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Short Abstract
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SCRAMJET: Future High Speed Aircraft

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Abstract: In the current era of technological advancement, the scramjet has become one of the most conventional engines for achieving supersonic speeds in aircraft. The scramjet comprises three basic components: the inlet, combustor, and nozzle. Various fuels, such as Kerosene, JP-7, JP-8, hydrocarbon-based fuels, and hydrogen, have been used in scramjets, demonstrating distinct performance characteristics. Tests have shown that hydrocarbon-fueled scramjet engines can achieve a Mach number range of 3.5 to 7, while solid-fueled scramjets have the potential to achieve combustion efficiencies of 0.7–0.9. Fuel injection and mixing techniques were applied in the combustor to enhance thrust and pressure ratios. Advanced injection methods were incorporated into the strut or walls of the combustor to improve combustion efficiency. The air intake capability of the scramjet depends on the inlet design, which should aim to minimize spillage drag and ensure adequate shock train formation. The flamelet approach has demonstrated improved combustion performance and maximized fuel efficiency through the effective placement of the flamelet. Additionally, the flamelet approach optimizes fuel mixing and injection processes within the supersonic flow. By employing a dual-mode scramjet isolator, an equivalence ratio range of 0.06–0.32 was achieved during the transition from supersonic to subsonic combustion. Combustion analysis revealed the behavior of the combustor when using jet fuels and additives. CFD data indicated that incomplete combustion releases harmful gases, such as carbon monoxide and nitrogen oxides, while complete combustion produces stable by-products like water and carbon dioxide. These issues are often attributed to inadequate air-fuel mixing or insufficient air supply. Simulations highlighted the need for improvements in combustor design to prevent thermal choking under specific conditions.

Keywords: Scramjet, Hypersonic, Supersonic, Computational Fluid Dynamic.

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