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燃烧加热污染空气对煤油超燃冲压发动机性能的影响

Effects of combustion heating vitiated air on kerosene-fueled scramjet performance

投稿时间: 2012-10-31

DOI:

中文关键词: [超燃冲压发动机](#) [煤油燃料](#) [燃烧加热](#) [污染效应](#) [数值计算](#)英文关键词: [scramjet](#) [kerosene fuel](#) [combustion heating](#) [vitiating effect](#) [numerical calculation](#)

基金项目: 西北工业大学科技创新基金(2012KJ01004)

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中文摘要:

针对目前超燃冲压发动机地面试验设备普遍存在的工质污染问题,采用经过验证的数值计算方法开展了燃烧加热污染空气对煤油超燃冲压发动机性能的影响研究.以飞行马赫数为6.0作为基准状态,分别对纯净空气来流和不同参数匹配方案的污染空气来流下发动机整机流场和性能进行了数值模拟.计算结果表明:在压力参数中选择匹配静压时最接近于纯净空气来流的结果,选择匹配总压时差别最大;在温度参数中选择匹配静温时最接近于纯净空气来流的结果,选择匹配总温时差别最大;压力参数匹配选择的影响更具有决定性作用,需要优先考虑.研究结果可为认识整机污染效应影响,确定污染空气来流下地面试验模拟准则提供理论依据.

英文摘要:

For the problem of test media vitiation associated with scramjet ground test facility, the effects of combustion heating vitiated air on kerosene-fueled scramjet performance were investigated with validated numerical approach. Under the simulating condition of flight Mach 6.0, the flow-field and performance of the scramjet were numerically calculated with clean free airstream and vitiated free airstream, respectively. Several matched parameter schemes for vitiated free airstream relative to clean air were considered. It indicates that among the pressure-interrelated parameters, the least discrepancy resulting from vitiation effects is found when the static pressure is matched, while the most discrepancy is found when the total pressure is matched; among the temperature-interrelated parameters, the least discrepancy resulting from vitiation effects is found when the static temperature is matched, while the most discrepancy is found when the total temperature is matched. As for the vitiation effects of combustion heating vitiated air, selection of pressure-interrelated parameters to be matched is more significant than selection of temperature-interrelated parameters. The present efforts can provide theoretical basis for understanding the vitiation effects on the scramjet and determining the simulation rules of ground test with vitiated free airstream.

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