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5219 Ed Coy, Doug Talley, Jonathan Watts, "Pulse Combustion Rockets for Space Propulsion Applications"

41st AIAA Aerospace Sciences Meeting & Exhibit (Statement A)
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Abstract for 41st AIAA Aerospace Sciences Meeting

Pulse Combustion Rockets for Space Propulsion Applications

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Pulse combustion propulsion devices are currently being considered as alternatives to conventional constant-pressure engines. Potential advantages include reduction or elimination of pumps and/or compressors, and improved Isp for a given feed system supply pressure. In this paper we compare pulse combustors, or constant-volume engines, with pulse detonation engines and discuss why in some applications the former may be the preferred cycle. A model is presented for a monopropellant-fueled, constant-volume, pulse combustor which includes finite-rate processes for injection, heat release and exhaust. The model is used to explore the time and dimensional scales of the device and to predict performance and optimal geometry. The pulsed propulsion device is found to have nearly identical specific impulse as the steady-state engine operating with the same mass flow and throat area, and the nozzle optimizes at the same area ratio. Pulsed combustor behavior is found to depend on two time scales: the ratio of the heat release time to the chamber blow-down time, and the ratio of the blow-down time to the injector pulsing period. We briefly consider the application of pulse combustion devices in pressure-fed satellite propulsion systems and examine the effect on satellite mission.