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ONE DIMENSIONAL MODEL SIMULATION OF SRAMJET ENGINE BASED ON MULTI-CORE PARALLEL COMPUTATION

Abstract

At the time of control system design, an appropriate engine model could greatly shorten design cycle and reduce costs in research and development. Control-oriented scramjet computational model is required to have relatively high accuracy, speed and stability. Zero dimensional model has fast calculating speed,but its accuracy is poor.And the state of supersonic flow field and combustion field cannot be described by it.On the contrary, two or three dimensional model is high in precision but slow in speed because of enormous computational scale.By contrast, one dimensional(1D) model balances the contradictory between accuracy and speed.It reflects the main characteristic information of scramjet flow field, which is the primary tool for performance simulation.But the existing 1D model adopt serial calculation method and costs much time.In this paper ,divided into 70 grids, the 1D model of the scramjet isolation segment and combustor was studied.Optimized by algorithm and compilation, the single cycle calculation time of this model is 100 120ms on industrial simulator. This is the upper limit of the computational speed of this 1D serial model, however, it cannot meet the real-time requirements.Based on this model, a multi-core parallel computing method was proposed.In the high-performance digital signal processor called TMS320C6678, the model was decomposed into seven parts on average and each part was assigned to a processor core to run in parallel.Each processor core calculated independently ,and inter-core communication was carried out in every small cycle.By improving the data communication mode and increasing the boundary overlap area, the rate of calculation and convergence was improved dramatically.A large number of simulation results prove that the parallel model computation time is less than 30ms, reduced by more than 70