IAF SPACE PROPULSION SYMPOSIUM (C4)
Solid and Hybrid Propulsion (2) (4)

Author: Dr. Landon Kamps
Letara Ltd., Japan

Mr. Shota Hirai
Letara Ltd., Japan
Mr. Toku Sakai
Letara Ltd., Japan
Mr. Yuki Nobuhara
Letara Ltd., Japan
Dr. Marco Rotondi
Letara Ltd., Japan
Mr. Yasuhiro Fukumoto
Letara Ltd., Japan
Mr. Kazumasa Yamamoto
Letara Ltd., Japan
Prof. Harunori Nagata
Letara Ltd., Japan

SCALABLE HYBRID ROCKET SYSTEMS FOR AGILE AND AFFORDABLE IN-SPACE PROPULSION

Abstract

Spacecraft launches have increased in frequency from a few dozen per year in 2013 to a few thousand per year in 2023. This drastic increase was made possible by ridesharing numerous small spacecraft in place of a few large spacecraft. As a result, a new demand for chemical propulsion systems has also emerged, to allow for transfer from the rideshare orbits to more desirable orbits. Here we have a serious concern over safety because existing chemical spacecraft propulsion systems are essentially smaller versions of the launch vehicles' engines. This means they have the same inherent risk of explosion because they use the same or similar flammable and explosive liquid fuels. The creation of an inherently safe propulsion system with similar thrust to existing systems that is inherently non-flammable and non-explosive is necessary to drastically improve space transportation safety and thus truly unlock the potential of both the human and cargo commercial space sector.

The hybrid chemical rocket configuration, historically the most overlooked and underdeveloped chemical rocket configuration, may in fact be the most relevant for drastically improving space transportation safety right now. The hybrid is structurally simple like the solid yet has the shutdown and restart capability of the liquid. Most importantly, the hybrid is inherently non-flammable and non-explosive. Not only are hybrids inherently simpler and safer to build, test and operate than solid and liquid rockets, but they are highly scalable, storable, and throttleable.

Several startups worldwide are developing hybrid rockets to improve safety and lower the cost of Earth launches. However, there are fewer organizations who are working to advance hybrid rocket technologies specifically for in-space propulsion applications. Since 2017, the authors have been leading in the develop of technologies necessary for dual-mode, throttleable, restart capable, and scalable hybrid chemical propulsion systems that will be applicable to all foreseeable chemical propulsion needs for in-space propul-

sion. We will report of progress from the past six years of development and plans for qualification and implementation of these technologies in future missions. Moreover, we will introduce new state-of-the-art space propulsion testing facilities being constructed in Hokkaido, Japan.