Key Technologies (7)
Key Technologies (1) (1)

Author: Mr. BHUSHAN THOMABRE
SRM Institute of Science and Technology, India, bhushanthombare10121999@gmail.com

Mr. Saumya Shekhar
SRM Institute of Science and Technology, India, sr5183@srmist.edu.in
Mr. Vinayak Malhotra
SRM University Chennai, India, vinn99@gmail.com
Mr. Mohammed Abrar Nizami
IIIT Madras, India, abrarn17@gmail.com

EFFECT OF ADJUNCT HEAT SOURCES AND HEAT SINKS ON SPACECRAFT PERFORMANCE

Abstract

Combustion is critically important and forms an established energy part of aerospace propulsion. Improving the propulsive efficiency by controlling the external factors has been an active area of research for most of terrestrial and extraterrestrial systems. Appreciable work had been done but complexity of the problem has prevented thorough understanding due to heterogeneous heat and mass transfer. The severe testing issues like, difficult to gain true replication in controlled environment, challenging to design testing facility with structural integrity to withstand massive thrust, inept safety provisions to protect against destructive unplanned engine detonation, massive noise pressure level and environmental hazards with hazardous plume, have increased the restrictions in prediction of the uneven energy transfer. On record, severe issues have surfaced amounting to irreplaceable loss of mankind, instruments, facilities, and huge amount of money being invested every year making it mandatory to develop significant correlations for effective lab-large scale testing for futuristic missions. Enhanced combustion understanding for effective, safer operations and minimization of hazards/safety are the most prevalent research aspects to evolve superior propulsion systems. The combustion process is always assisted by the presence of external heat source(s)-heat sink(s) coupling and it is necessary to understand the mechanisms by which the combustion process re-establishes. The dominance of the external energy source(s) is likely to decide the relative aerospace propulsion performance. Better understanding of this coupled phenomenon will induce higher safety standards, efficient missions, reduced hazards risks, with better designing, validation and testing. The coupled effect of external heat source and heat sink on the burning process in combustible surfaces is an aspect yet to be comprehensively articulated. Present work proposes to fundamentally understand the controlling mechanism through systematic lab scale experimentation followed by numerical study for validation. The experimentation would comprise of utilization of thin solid viz., incense sticks, paraffin wax candles and gaseous fuels (hydrocarbons). The work involves investigations on the combustion behavior in presence of coupled external heat source(s) and heat sink(s) under varying conditions of, linear and non-linear spatial configurations, temporal/unsteady analysis of energy transfer prediction, varying fuels and arrays configurations. Different configurations of external heat sources and heat sinks will be experimented under diverse conditions and changes in the pilot fuel combustion rates would be systematically assessed. The combustion characteristics viz., flame spread rates, regression rates and thermal decomposition using TGA analysis would be studied followed by the numerical simulation analysis for validation. The work is motivated by the need to have enhanced combustion understanding and fire safety for better testing, validation and designing of futuristic missions under varying conditions. To optimize propulsive designs for effective performance and minimization of current shortcomings. The results are likely to help in devising

accurate energy prediction systems by developing appropriate correlations based on the experimental and numerical results for effective energy transfer prediction and thus better and safer missions.