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Flow Field Analysis of Different Intake Bump (Compression Surface) Configurations on a Supersonic Aircraft

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Abstract : This paper presents modeling and analysis of different intake bump (compression surface) configurations and comparison with an existing supersonic aircraft having bump intake configuration. Many successful aircraft models have shown that Diverter less Supersonic Inlet (DSI) as compared to conventional intake can reduce weight, complexity and also maintenance cost. The research is divided into two parts. In the first part, four different intake bumps are modeled for comparative analysis keeping in view the consistency of outer perimeter dimensions of fighter aircraft and various characteristics such as flow behavior, boundary layer diversion and pressure recovery are analyzed. In the second part, modeled bumps are integrated with intake duct for performance analysis and comparison with existing supersonic aircraft data is carried out. The bumps are named as uniform large (Config 1), uniform small (Config 2), uniform sharp (Config 3), non-uniform (Config 4) based on their geometric features. Analysis is carried out at different Mach Numbers to analyze flow behavior in subsonic and supersonic regime. Flow behavior, boundary layer diversion and Pressure recovery are examined for each bump characteristics, and comparative study is carried out. The analysis reveals that at subsonic speed, Config 1 and Config 2 give similar pressure recoveries as diverterless supersonic intake, but difference in pressure recoveries becomes significant at supersonic speed. It was concluded from research that Config 1 gives better results as compared to Config 3. Also, higher amplitude (Config 1) is preferred over lower (Config 2 and 4). It was observed that maximum height of bump is preferred to be placed near cowl lip of intake duct.

Keywords : bump intake, boundary layer, computational fluid dynamics, diverter-less supersonic inlet
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