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# PARAMETER RESEARCH OF MHD CONTROLLED INLET AND THE VISCOUS EFFECTS ANALYSIS

**Abstract**

The scramjet inlet is usually designed for a specified flight mach number to satisfy the shock-on-lip condition, at off-design mach numbers, performance of the engine will severely decline. MHD controlled inlet has the potential to resolve the problem. At flight Ma number regime of 6 10, the inlet could be designed at Mad=6, and use a MHD generator to move the shocks back to the cowl lip when the flight Ma number is high than the design value. Two-dimensional numerical simulations indicated that the MHD generator mounted on the upper ward of the compression ramps can slow down the flow, and make the shocks back to the cowl lip, but will loss some total pressure. The numerical and experimental investigations carried out at the Ioffe Physico-Technical Institute in collaboration with the Johns Hopkins University show the possibilities of an effective control of the shock wave structure of supersonic gas flows by MHD method. The Princeton University has done some qualitative analysis about the choosing of the MHD interaction location, but no detailed parameter analysis has been done. These researches concluded that the MHD controlled inlet is promising, but viscous effect was not considered. Theory and practice all show that the viscous effect is important in the hypersonic inlet, and has to been considered. Two-dimensional inviscid steady-state flow equations coupled with MHD effects are solved jointly with MHD equations to research the performance of an MHD controlled inlet when flight Mach number is larger than the design value. At a proper choice of parameters the shocks are moved back to the cowl lip, and the outlet parameters became evener. The influence of the MHD interaction location, width and depth to the MHD controlled inlet have been analyzed, the calculations show that, if technical condition allow, to make the outlet flow evener the MHD region should be placed upper stream and probe into the flow deeper. With a wider MHD interaction region, smaller magnitude of the magnetic induction is needed to move the shocks back to the cowl lip. Base on the inviscid results, a group of optimized parameters were chosen to research the viscous effects of the MHD controlled inlet. Results show that the MHD controlled inlet can depress the boundary layer separation, and make the flow in the inner inlet back to the design state.