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M1Or4A-06: [Invited] Impacts of Liquified-Petroleum-Gas (LPG) and Liquid-H2 Cryogenic Fuels to improve the Performance and Thermal Management of Aerospace Vehicles

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Alternative families of propulsion fuels such as hydrogen, the liquified-petroleum-gas (LPG) family (methane, ethane, propane, butane, other), alcohols of hydrocarbons (methanol, ethanol, propanol, other), natural gas, biofuels, and other, are increasingly being considered for transportation industries and applications, including shipping, aerospace and rocket propulsion. And the cryo-cooled versions of these fuels are being studied for transportation, since their higher volume densities critically affect cost, viability and performance benefits. The use of liquified-natural-gas (LNG) or bio-LNG with (˜ > 98% methane content) has strong benefits for transportation, including ˜ 30 % higher energy-per-mass, greatly reducing thermal-management-system (TMS) hardware needed with direct cooling, lower average cost, very high domestic reserves, and broadly located production and distribution piping networks. However, LNG has the drawback of ˜ 40 % lower volume density than petrol or kerosene fuels including JP8. The family of LPG gases other than methane (bio-LNG) have relatively unknown properties of similar benefits to methane of ˜ 25-30 % higher energy density than JP8, however without the drawbacks of lower volume density that methane has.
This talk will be present about general properties of alternate families of cryogenic fuels, and the benefits for performance and thermal management focusing mostly on aerospace applications. Relatively unknown fuels and properties will be presented, such as liquid mixtures that have freezing points as low as ˜ 63K, that can enable significantly higher power density and more efficient cryogenic power electronics using ultra-pure metals and superconductors. Cryogenic fuels also have important system benefits to provide much larger lift capacities even ˜ 4-100 x than JP8, which will be important to address the increasingly larger and low-temperature thermal loads resulting from increasing electrification of propulsion.
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