

论文

三维激光烧蚀流体界面不稳定性程序的并行化

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摘要:

在共享存储并行机和MPP并行机上,基于MPI(MessagePassingInterface)并行编程环境,本文研究三维激光烧蚀界面不稳定性程序(Lared-S)的并行实现.三维激光烧蚀的数值模拟采用分裂方法,其90%以上的计算负载存在于流体方程和热传导方程的求解(流体方程的求解采用分裂显格式,热传导方程的求解采用分裂隐格式).本文给出基于三维分裂格式的交替平面数据通信模式.分裂隐格式的求解转化为三对角方程组的求解,其并行实现采用块流水线并行算法.数值实验结果表明交替平面数据通信策略和块流水线并行算法是有效且可扩展的.在共享存储并行机上,应用64台处理机获得93%以上的并行效率;在MPP并行机上,应用128台处理机获得90%以上的并行效率.

关键词:

PARALLEL IMPLEMENTATION OF 3D LASER ABLATIVE FLUID INTERFACE INSTABILITY CODE

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Abstract:

This paper studies the Parallel implementation of 3D laser ablative fluid interface instability (Lared\_S) by splitting method based on Message Passing Interface(MPI) on shared memory parallel computer and MPP parallel computer respectively. More 90% computational workload of Lared\_S code exists in fluid computing by split explicit scheme and heat conduction computing by split implicit scheme. This paper gives the paradigm of alternation plane data communication strategy based on split method in 3D computing. Block pipeline technology is applied in triangular sparse matrix solver in heat conduction computing by split implicit scheme. Numerical results have shown that the alternation plane data communication strategy and block pipeline parallel method applied are effective and scalable. More than 93% parallel efficiency is achieved on shared memory parallel computer with 64 processors and more than 90% parallel efficiency is obtained on MPP parallel computer with 128 processors.

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