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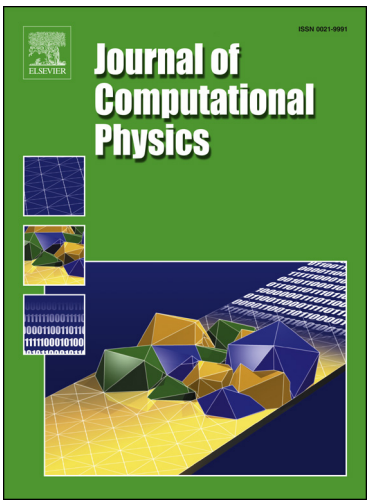

A Gridfree Scheme for Simulation of Natural Convection in Three Dimensions

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PII: S0021-9991(18)30304-8
DOI: https://doi.org/10.1016/j.jcp.2018.05.012
Reference: YJCPH 8011

To appear in: *Journal of Computational Physics*

Received date: 19 October 2017
Revised date: 22 March 2018
Accepted date: 7 May 2018

Please cite this article in press as: J.P. Collins, P.S. Bernard, A Gridfree Scheme for Simulation of Natural Convection in Three Dimensions, *J. Comput. Phys.* (2018), https://doi.org/10.1016/j.jcp.2018.05.012

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ACCEPTED MANUSCRIPT

A Gridfree Scheme for Simulation of Natural Convection in Three Dimensions

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Abstract

The gridfree vortex filament method (VFM) is extended to the treatment of three-dimensional flows including heat transfer and natural convection. A class of energy particles accounting for the temperature over and above the ambient are added to the vortex tubes in the VFM. Successful implementation of the algorithm requires advances in code acceleration via parallelization of computation, storage and load balancing, improvements to the specification of loop removal and the development of a least-square scheme for baroclinic generation of vortex tubes. Tests of the methodology are carried out for the rise of elliptically shaped heated regions due to natural convection and comparison to previous grid-based calculations.

Keywords: Vortex methods, natural convection

1. Introduction

A main impetus for developing gridfree vortex filament methods (VFM) for simulating turbulent flow [1, 2] derives from their comparatively small exposure to the debilitating effects of numerical diffusion that lowers the effective Reynolds numbers in under-resolved mesh-based computations. VFM's repre-

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