Heater-Free, Lowest Power Consumption & Highest Volume Availability Gas-Generator Propulsion System – Most Suitable for Micro to Nano Satellites

Patchedconics

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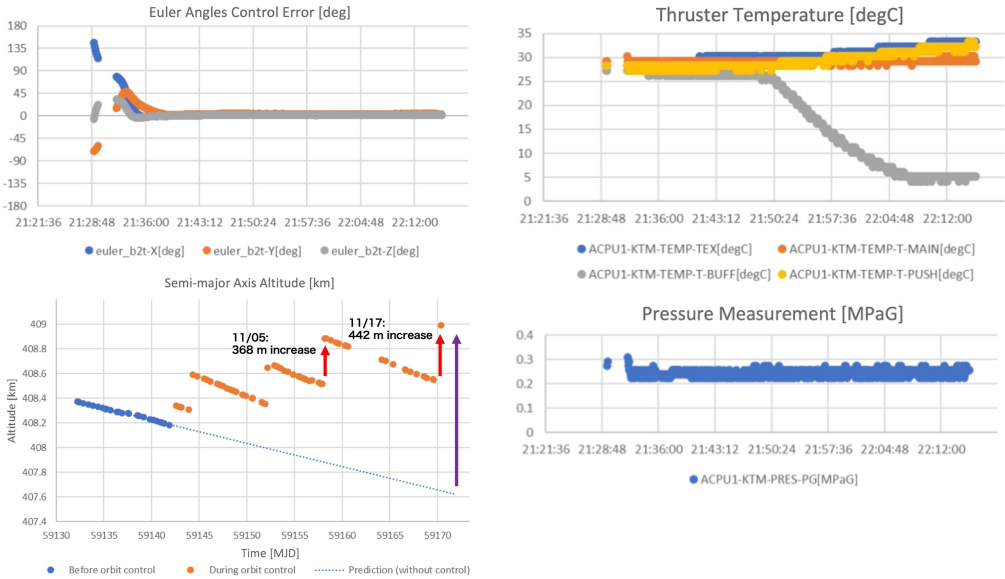

Figure 1: Real data from ALE2 showing behaviour of ALEx engine [2]. Courtesy of Tohoku University.

Patchedconics, LLC of Japan successfully delivered a gas generator propulsion system to a Japanese venture satellite company, ALE, in 2019 (figure 2). Results of the operation of ALEx engine, on-board ALE2 satellite, are shown (figure 1). We now present a new product featuring Heater-free, Lowest Power Consumption & Ultra High Volume Efficiency Gas-Generator Propulsion System. It is the most suitable low-cost solution for Micro to Nano Satellites (figure 3).

ALEx has shown the possibility of gas generation without active power consumption, through a device that makes use of Joules-Thomson effect, which can be observed on top right image of figure 1. We now extend this technology in a new design which allows all of the components of the propulsion unit to be submerged inside the liquid propellant tank. By using a low vapour pressure propellant, we were also able to develop a unit which does not require the use of spherical tanks, allowing it to have a cuboid shape, using the space available very efficiently, with virtually no dead volume. Patchedconics has already applied for patents for this technology [1].

Correction strategies to minimize decay due to atmospheric drag have been tested by Patchedconics, and results can be see on figure 4. The target of the correction is to reach an orbit with little to none eccentricity vector variation.

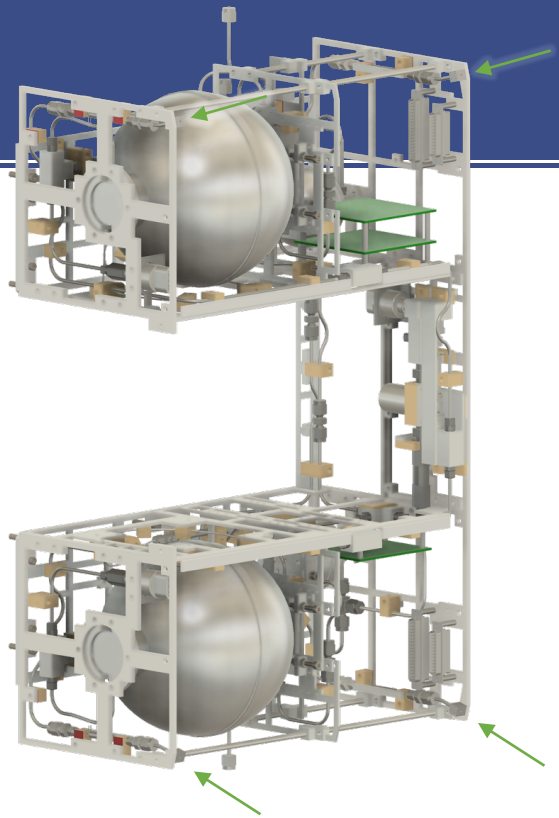

Figure 2: 3D render of ALEx propulsion unit delivered to ALE2 spacecraft. Green arrows represent forces generated by the 4 thrusters.

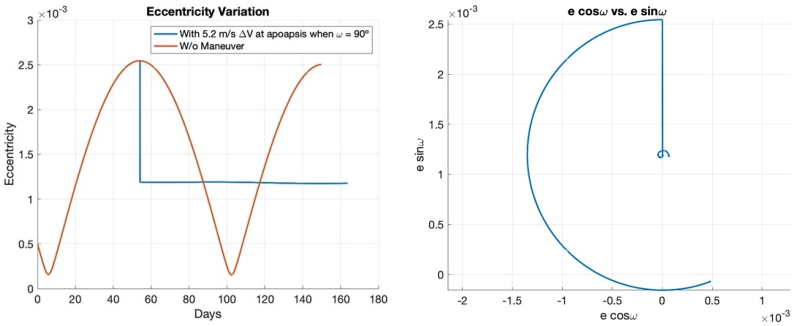

Figure 4: Results from the correction strategy. Left: eccentricity variation after maneuver. Right: *e* cos(w) x *e* sin(w) transitioning to nearly frozen orbit.

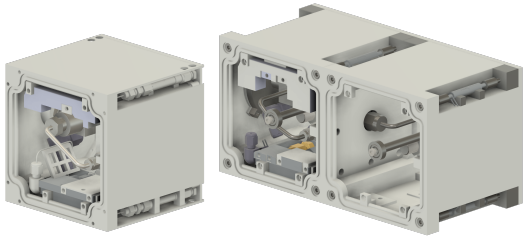

Figure 3: 3D render of Ultra High Volume Efficiency propulsion units. 1U model, 2U model (from left to right)

References

[1] Kawaguchi, Junichiro. (2020). Fluid Supply Device. World International Property Organization no. WO 2020/250284 A1. Available at: https://patentscope2.wipo.int/search/ja/detail.jsf?docId=WO2020250284&_cid=JP1-KPCJMA-38538-1 (Accessed: May 31, 2021)

[2] SSC21-III-09 Yuji, Sato, et. al. (to be presented at this conference)