Return to the Moon (02)
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FLUID STREAM MOMENTUM TRANSFER FOR HIGH-EFFICIENCY ORBITAL MANEUVERING OF SPACECRAFT

Abstract

For three decades, engineers have studied the utility of using droplet streams projected over a short distance to remove heat from large structures in space. The same droplet streams that provide cooling when aimed toward an on-board collector can be used for exchanging momentum between spacecraft that pass close enough for droplet transfer. This study considers ionic liquids that have low vapor pressures and remain in a liquid state over a wide temperature range. The ability of ionic fluids to absorb heat without vaporization or breakdown makes it possible to collect ionic fluid streams in space at relatively high speed without significant fluid loss. High-speed fluid collection enables momentum transfer between spacecraft travelling at relative velocities approaching 1500 m/s without fluid vaporization. Four applications of momentum transfer between spacecraft were analyzed in this study. Each application reduces the amount of spacecraft propellant otherwise needed to perform the particular mission. The last scenario analyzed in this study is the transfer of fluid from the surface of Earth's moon to a spacecraft landing on the moon. Transfer of fluid from the moon to a landing spacecraft significantly reduces the amount of propellant required for lunar missions and could enable launch of lunar missions by a single Delta Heavy class vehicle. Approximately 10,000 kg of fluid on the moon is sufficient to slow typical landing craft and fluid is recovered and reused during each landing. The same fluid supply could also serve as a coolant for a nuclear reactor or other energy conversion system. Based on current low-end advertised trans-lunar orbit launch costs, savings are over $300M for each landing and subsequent launch from the moon's surface. This equates to billions in savings over the life of a lunar
*situ synthesis of fluids, once celestial bodies would further reduce transportation costs and eliminate the need for the pre-
positioning of fluid. Fluid production on the moon could prove to be a cost effective activity. Production of combustible ionic flui*