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COMMENTARY

Moore's Bylaw

Benefits of microelectronics advances are inversely proportional to aircraft size

Most aerospace technologies cannot hope to match the rate of progress enshrined in Moore's Law—the observation that microchip performance doubles every 18-24 months. But in small unmanned aircraft systems (UAS), where payload size, weight and power are critical, rapid progress in communication, sensor and even power electronics is paying speedier dividends.

AeroVironment and Insitu, leaders in the small UAS market, have introduced gimbaled sensors that are both smaller and more capable. Until now, Insitu's workhorse ScanEagle has flown with either electro-optical (EO) or infrared (IR) turrets. Now the company is testing both a combined EO/IR sensor and an EO turret that provide wide-area along with close-up imagery simultaneously, with a "picture-in-picture" display.

"Future capability will be less about the truck and more about the payload," says Insitu CEO Steve Morrow. While Insitu's sensors are provided by Hood Technology, AeroVironment made the "strategic move" to develop its own gimbaled EO/IR systems for its small UAS family. "It required a significant technical push" to develop a small gimbal rugged enough to "crash into a rock" on recovery and survive, says Roy Minson, senior vice president and general manager of unmanned aircraft systems.

Satellite communications are normally associated with large antennas of large aircraft, but Israel's Gilat Satellite Networks has developed a 23-lb. system that will transmit 1 Mbps via K_a-band satellite. The mechanically steered phased-array antenna was to begin test flights last week on a 300-lb.-class tactical UAV.

But Gilat is going even smaller, developing an electronically scanned satcom antenna with no moving parts and a very low profile, saving space and reducing drag. There is also an order of magnitude reduction in price, "from six digits to five," says Eran Agmon, assistant vice president and head of integrated defense solutions.

In Israel, which has good K_u- and K_a-band coverage from the country's Amos satellites, a 9 X 9-cm electronically steered antenna provides 500 Kbps capacity, says Agmon. Gilat has demonstrated the antenna and is now integrating the system, including a loitering missile application, "for a couple of Israeli customers." A first proof-of-concept flight test is expected before year-end.

Gilat's design mounts the radiating elements and beam-steering chips on either side of a circuit card, and directly benefits from advances in microelectronics manufacturing. "Pricing is per square millimeter of silicon, and we use industry-standard pick-and-place assembly," Agmon says. Based on a unit cell of four radiating elements and a chip, Gilat can make any size of antenna for a customer.

Piston and turbine engines do not obey Moore's Law, but the UAV industry is seeing rapid progress in electric propulsion. Silent Falcon UAS Technologies is tapping into advances in both battery and solar power, with a small UAV that is planned to enter production early next year. The Silent Falcon (see photo) combines 85 watt/meter² thin-film photovoltaics from Ascent Solar Technologies with advanced 220 watt-hour/kg lithium ion batteries to provide flight times up to 14 hr. from a hand launch.

Ascent Solar is producing flexible solar modules by the roll, with arrays of thin-film GIGS (copper indium gallium selenide) semiconductors on a polyimide substrate—a technology first developed by Martin Marietta Aerospace in 1990. Development is being driven by commercial applications ranging from solar chargers built into smartphones to power systems integrated into building exteriors.

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Silent Falcon uses the flexible modules on the upper surface of the UAV's wing, which comes in three interchangeable sizes: 6.9 ft., 10.5 ft. and 17.1 ft. Endurance ranges from 6 hr. for the smallest span to 14 hr. for the longest. Weight ranges from 21.1-27.1 lb. and nighttime endurance on battery power from 4to 6 hr., respectively. The UAV carries a small gimbaled EO/IR sensor developed by Silent Falcon.

Ascent Solar is continuing internal and funded R&D to push module efficiency from just above 11% to a goal of 20%. Meanwhile Bye Aerospace, which spun off Silent Falcon as a separate company, continues to work on a larger UAV, the Silent Guardian, that combines a Williams International turbofan engine for rapid climb to high altitude with stored electric power and thin-film photovoltaics to extend endurance.