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**Title**

# Innovative propulsion technologies for increased CubeSat efficiency

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## Abstract

With the blooming of the ever-growing space activities thanks to the rise of New Space's compagnies, numerous satellites are put into orbit. Among them are CubeSats, little box-shaped satellites that are composed of multiples 10 by 10 centimeters units, containing anything from on board computer to telecommunication devices. These orbital platforms are prized for their relatively low price to produce, as well as the versatility that they offer in term of missions variation. From telecommunication and surveillance to small-scale scientific experiments, the possibilities are endless. However, in case of low orbit mission, satellites of all sorts are facing a major obstacle: the residual Earth atmosphere. The drag induced by it can reduce by up to 50% the possible lifespan of a standard CubeSat, sometimes leading to multiples launches to achieve objectives that could have been done with one satellite.
IPSA ONE (Orbital Nano Experiment) is a student-only association at IPSA, an aerospace engineering school at Ivry-sur-Seine (near Paris). For the last two years, IPSA ONE worked to produce a solution to counter the atmospheric drag found in low orbit with SmallSats and especially CubeSats. Among the many devices that could be implemented onboard, the electric propulsion option was retained. Furthermore, to keep reducing fuel dependencies, a first study approach for a CubeSat launch scenario by rail launcher was produced in collaboration with the Franco-German Research Institute in St. Louis.
The conference's presentation will focus on the two technologies we have developed to increase lifespan and efficiency of CubeSats in low Earth orbit.
We will first go over the processes needed to create an 1U (one CubeSat unit) module containing necessaries to operate an ionic grid thruster powerful enough to counter the drag induced by 3U CubeSat in low Earth orbit by providing around 100 µN of thrust. As a student-only association and thanks to a collaboration with ICARE laboratories from the CNRS, IPSA ONE developed and tested an innovative ionic thruster using a grid-based particles acceleration system with multiple magnetic containment configurations.
Then, about the side project made to furthermore reduce CubeSat dependencies, we developed an alternative launch system of rail launcher. By using the generated Laplace force, this would allow to give a sufficient initial speed to get rid of a first stage launcher leading to drastic reduction of costs and dependence on fuels. Thus, we will present the main information retained in the bibliography given by the ISL and that available on the web. From this information, a scenario proposing a circularization of the orbit by electric propulsion was retained and the dimensioning of a system was carried out accordingly. All the tests and standards of certification on the electromagnetic compatibility will be specified, allowing to realize static and dynamic tests. Finally, a first market study allows to obtain an order of magnitude in terms of costs of such a project.
Utilized in conjunction, those two technologies could increase the lifespan of many CubeSat in low orbit, as well as reducing the potential presence of launcher debris in space, thanks to an innovative rail launching system.