TechWatch

The Prius of Spy Satellites?

Rafael's Ionic Thrusters May Extend Service in Low Earth Orbit

By BARBARA OPALL-ROME

TEL AVIV — Israel's Rafael is putting many of the miniaturization, propulsion and orbital control capabilities developed for the nation's small imaging satellites into a new breed of fuel-efficient, micro-sized, maneuvering systems designed for years of close-in spying from space.

Shaped like missiles with a sleek, drag-resistant silhouette, Rafael's planned LiteSat-A and LiteSat-B measure a mere 5 feet in length, have a 1-foot cross section and weigh 100 and 85 kilograms respectively. The former is chemically powered, but the latter uses solar-generated electric thrust — positioning it to become the space-based Toyota Prius, a pioneer in the emerging niche market for efficient, long-endurance micro-class satellites.

While most satellites in dense low orbits guzzle fuel to maneuver along their orbital paths, LiteSat-B aims to convert energy stored in solar panels into ionic-charged thrust, allowing it to maneuver into slightly different angles to capture specific targets of interest.

"If you take a regular satellite at this altitude, its lifespan will be one or two years. Or, conversely, you can prolong the life with a ton of propellant, which is usually what the big nations are doing with spy satellites," said Jacob Herscovitz, chief systems engineer at Rafael's Space Systems Directorate. "But we will demonstrate a microsatellite with a launch mass of 85 kilograms give or take that sustains itself in a very Low Earth Orbit for seven years, maybe more."

Company-funded and still in early development at Rafael's Space Systems Directorate, the LiteSat-B draws on lessons from the firm's Israeli HALL Effect Thruster, a first-generation hybrid electric propulsion unit that aims to operate exclusively on electric thrust, yet features eight backup hydrazine thrusters. The Israeli HALL Effect Thruster is slated for its first launch by early 2014 as part of a mini-class satellite built by Israel-Aerospace Industries as part of the joint Franco-Israeli Venus scientific vegetation and Earth monitoring program.

Herscovitz said the second-generation, all-electric engine planned for LiteSat-B will allow the satellite to orbit around 300 kilometers up, a good altitude for submeter imaging, for seven years. That's far more than the two-year lifespan of chemically powered microsatellites now in orbit, he said.

"Electric propulsion is commonly used for large, expensive satellites weighing many tons, but we haven't yet seen very small, micro-class imaging satellites benefiting from the efficiencies of electric propulsion. This is an emerging technological sector where Rafael can take the lead," the Rafael executive said. "Our added value comes from combining propulsion technologies with the work we're doing in applying missile design profiles, autonomous control algorithms and image process capabilities to this promising new niche sector of microsatellites."

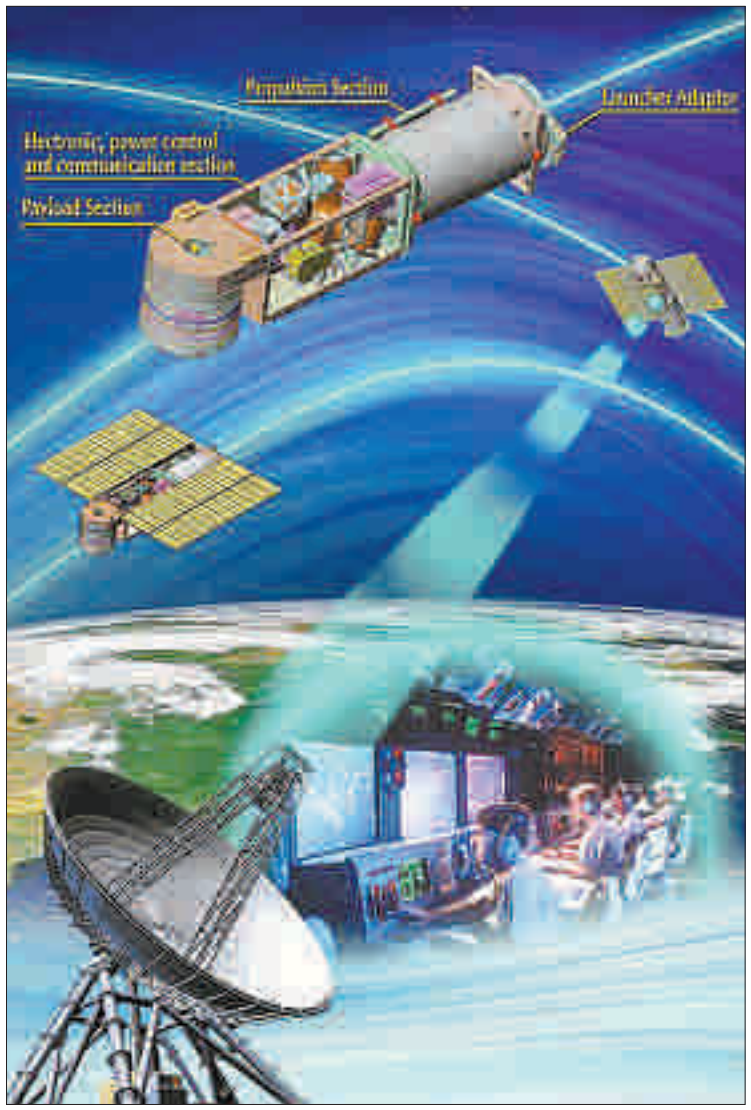
Rafael presented its LiteSat concept last month at an international space conference hosted by Israel's Fisher Institute for Strategic Air and Space Studies.

