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KEYNOTE: ELECRIC PROPULSION FOR CUBESATS: A REVIEW

Abstract

CubeSats have become increasingly common in recent years because they allow to access space at a markedly lower cost than classical medium-to-large systems. Many universities, schools and private companies have taken advantage of the opportunities these satellites provide for placing small payloads into Earth orbit. Nonetheless, the CubeSat technology has developed very rapidly and nowadays it is considered also for commercial applications such as Earth observation and telecommunications. However, the lack of reliable and efficient propulsion subsystems was in the past one of the main blocking points to enable advanced utilisation of CubeSats. In fact, integrating a propulsion system in a CubeSat is a very challenging task because of the intrinsic complexity of a space thruster and the strict constraints and requirements on mass, volume, power and cost of this class of satellites. As a consequence, until 2011, the only Cubesat propelled was the CanX-2 that employed a cold-gas thruster to perform orbital corrections. However, not having a propulsion system is nowadays unacceptable, in particular for CubeSats designed for commercial or scientific purposes. In fact, the capability of accomplishing orbital manoeuvers is necessary to ensure the feasibility and the long-life of these type of missions. For such reasons, research to develop suitable propulsion systems for CubeSats is nowadays extremely active.

In this framework, Electric Propulsion (EP) seems particularly promising for missions planned for the near-future as constellations of CubeSats and Solar system exploration. Specifically, it is possible to take full advantage of EP systems in missions in which manoeuvers with high ΔV (>100 m/s) are required and the time constraint is not a major issue. In fact, the peculiarities of EP systems are: the specific impulse is high (up to 10000 s) and the thrust is low (<1 N). Some of the more appealing features enabled by EP on commercial CubeSats are orbit change, maintenance, attitude control (with precision pointing), along with constellation phasing, deployment and formation flying. Also de-orbiting operation and drag compensation are possible. On the other hand, the proximity operation, such as collision avoidance, need to be carefully planned because of the low thrust provided by electric systems and, in turn, the lack of a fast response.

The aim of this paper is to present a review on the most advanced concepts of EP systems for CubeSats available on the market. Moreover, the most promising technologies for the near-future and mid-future will be discussed.