Paper ID: 76072
oral

IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (1) (3)

Author: Ms. Hessa Almarzooqi
Technology Innovation Institute (TII), United Arab Emirates

Dr. Ozan Kara
Technology Innovation Institute (TII), United Arab Emirates

IN-SITU PROPELLANT DESIGN FOR MOON AND MARS EXPLORATION USING HYBRID ROCKETS

Abstract

With the development of the space sector in recent years, new entrepreneurship companies have emerged. Executive summary by BryceTech supported this argument in their start-up report as 15.4 billion dollars invested in 2021 across 241 deals (and investments are doubled in 2021 compared to 2020). These companies focus on as small satellites, high-tech materials, cyberspace, artificial intelligence applications and low-cost launch vehicles. Among them, "low-cost launch vehicle systems" is required for sustainable deep space transportation as well as the in-situ rocket systems for the Moon and the Mars. Because, after going to the Moon or the Mars, in-situ propellants are absolutely needed for Earth-return or surface transportations. Thus, hybrid propulsion offers safe, reliable, non-hazardous and cost-effective system compared to both liquid and solid systems. Hybrids can also operate at really low temperatures that features makes hybrids quite practical for Martian (or Lunar) operations. In this research, in-situ propellant options for in-situ Moon and Mars launch vehicles, are evaluated using hybrid propulsion system. Proposed propellant for Mars includes liquid state CO2 as the oxidizer, and Paraffin/Magnesium mixture is the fuel. Nitrous oxide and liquid oxygen are also discussed as the potential oxidizer compound for Martian operations. Aluminum/Paraffin mixture is another candidate for the fuel side for the Mars. For the moon, Silica/Oxygen based propellant is investigated for this research. Literature review of possible hybrid rockets for ascent vehicles are also discussed. Advantages of the proposed systems over liquid and solid rockets are also presented with a propellant optimization by using CEA tool.