Paper ID: 36751
student

Key Technology of Space Exploration (8)
Key Technology of Space Exploration (2)

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ADDITIVE MANUFACTURED AEROSPIKE REACTION CONTROL SYSTEM (AMARCS)

Abstract

The Additively Manufactured Aerospike Reaction Control System (AMARCS) is a small bi-propellant engine for spacecraft reaction control that utilizes a 3D printed, regeneratively cooled, aerospike nozzle. By using 3D printing, it is possible to manufacture an annular aerospike nozzle with the fuel line built into the nozzle for regenerative cooling and pre-heating of the propellants for better combustion. The additional benefits are reduced weight and engine size. AMARCS is funded by United Launch Alliance (ULA) with emphasis on the design, testing, and analysis of the complex additively manufactured parts. The project is scheduled around a two year life cycle broken into four semesters. The fall semester of 2015 was focused on trade studies and subsequently using those trade studies to develop and analyze a final design for the engine. Parts requiring additive manufacturing were outsourced to ULA's additive manufacturing department. The spring semester of 2016 was focused upon manufacturing the remaining engine parts, test stand development, plumbing design, and control software testing. The fall semester of 2016 focused on inspecting and testing the manufactured parts for dimensional accuracy, parts defects, and functionality. This semester also focused on assembly of the entire engine, injector atomization testing, refining cold flow test procedures, and eventually a cold flow test. The spring semester of 2017 will be focused on a static test fire and post processing of all data collected for delivery to ULA.