

HYBRID MODELLING OF SINGLE AND DOUBLE STAGE HALL THRUSTERS

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Hall Thrusters (HTs) –also referred as Stationary Plasma Thrusters (SPT) in the literature –are now a mature technology to be used on board satellites to maintain a spacecraft on a geostationary orbit and for scientific probe missions able to explore the solar system. In a HT, a heavy gas, most often xenon, is introduced through an anode plane and is ionized by an electron current coming from a cathode located outside the thruster channel. In order to increase the ionization mean free path, a radial magnetic field –maximum in the exhaust plane –is applied to impede the axial transport of the electrons. The discharge takes place in an annular channel between two concentric cylindrical walls. The channel walls are composed of dielectric materials that serve to protect the magnetic circuit from ion erosion. The applied voltage between the anode and the cathode, concentrated in the region of low conductivity/large magnetic field, serves to heat the electrons and to accelerate the ions in the axial direction that supply the thrust.

The mission domain of HTs has recently enlarged since they are also possible candidates to replace chemical thrusters for orbit transfer. The dual-mode operation of a HT consists to firstly operates at high thrust and low ion velocity to minimize the orbit transfer duration and to secondly operates at ion velocity and low thrust to minimize the propellant consumption. Nevertheless, for a given electric power, the use of a Single Stage HT (SSHT) is not able to fulfill these two missions. Double Stage HT (DSHT) concepts have been proposed and tested. Two-dimensional transient hybrid model results for SSHT and DSHT concepts will be presented.

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