An Israeli firm is proposing an advanced, ducted, tandem-rotor helicopter for emergency and special operations missions. Bell Helicopters, its partner on the project, considers the concept the next thing in vertical-lift aviation.

Bell Helicopter and an Israeli firm are pursuing development of an advanced-technology rotorcraft that some at the U.S. manufacturer believe could change the face of vertical-lift operations.

The concept is based on the patented "fancraft" technology of the Israeli firm, Urban Aeronautics. The concept calls for a highly integrated propulsion and flight-control system that makes it possible to decouple the aircraft's movements, particularly in hover operations.

In light winds, most helicopters can easily maintain their position in a hover. But in gusts, a helicopter must roll or pitch into the wind to do that. In gusts varying greatly in speed and direction, "no helicopter can hover in one place accurately. It can also not stay horizontal," said Urban Aeronautics President and CEO Raff Yoel.

"Once we decouple the six degrees of freedom," he said, a rotorcraft can be developed that can serve as a stable hovering platform in such conditions.

The six degrees of freedom are the three translational ones—moving straight forward and back, up and down, and side to side—and the three rotational ones familiar to aviators as pitch, roll, and yaw about the center of gravity.

The ability of a "fancraft" to move independently in any one of those freedoms, combined with the design's elimination of exposed rotors, creates the operational possibilities not available today. Such an aircraft theoretically could sidle up to a building in midair until the hull makes contact with the structure, so people stranded by a fire below could be rescued, for instance, or a tactical team could be deployed to an advantageous position against a foe. Such an aircraft should have a great ability to operate in confined areas.

"This is the next new thing in aviation, vertical lift-wise," John Tatro, Bell Helicopter's director of advanced concept development, said of the "fancraft.

"We prefer to call it a compact helicopter," he said. "It's a tandem helicopter with high disk loading and we have the ability to put ducts on it."

Yoel, a former aerospace engineer for Israel Aircraft Industries, set up Urban Aeronautics in 2001 in part to refine that technology. The company today is based in the Yavne industrial park about 15 mi south of Tel Aviv.

In 2003, Yoel borrowed the initial, two-seat version, the CityHawk, in Israel. "We started off with basic technological work," he said. "CityHawk was just a proof of concept, but it had no future. It had piston engines that were constantly overheating.

"So we knew back in 2003 that we needed to build a larger vehicle with turbine
Among the elements that appealed to Bell were Urban Aeronautics two key patents. One is for the vane control system, which provides the ability to control the vehicle in roll and side-ward motion. The design calls for two, counter-rotating, horizontal, 8,284-lbf (5.5-m) rotors inducts for and aft on the aircraft. Above and below each is a set of 100 small vanes. Among the elements that appealed to Bell were Urban Aeronautics two key patents. One is for the vane control system, which provides the ability to control the vehicle in roll and side-ward motion. The design calls for two, counter-rotating, horizontal, 8,284-lbf (5.5-m) rotors inducts for and aft on the aircraft. Above and below each is a set of 100 small vanes. (between the rotors would be a cabin roughly the size of that on a Bell 212 and designed to carry 10 passengers. The pilots would sit in cockpits on the outboard sides of the cabin, just behind the front rotor.) To suspend the 6,700 lb of the vehicle, we are obviously throwing down a lot of air very fast, Yoffi explained. Air goes down faster in a helicopter because the disk loading is higher, but this also has positive sides. If you put a movable vane inside this flow and you rotate it a little bit, it creates a side force. If all these vanes are rotated like 5 deg each you can generate up to 500 lb of side force with no roll, he said. We can have our lift vector perpendicular to the ground and still generate side forces.

