World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:13, No:07, 2019

Mathematical Analysis of Variation in Inlet Shock Wave Angle on Specific Impulse of Scramjet Engine

Authors : Shrikant Ghadage

Abstract : Study of shock waves generated in the Scramjet engine is typically restricted to pressure, temperature, density, entropy and Mach number variation across the shock wave. The present work discusses the impact of inlet shock wave angles on the specific impulse of the Scramjet engine. A mathematical analysis has done for the isentropic hypersonic flow of air flowing through a Scramjet with hydrogen fuel at an altitude of 30 km. Analysis has been done in order to get optimum shock wave angle to achieve maximum impulse. Since external drag has excluded from the analysis, the losses due to friction are not considered for the present analysis. When Mach number of the airflow at the entry of the nozzle reaches unity, then that flow is choked. This condition puts limitations on increasing the inlet shock wave angle. As inlet shock wave angle increases, speed of the flow entering into the nozzle decreases, which results in an increase in the specific impulse of the engine. When the speed of the flow at the entry of the nozzle reduces below sonic speed, then there is no further increase in the specific impulse of the engine. Here the Conclusion is the thrust and specific impulse of a scramjet engine, which increases gradually with an increase in inlet shock wave angle up to the condition when airflow speed reaches sonic velocity at the exit of the combustor. In addition to that, variation in drag force at the inlet of the scramjet and variation in hypersonic flow conditions at every stage of the scramjet also studied in order to understand variation on flow characteristics with respect to flow deflection angle. Essentially, it helps in designing inlet profile for the Scramjet engine to achieve optimum specific impulse.

Keywords : hypersonic flow, scramjet, shock waves, specific impulse, mathematical analysis
Conference Title : ICAPES 2019 : International Conference on Aerospace, Propulsion and Energy Sciences
Conference Location : Stockholm, Sweden
Conference Dates : July 15-16, 2019