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Author: Mr. Raja Pandi Perumal
University of Luxembourg, Luxembourg , raja.pandiperumal@uni.lu

Prof. Holger Voos
University of Luxembourg, Luxembourg , Holger.Voos@uni.lu
Mr. Florio Dalla Vedova
LuxSpace Sarl, Luxembourg , dallavedova@luxspace.lu
Dr. Hubert Anton Moser
LuxSpace Sarl, Luxembourg , moser@luxspace.lu

COMPARISON OF MULTIDISCIPLINARY DESIGN OPTIMIZATION ARCHITECTURES FOR THE DESIGN OF DISTRIBUTED SPACE SYSTEMS

Abstract

Advancement in satellite technology, and the ability to mass-produce cost-effective small satellites has created a compelling interest in Distributed Space System (DSS), such as Low Earth Orbit (LEO) satellite constellations. Optimization of DSS is a complex Multidisciplinary Design Optimization (MDO) problem involving a large number of variables, and coupling relations. This paper focuses on comparing three different MDO architectures for a DSS design problem. Initially, an overview of the subsystems model, the constellation model, and the coupling relationships between the subsystems and the constellation are provided. The modelling of the subsystems and the constellation configuration are carried out in OpenMDAO, which offers up to 3 orders of magnitude faster computational performance than other MDO frameworks. Later, three monolithic MDO architectures, namely Simultaneous Analysis and Design (SAND), Individual Discipline Feasible (IDF), and Multidisciplinary Feasible (MDF) are compared by implementing them to the developed DSS model. Preliminary results indicate that MDF slightly outperforms the rest in terms of optimality but at a higher computational cost.