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VecMan – Vectorial Magnetic Nozzle

Simple solution to control the direction of the thrust vector in space plasma thrusters, with no moving mechanical parts, and without affecting the internal operation and efficiency of the thruster or the satellite operation.

Researchers from the Technical University of Madrid propose a new solution to guide a plasma jet using a steerable magnetic nozzle. Its application allows deflecting the thrust vector 10 to 15 degrees in any direction from the thruster axis. It provides greater flexibility for the space mission, allowing the compensation of thrust misalignments ***without requiring any gimballed platform****. The system is applicable to any plasma thruster compatible with a quasi-axial magnetic field, which covers many of the existing and future plasma thrusters.*

Technological solution supported by the Technical University of Madrid

Technological solution

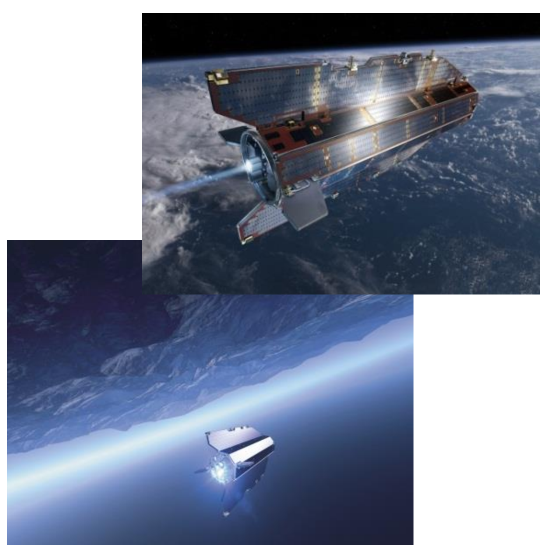
The proposed solution consists of a magnetic field generator that allows the controlled deflection of a plasma jet without any moving parts.

This constitutes a clean alternative to current solutions characterized by the presence of moving parts or naked electrodes, which unavoidably increase the weight and complexity of the system, and can deteriorate the efficiency of the thruster.

Areas of application

- **Space**: application in space missions including large institutional agencies and large contractors of space technology.

"VecMan can control the thrust vector direction from a space plasma thruster in 10-15 degrees"



Source: European Space Agency

Market demands

- **Space & Communications**

• Manufacturers and integrators of satellites and spacecraft often point the need to re-orient the thrust vector in 5 to 10 degrees during the mission. These small deflections would suffice to compensate the drifts in center of mass position that occur through the life of the satellite, as well as any manufacturing misalignments.

• Enabling thrust vector control provides greater freedom in the propulsive tasks of a mission, like the ability to use the main thruster to change the attitude, or to de-saturate the reaction wheels while thrusting. This is specially interesting for both long duration, low thrust transfer manoeuvers and orbital station keeping.

• Current solutions rely on mounting the thrusters on gimballed platforms, with high weight costs and associated complexity.

"Vectorial Magnetic thrust with no moving mechanical parts and without affecting the operation of the satellite, greatly increasing the operational capacity of the propulsive system"

Market potential

- **Space**

• In the period 2013 - 2022 operators and governments will launch an average of 115 new satellites per year to meet the demand for voice, data and broadcast [Euroconsult].

• The revenue from the manufacture and launch of these 1,150 satellites is estimated at $236,000 million [Euroconsult].

• There are currently more than 240 active satellites based in electric propulsion [Aerojet data].

• The satellite industry volume will triple between 2001 and 2012 [SIA].

• 3,164 space payloads proposed to be constructed between 2013 and 2032, with a business value of $235 billion [Satellite Markets & Research].

- **ICT, embedded systems for communications**

• In 2013, over 2.7 billion people are using internet, which corresponds to 39% of the world's population [International Telecommunication Union, ITU].

Competitive advantages

• No mechanical parts (e.g. gimbals), nor electrodes exposed to plasma.

• The concept requires only a slight modification in the magnetic field generator of those thrusters that have one (or its addition to thrusters without one)

• There is a considerable gain in simplicity, reliability, weight, and operational capacity by allowing 10-15 degrees deflection.

• Many of the space plasma thrusters existing or under development are covered, including gridded ion engines, helicon plasma thrusters, applied field magneto-plasma-dynamic thrusters (AF-MPDT), the VASMIR engine, Cylindrical Hall effect thrusters, HEMP thrusters and Hall effect thrusters with magnetic cusps.

References

- Research group with extensive experience in the field of space plasma propulsion and plasma physics, and a continued collaboration with leading companies and industry organizations worldwide.
- Active participation in multiple R & D projects related to magnetic nozzles [United States Air Force (FA8655-10-1-3085 and FA8655-12-1-2043), EU-7th (218862) and ESA (4000107292/12/NL / CO)]

IPR

- Patent applied in Spain P201331790

Development stage

- ⊕ Concept
- ○ R & D
- ○ Lab Prototype
- ○ Industrial Prototype
- ○ Production

Contact solution

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