TECHNOLOGY

# CoFlow Jet Moves To Develop Deflected-Slipstream eV/STOL

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**U.S. startup CoFlow Jet has struck an agreement with NASA to commercialize deflected-slipstream technology that would enable an electric vertical/short-takeoff-and-landing (eV/STOL) aircraft to transition to efficient cruise without requiring tilting mechanisms or separate lift rotors.**

Founder Gecheng Zha has been developing the CoFlow Jet (CFJ) active flow-control technology at the University of Miami, where he is a professor. A wing that generates both high lift and thrust using CFJ flow control has been demonstrated with funding from DARPA.

In the CFJ concept, a small amount of air is sucked into the airfoil at the trailing edge, pressurized by a microcompressor inside the airfoil and injected tangentially into the flow over the airfoil near the leading edge.

In CoFlow Jet's eV/STOL concept, the slipstream from multiple propellers on the leading edges of the tandem wings is turned vertically downward to convert all of the thrust into vertical lift—the 90-deg. turn in the airflow enabled by CFJ flow control over the flaps.

CoFlow Jet has completed a preliminary design and is seeking investors. "We plan to have a scaled 400-lb. Phase 1 prototype built and flight tested in two years. In Phase 2, we will have a full-size, 3,500-lb. urban eV/STOL vehicle built, flight tested and certification started," Zha told Aviation Week. The company's Owl-1 is an all-electric four-seater with a design range of 220 mi. (191 nm) at 180 mph. (156 kts).

"We have demonstrated the CFJ wing system with embedded microcompressors. It performs very well, with the CLmax [maximum lift coefficient] exceeding the theoretical limit," he said. In addition to increasing lift, the system is designed to reduce drag while also producing thrust.

"The uniqueness of CFJ is that the micro-compressor is a part of the integrated propulsion system while increasing the lift at the same time. It always increases the lift and reduces pressure drag at the same time. One cannot separate them," Zha said.

"As a part of the propulsion system, its power density in terms of kW/kg is much higher than a conventional propeller system, by up to an order of magnitude. This is because the small compressor radius can allow very high speed, up to 140,000 rpm."

Zha also said, "The microcompressor can be designed to have very high efficiency, greater than 80%. Typically, at cruise, 20% of the thrust will be generated by the microcompressors with the benefit of high cruise-lift coefficient." This allows a smaller, more highly loaded wing to improve ride comfort.

The embedded microcompressors are electrically powered. "CFJ is able to achieve high lift coefficient at takeoff/landing and high cruise efficiency. Because of all these advantages, the total power consumption is significantly reduced compared with conventional technology," Zha explained. "The power required by CFJ itself is also small."

Noise is an important metric for air taxis. "We do not have quantitative values of the noise yet, but qualitatively it should be lower than conventional configurations because it does not have rotor downwash interacting with the wings," Zha said. "We see few other technologies that could have more advantage to reduce noise than the deflected slipstream enabled by CFJ."

While all eVTOL aircraft face certification challenges, the CFJ design is simpler than for tiltrotors, tiltwings or lift-plus-cruise configurations, Zha argued, and uses plain flaps. "Because the CFJ airfoil has a very high-stall angle of attack and is virtually 'stall-free,' the transition between hover and cruise will be smoother and safer than in a conventional eVTOL," he said.

"All the CFJ microcompressors and distributed propellers are powered independently and thus have high redundancy. The likelihood that they all fail at the same time is low," Zha emphasized. Each unit is designed to have extra reserve power and power supply redundancy is designed in.

"The overall aircraft can be better controlled than conventional aircraft because each microcompressor and propeller is an actuator that can control the local lift and drag," he added. Yaw and roll control are performed by locally changing lift, drag or thrust. The tandem-wing configuration provides for pitch control.