

SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

Author: Prof. Salvo Marcuccio
Università di Pisa, Italy, salvo.marcuccio@unipi.it

Dr. Pierpaolo Pergola
Sitael/Alta, Italy, p.pergola@alta-space.com
Mr. Stefan Gregucci
Sitael Spa, Italy, s.gregucci@alta-space.com
Prof. Mariano Andrenucci
Sitael Spa, Italy, m.andrenucci@alta-space.com

LOW-THRUST PROPULSION SYSTEMS FOR SMALL SATELLITES

Abstract

Nowadays small platforms represent valuable options for small scientific missions. One of the main challenges for these micro spacecraft ($m < 100$ kg) is the inclusion of an autonomous propulsive subsystem. It would significantly enhance the performance of these platforms broadening the possible applications and/or extending their lifetime. The lower the size the harder this task inasmuch as the great majority of micro (and all the more so nano) spacecraft does not have any manoeuvre capability. For these applications electric propulsion schemes are more suitable than chemical systems as they allow a larger payload mass fraction reducing the propellant mass requirement with a minor increasing in the power generation system mass. The aim of this study is to investigate about electric propulsion options for small spacecraft. Earth observation missions, atmospheric layers characterization, magnetic field mapping or even simple technological demonstrators are considered as applications in order to assess the performance resulting from equipping small size (both in terms of mass and available volume) with Hall Effect Thrusters, Arcjets and Field Emission Electric Thrusters. By means of these thrusters on small platforms, for instance, some years of orbit maintenance can be achieved at very low altitudes, thus increasing data collection and/or ground observation, even with limited propellant mass fractions of the order of 10–20%. In this scenario, Cubesats are the more challenging configurations due to their very small size and mass. Thus, integrating an electric device into one of these platforms represents the true test to face with from a system integration point of view, but it would be also the situation offering the best mission performance. In this study an overview of the possible electric propulsion systems for small satellites is presented and the main performances of such platforms are assessed. The preliminary spacecraft sizing and design of the most promising solutions are also presented.