Three of the Madison, Alabama-based company's automated systems have been installed at the F-22 Depot at the Ogden Air Logistics Complex, Hill Air Force Base.

Company officials say the technology has applications for the F-16, and the Air Force is investigating using the same system for the F-18 as well as the F-35 jet fighter in production for Northrop Grumman and Lockheed Martin.

SBIR FUNDING AND AFRL'S EXPERTISE WERE CRITICAL

Support from the Air Force SBIR program was crucial to the success of Aerobotix's painting technology and the growth associated with it.

"Without the Air Force SBIR program we would not have been able to do what we've done to this day," said Bret Benvenuti, senior robotics engineer for Aerobotix. "Being a part of this SBIR program with the Air Force really gives us a sense of pride in seeing one of the best fighter jets that the Air Force has get back into service a lot quicker. When we see the aircraft flying overhead, knowing that we had a hand in making it what it is, really gives us a sense of accomplishment."

The \$1.65 million in SBIR funding positioned the company to investigate newer technologies and designs. This includes a compact-spray gun and longer carbon-fiber tube technology to reach recessed areas of the inlet ducts.

Moreover, the funding also paved the way for the advancement of robotic sanding, wet film thickness measuring, and state-of-the-art collision avoidance path planning. 🤖

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