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Effects of throttling on the spray injection performance in a small LRE-injector

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Summary

An injector plays an important role in the process of an efficient combustion in liquid-rocket engines (LRE) because it affects the evaporation rate of liquid fuel through spatial distribution and atomization of spray droplets. This paper is focused on the injection performance of a small LRE-Injector by employing the spray characteristic parameters made up of the velocity components, mean diameter, turbulence intensity, span (width of drop size distribution), number density, and volume flux of spray droplets. An experimental investigation is carried out with the aid of a dual-mode phase Doppler anemometry (DPDA) according to the injection pressure variation and along transverse and longitudinal axes, spatially. As the injection pressure increases, the velocity, turbulence intensity, span, number density, and volume flux become higher, whereas the droplet sizes such as arithmetic mean diameter (AMD) and Sauter mean diameter (SMD) get smaller. Also, it is clearly shown that the magnitudes of those parameters are smoothed out by dispersion when the spray droplets travel toward downstream along the longitudinal axis. It is another observable consequence that velocity and volume flux are mostly proportional to the SMD. The local spray-breakup characteristics examined in the present study are useful directly for the validation of injector performance and it may further provide an empirical background for the design of a brand-new thruster.

keywords: Liquid Rocket Engine (LRE), Injector, Spray Droplet, Atomization, Dual-mode Phase Doppler Anemometry (DPDA)

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