EMPIRICAL SYSTEMS AEROSPACE, INC.

While most people equate NASA with space exploration, the agency actually sets standards across the general aviation industry and influences how Americans fly everyday. One of the most pressing objectives is the need to increase efficiency across all commercial aircraft, thus decreasing both fuel costs and harmful emissions; a goal that is shared by Empirical Systems Aerospace, Inc. (ESAero).

PROJECT
SCEPTOR Distributed Electric Propulsion Aircraft

MISSION DIRECTORATE
Aeronautics Research

PHASE III SUCCESS
$8 million in Phase III contracts from NASA

SNAPSHOT
California-based ESAero has a rich history with the NASA SBIR program and has tied together several Phase I and II projects to deliver a new suite of electric aircraft propulsion system designs and tools to its government clients

EMPIRICAL SYSTEMS AEROSPACE, INC.
P.O. Box 595
Pismo Beach, CA 93448

"We believed early on that investments needed to be made in electric aircraft propulsion," says Andrew Gibson, President of ESAero. "We already had a history in this area and had proven that electric aircraft brought benefits; we felt we could meet NASA's goals for future aircraft."

This belief led the Central California-based team at ESAero to pursue funding from the NASA Small Business Innovation Research (SBIR) program. After a successful SBIR stint in 2009 with NASA Glenn looking at hybrid electric aircraft, which utilize cooled liquid hydrogen to cool superconducting generators, ESAero began to focus on non-superconducting technologies, which they felt better aligned with the current supply chain. A few years later, SCEPTOR took form – Scalable Convergent Electric Propulsion Technology Operations Research – and it is allowing NASA to explore the next generation of electric aircraft designs.

SCEPTOR, with which ESAero is working in tandem with Armstrong Flight Research Center, Langley Research Center, and partner small businesses, serves as an electric propulsion testbed designed to test new distributed electric propulsion concepts in flight. Through a follow on Phase III contract with ESAero, Armstrong purchased an airframe for modification that is currently being built. SCEPTOR provides NASA with flight data on distributed electric propulsion, allowing the comparison of computer modeling and simulation data with actual in-flight performance data.

"The SBIR program helps small businesses to better compete with larger companies - this is work that a large prime contractor could do, but because it is so far off and such a low TRL, they are not making the investments," explains Gibson. "Through SBIR, small businesses can be cutting edge and put their stake in the ground. Eventually this development, once created for NASA, will go mainstream. And that is the ultimate commercialization."

ESAero's Scalable Convergent Electric Propulsion Technology Operations Research (SCEPTOR) technology is being used by NASA to explore the system level impacts of distributed electric propulsion
// Photo courtesy of NASA //

NASA has high hopes for SCEPTOR, and they are expecting the technology to result in 3 ½-5 times less energy use, 25-30% less gas use, more fuel efficiency, and better aerodynamic performance. Since NASA invests in much of the early research and development work in aviation, meeting these milestones paves the way for others in the industry to conform. Reducing carbon emissions is also an end goal and NASA realizes to get there, they must convert to hybrid or electric.

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SCEPTOR came on the heels of another successful SBIR technology belonging to ESAero. PANTHER (Propulsion Airframe iNTegration for Hybrid Electric Research), also developed with NASA funding across several Phase Is and internal development, is a tool suite for the sizing and performance of electric and hybrid electric air vehicles. The company's focus is to innovate in the area of electric aircraft design and integration, which has applicability across many branches of the government and in the commercial aviation sector as well.

Another follow on Phase III contract awarded to ESAero saw the development of a ground test capability called the HEIST (Hybrid Electric Integration System Testbed), which involved the utilization of the LEAPTech (Leading Edge Propeller Technology) wing. The LEAPTech wing utilizes a different form of distributed propulsion, in that it distributes propellers across the leading edge of a wing rather than in ducts. This is a more near term application for electric distributed propulsion.

Wanting to fully understand how things work at the component level and studying how electric motors perform, ESAero received an award for another NASA SBIR project to better comprehend failure as it relates to the rest of the propulsion system. This SBIR Phase II project focuses on intelligent prognostics and health management (PHM) systems, which monitor aircraft performance. It is being designed and executed by ESAero for HEIST. By teaming with General Atomics Intelligent Systems, ESAero is creating the ability to monitor the degradation of a subsystem in real-time, so that self-repair decisions are possible.

With two NASA follow on Phase III contracts worth $8 million, subcontracts with the Department of Defense, and increasing work with many of the nation's top prime contractors, ESAero is staking its claim in the area of innovative and futuristic electric aircraft design.

"Electric vehicles are a game changer – how you design aircraft, how you approach a mission; the problem is being redefined and nobody understands how to integrate it," adds Gibson. "This opens up the design space so much. We are just beginning to understand and have those capabilities, as a community. We want to be a leader in that area and maintain the lead."