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# MULTI-OBJECTIVE OPTIMIZATION OF A SMALL LAUNCH VEHICLE AERODYNAMIC PAYLOAD FAIRING FOR MINIMUM DRAG AND MASS

**Abstract**

A continuation of "Multi-Objective optimization of a Small Launch Vehicle Aerodynamic Payload Fairing for Minimum Drag and Mass" study presented at 2019 IAC Conference was conducted. A small-launch vehicle payload fairing was analyzed to determine the pareto front of a multi-objective structural, aerodynamic and mass optimization. CFD (Computational Fluid Dynamics) calculations were done using ANSYS FLUENT and structural FEA (Finite Element Analysis) were done using ANSYS Mechanical. However, the design space and scope of analysis was limited by the intensive computational resources required to obtain aerodynamic performance and loading from CFD. The aerodynamics model was replaced with the computationally inexpensive Missile DATCOM 1999, a tool used for the generation of aerodynamic coefficients, and pressure loads for a launch vehicle. Therefore, the scope of the analysis is expanded to include the entire predicted vehicle flight path, rather than analyzing a single point along the flight path. The inexpensive computational cost enables a more complex B-Spline controlled geometry-generation parametric function to allow for a wider range of potential fairing geometries. The full launch-vehicle aerodynamic performance was modelled rather than the fairing in isolation. The resulting aerodynamic loads from Missile DATCOM are transferred onto a structural model in Ansys Mechanical which optimizes the thickness of the core material, number of plys and laminate directions for minimum mass. The structural-model is improved over the previous study to include the effects of non-linear buckling. The GA uses an objective function comprising of the total drag profile and the structural mass of a single design, and compares the design against the population to determine the best fit. Additional members and mutations are generated by modifying the parameter set for the fairing geometry of the fittest members of the population. The result of the optimization shows a marked improvement on the flight profile compared to the fairing optimized at a single design point.