SPACE PROPULSION SYMPOSIUM (C4)
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THE IN-SPACE PROPULSION (ISP-1) PROJECT

Abstract

In the frame of the European FP7, the In-Space Propulsion (ISP-1) project was initiated in 2009 with the objective of improving the knowledge and the techniques which are necessary for future space missions cryogenic propulsion.

ISP-1 does not focus on early launch phase, but on the technologies involved in the subsequent phases of a space mission, once the spacecraft or upper stage has already been placed in orbit. Hence the program name "In Space Propulsion", which applies to launcher upper stages, orbital transfer vehicles or space exploration. ISP-1 is mainly based on the concept of Low Thrust Cryogenic Propulsion, which was presented in previous publications.

The propulsion system is using very small propellant pumps each powered by an electric motor. The electric power can be supplied by a fuel cell. It is considered to be cheaper than a re-startable upper stage of a launcher but as a consequence of the low thrust level, the mission lasts around 1 week instead of some hours.

The ISP-1 program is structured into five main work packages which deal with various technological difficulties associated to the development of a Low Thrust Cryogenic Propulsion system. It concentrates on liquid oxygen, liquid hydrogen, and liquid methane propellants. The work packages address LOX-methane combustion, propellants energy management of low thrust propulsion system, material compatibility and tribology in liquid oxygen, hydrogen embrittlement, and electrically driven cryogenic turbopump.

The intent of the publication is to provide a summary of the activities which were initiated at the end of 2009 and describe their road map up to completion.

The combustion work package is focused on LOX-CH4 combustion for a liquid-liquid injection. The Hydrogen embrittlement activity covers innovative material with a focus on high cycle fatigue. The LOX and CH4 material compatibility activity covers material used in cryogenic pumps on both experimental and theoretical aspects. The energy management and electric pump work package will both lead to the assembly and testing of demonstration hardware in their respective field, i.e. a heat accumulator and a liquid nitrogen electrically driven pump.

Altogether these work packages serve the purpose of improving the maturity of technologies which are key elements of cryogenic space propulsion systems.