No Contracts Yet

The chemically powered LiteSat-A is slated for preliminary design review later this year, while LiteSat-B is in early concept feasibility studies, Herscovitz said. Both satellites will require about four years before they are ready for launch, and Rafael executives acknowledge they have no firm contracts or near-term government funding pledges for either program.

Amit Bergman, Rafael's microsatellite systems director, said LiteSat will have an imaging resolution of slightly less than one meter and will make use of the firm's ImiLite imaging exploitation system initially developed to support UAVs. The planned microsatellite was optimized for launch from aircraft, but multiple LiteSats could be delivered into space from a conventional ground-launched vehicle, Bergman said.

Ideally, government and industry sources here said, multiple LiteSats should be deployed simultaneously, operating as a constellation whose force-multiplying effect far exceeds the sum of its individual parts.



RAFAEL

Efficient and Endurable: Rafael's planned LiteSat-B, pictured in an illustration from a company brochure, is intended to use solar-generated electric thrust instead of conventional chemical thrusters to move about in orbit.

Chaim Eshed, the Ministry of Defense's longtime director for space programs, was noncommittal about near-term MoD funds for the LiteSat concept per se. Nevertheless, he insisted the general concept represents a new capability that must be developed for security as well as commercial and civilian applications.

"The added value that comes from mating fuel-efficient propulsion and low-cost multimission microsatellites is obvious, and such a concept is an example of where we need to be in the not too distant future," he said.

Tal Inbar, Fisher Institute director for space and unmanned aerial vehicle programs, said the Rafael initiative could be used to establish Israel's leadership role in a new era of formation flying for various applications.

"Rafael's fuel-efficient HALL effect electric propulsion system is unique at this time in its ability to support a new class of very small and inexpensive remote-sensing satellites," he said. "But without the budget, its added value will erode and we end up with yet another missed opportunity to establish ourselves as providers of innovative options for responsive space." ☐

E-mail: bopallrome@defensenews.com.

Paperless Cat Launches

Flight crews who launch aircraft from the decks of U.S. Navy carriers are moving into the computer age, thanks to an Office of Naval Research (ONR) TechSolutions effort to move paper tables onto handheld devices.

The Catapult Capacity Selector Valve Calculator could eliminate the need for paper-bound launch bulletins. The device underwent final evaluation in January aboard the Harry S. Truman.

The capacity selector valve is used to set the energy level needed for a launch on an aircraft carrier. Calculations are based on aircraft type, weight and wind speed, among other variables. All that information is contained in a loose-leaf notebook, and crews must look up the data to determine the energy level for each launch.

Now, "the launch bulletins are stored in the calculator, and they are updated automatically," said Stephanie Everett, ONR's TechSolutions program manager.

XCV2 Design Challenge

The Defense Advanced Research Projects Agency (DARPA) hopes to leverage the power of the crowd to reduce the yearslong process of military vehicle manufacturing, from concept to construction.

For the Experimental Crowd-derived Combat-support Vehicle (XC2V) design challenge, facilitated by Local Motors, DARPA is asking individuals to conceptualize a vehicle body design for two missions: combat reconnaissance, and combat delivery and evacuation. Service members, auto enthusiasts and others interested in engineering, materials, industrial design, etc., could win up to $10,000 and see their design become a fully functioning concept vehicle.

Final entries are due March 3. Details are available at http://www.local-motors.com/XC2V.

Incoming: Better Helmets

The new Enhanced Combat Helmet doesn't look much different than the Advanced Combat Helmet it's designed to replace, but the performance difference is huge, said Col. William Cole, the U.S. Army's project manager for Soldier Protection and Individual Equipment.

"We had hoped for a 35 percent improvement over the ACH in terms of ballistic protection, and it's way better than that," he said of the new helmet, likely to be fielded in the fall. ☐

Compiled by Michele Savage.