Lift Off

by **Dario Schor**

The space industry in the late 1950s transformed the eloquent words of science fiction writers into reality with the launch of artificial satellites and humans into space. Since then, we've witnessed humans stepping on the moon, spacecraft exploring the Solar System and beyond, the development of the Space Shuttle as a re-usable vehicle to reach low-Earth-orbit, and the beginning of human habitats through space stations. More recently, we find ourselves in the era of commercial space with start-ups and private enterprises expanding their ventures to low-Earth-orbit and beyond. The commercialization foments competition and innovation, but also challenges the principles laid out in the 1967 Outer Space Treaty of the United Nations with regards to resource extraction from celestial bodies.

This column will highlight a few of the exciting projects, missions, spin-offs, and findings from current space activity, while also touching on key national and international policies affecting the industry. Furthermore, each issue will feature a Canadian student project, showcasing the up-and-coming talent within our community.

We welcome feedback and suggestions for topics.

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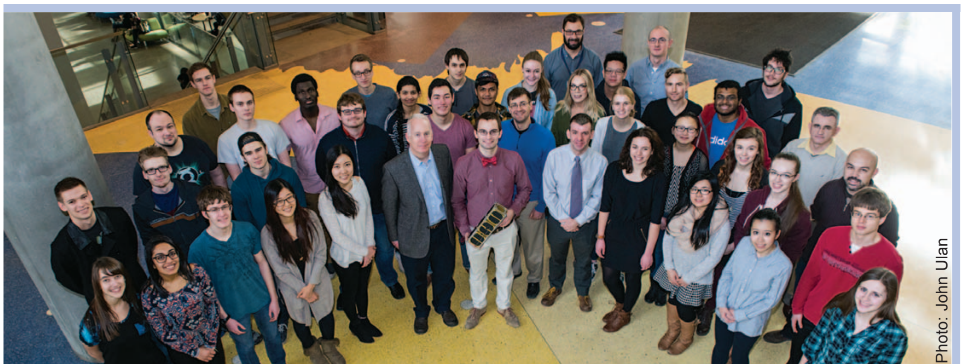
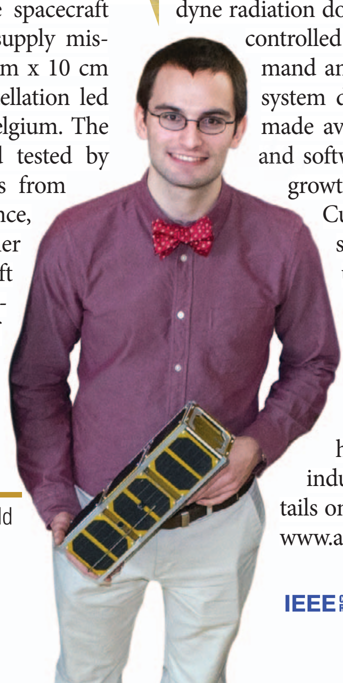


Ex-Alta 1 – Becoming the first orbiting student-designed CubeSat from the University of Alberta (UofA), the spacecraft launched April 18 on a cargo resupply mission to the ISS. The 34 cm x 10 cm x 10 cm satellite is part of the QB50 constellation led by the Von Karman Institute in Belgium. The spacecraft is designed, built, and tested by a group of 60 dedicated students from the faculties of Engineering, Science, Business, and Education. Like other CubeSats from QB50, the spacecraft carries a primary payload to provide multi-point measurements of plasma in low-Earth-orbit using a Langmuir probe designed by the University of Oslo. Ex-Alta 1 carries two additional payloads designed by research teams at the UofA: A digital fluxgate magnetometer and a teledyne radiation dosimeter. The spacecraft is controlled by a custom-built Command and Data Handling (CDH) system designed by students and made available as open hardware and software to help expedite the growth and development of the CubeSat community. The spacecraft was deployed using Nanoracks. The team members share their enthusiasm with the community through outreach events and hope that Ex-Alta 1 will help launch the aerospace industry in Alberta. For details on the launch, please visit www.albertasat.ca.



The satellite will measure magnetic field strength, radiation and plasma levels.

The modern day "Race to the Moon" is approaching its final stage. Five rovers will be launched Moonward in 2017 as part of the Google Lunar XPRIZE competition. The first of these privately funded missions to demonstrate it can travel 500 metres and transmit high-resolution video from the surface of the Moon will be awarded the US$ 20 million grand prize. The pool of teams has decreased from 32 registered, to 16 that participated in all activities, and now to five that obtained a verified launch contract by December 2016. The five teams remaining are (i) Moon Express, a US-based company aiming for multiple missions to ultimately extract resources from the Moon, (ii) Japanese team Hakuto utilizing a state-of-the-art infrared Time-of-Flight 3D Camera to detect and automatically avoid mission hazards while travelling on the lunar surface, (iii) SpaceIL from Israel, whose novel propulsion system will enable its rover to hop over obstacles, (iv) Team Indus from India using a lightweight 5-kg rover with a unique wheel design not needing suspension to overcome the rough lunar terrain, and (v) the international collaboration of Synergy Moon, attempting to be the first moon-based internet web server. These five organizations share a commercial goal, STEM educational objectives, and aspirations for their own "Apollo moment" on the surface of another celestial body.

Traditionally, satellite systems are designed with the understanding that once in orbit, there is no room for failure. As such, the designs include many layers of redundancy, autonomous health checks, and are built from expensive components with mission heritage, manufacturing traceability, and undergo thousands of hours of enviromental testing. In addition to the increased costs to launch the missions, it also requires that these satellites be replaced as they approach their end-of-life such that society can continue to utilize their services. Space agencies have produced extensive reports, like the "NASA On-Orbit Satellite Servicing Study," outlining the benefits and challenges of developing the capabilities for on-orbit servicing. These would build on the Shuttle experience where astronauts replaced faulted parts of the Solar Maximum Mission in 1984 and later repaired the Hubble Telescope lens in the 1990s. In early 2017, Space Systems Loral (SSL) was selected by DARPA to develop the Robotic Servicing of Geosynchronous Satellites (RSGS). This technology will include the ability to repair, upgrade, relocate, and refuel both commercial and military spacecrafts in orbit. More specifically, SSL plans to use robotic technology similar to the Canadarm or Dextre to correct the most common mechanical anomalies in deployments, assist in orbital maneuvers, refuel spacecrafts, and upgrade payloads. This could dramatically change the slogan on space merchandise that currently reads "failure is not an option." ■

For **Dario Schor**'s biography please see page 27.