Proceedings of the 8th International Symposium on Radiative Transfer, RAD-16
June 6-10, 2016, Cappadocia, Turkey

RAD-16-P03

SOLVER EVALUATION FOR COMPUTING THE RADIATIVE TRANSFER EQUATION USING FINITE VOLUME METHOD AND BLOCK STRUCTURED MESHES

Flavia C. Miranda* and Johannes Janicka*
*Technische Universität Darmstadt
Jovanka-Bontschits-Str. 2
64287 Darmstadt, Germany

ABSTRACT. The finite volume method (FVM) is implemented to solve the radiative transfer equation (RTE) in complex 3D geometries using block structured grids. The FVM is one of the most widely used methods and presents a good compromise between accuracy and computational requirements. The numerical study of the RTE in flexible and complex grids is important for enabling the incorporation of radiation effects into the prediction of heat transfer in real industrial problems. In the standard solution algorithm, the discrete set of algebraic equations in the FVM is solved using the Gaus-Seidel method with the mesh sweeping algorithm. This algorithm gives an optimal order in which the control volumes are visited and the calculations are performed. In this method, the radiative intensity is first computed for all directions, then the boundary conditions are updated and the iteration process is employed until a convergence criterion is fulfilled. However, when dealing with complex geometries and block structured grids, the mesh sweeping algorithm fails because an optimal marching order can not be determined for all blocks. More iterations are therefore necessary to reach the convergence criterion. To the authors knowledge, this problem has not been reported yet and is the motivation for this work. Hence, we propose to investigate the performance of several different linear solvers as an alternative to the Gaus-Seidel method and sweeping algorithm. The configuration investigated in this work is a real combustion chamber with a block structured grid with approximately one million grid points. A temperature distribution was fixed inside and on the boundaries of the chamber. The radiative heat source term was calculated and the computational time required for each solver was measured. The results show that it is possible to have a gain of up to 15 % in comparison to the computational time required by the Gaus Seidel method and sweeping algorithm.