If the vanes are moved opposite to each other, that produces a pure rolling moment with no lateral translation, "because the whole thing is flying with computer-controlled, you can mix in any amount of side force with rolling moment," Yoffi said. Of course, you can have yawing moment and pitch, so in essence you have a vehicle that has movement in six degrees of freedom—升, tilt, and roll. The other patent that interested Bell covers the sets of vanes in front of the forward rotor duct and aft of the rear one. Those ducts are a penalty in forward flight, said Tatro. But the vanes reduce that penalty. In cruise flight, they open to make airflow over the vehicle more streamlined and increase the aircraft's potential speed. Yoffi figures the X-Hawk would cruise at 120 kt. You get down to 30 to 40 kt or so, Tatro said, you close the vanes up and that gives you that 20-30 percent lift augmentation.

As Yoffi explained, there are few more things that go into the X-Hawk beyond the vanes and vanes. One of the main plans is to use a very integrated flight control system. It's not like an aircraft that has a fuselage and a wing and they talk to each other where they mate, but not beyond that. In a helicopter, the cabin and the rotor are two separate entities, he said. With the X-Hawk, "everything is working together, so it's very, very important to make sure that this thing works as a package, that it's safe enough," Yoffi added to eventually win FAA certification of the aircraft. The X-Hawk's configuration creates very complex flows of air around and in the vehicle in hover and forward flight, sideward, backward, Yoffi explained. So this is really a very unique vehicle. Airflow is approaching this vehicle from all sides at one point or another. That poses some challenges, "but from the testing that Yoffi has done so far, it looks really good."

Yoffi initially targeted the X-Hawk as an emergency medical services aircraft. In addition to the Israeli military and special forces abroad as potential customers, we were also working with STAT Medevac in Pittsburgh, he said. They defined themselves as our design partners, and they were helping us on the EMS version, trying to get this into a useful machine.

Urban Aeronautics also talked to fire departments, police units, and "many, many customers, and decided that we needed to increase the size of the vehicle" to one with at least six seats and the ability to fly at 120 kt for 2-3 hr. This was the minimum requirement, Yoffi said. We started locating engines that would be suitable for that and we ended up for the higher end, realizing that as long as we're using a 1,300-lb engine, presently the LITEC 1800 family, we might as well make room for up to 10 people in the cabin and two crewmembers in the cockpit.

This, we believe, is a vehicle that has the widest market in terms of being able to break even on the program, "he said. It probably won't suit Jim Rosbein at STAT Medevac, except that he has a bigger helicopter. In addition to its target max takeoff weight, the X-Hawk now is designed for endurance, with maximum fuel of 1,300 lb, at about 3 hr with reserve. Its max range would be 330 nm and its operating radius would be 140 nm.

Yoffi said the X-Hawk won't compete with Eurocopter's EC135 and similar civilian aircraft. "But the military applications seem very bright, because you can actually fly for 2 hr with eight people on board, and wind tunnel tests have shown you can indeed go up to 140 kt, maybe more," Yoffi said. You can hover on a single engine after having lost an engine at max takeoff weight. You can do this in gusty winds, icing conditions, so this vehicle has tremendous potential."

The drawback is higher fuel consumption. "If you're over even terrain or open ground and you have a large load to carry for a long distance, you can take a Bell 212 or similar helicopter and you'll be fine," Yoffi said. "You'll burn less fuel using that. If you're talking about short range, about utility, about being able to get into a city or confined areas, or you want to be more stealthy, fly lower, create less noise, be less of a target, this vehicle is ideal."

The current configuration won't be the only one, he said. There are some special forces looking for something smaller, he said. "Certainly, the commercial market will look for something that's smaller. The aircraft must be certifiable to civil aviation standards, he said. "This cannot remain an experimental vehicle. This has to be fielded, marketed. So that's the horizon that we're working towards.

The company has completed the master tool for its prototype X-Hawk and is setting up shop in Yavne to begin creating the set of female molds needed to construct the vehicle's all-composite structure.

The Pardy Corp, in Manchester, Conn, is working on the X-Hawk's power distribution system. The lift rotors are also in production at Aero-Composites in Kensington, Conn. and are expected to be delivered towards mid-year. Urban Aeronautics is developing the flight control system.