Multidisciplinary Design Optimization of Hydrogen Peroxide Monopropellant Propulsion System using GA and SQP

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Abstract

An intense simplification in production, storage and handling of hydrogen peroxide develop a renewed interest in hydrogen peroxide thrusters especially for low cost attitude control or orbit correction (orbit maintenance). Chemical decomposition, aerothermodynamics flow and structure demand different optimum conditions such as tank pressure, catalyst bed pressure, concentration of H2O2 and geometry. These parameters play important role in propulsion system's mass and performance. Discipline conflicts are solved by Multidisciplinary Design Optimization (MDO) techniques with synchronized optimization for all subsystems respect to any criteria and limitations. In this paper, monopropellant propulsion system design optimization algorithm is presented and result of the design algorithm is validated. Results of the design algorithm have been compared with data of two different operational thrusters. According to the results, the proposed model can suitably predict total mass and performance with errors below than 10%. Then, MDO framework is proposed for the monopropellant propulsion system. Optimum propellant mass, thrust level, mass flow rate, nozzle geometry, catalyst bed length and diameter, propellant tank mass, feeding subsystem mass and total mass are derived using hybrid optimization (GA+SQP) for two space missions.
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References


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