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Data Centers' Temperature Profile Simulation Optimized by Finite Elements and Discretization Methods

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Abstract : Nowadays, data center industry faces strong challenges for increasing the speed and data processing capacities while at the same time is trying to keep their devices a suitable working temperature without penalizing that capacity. Consequently, the cooling systems of this kind of facilities use a large amount of energy to dissipate the heat generated inside the servers, and developing new cooling techniques or perfecting those already existing would be a great advance in this type of industry. The installation of a temperature sensor matrix distributed in the structure of each server would provide the necessary information for collecting the required data for obtaining a temperature profile instantly inside them. However, the number of temperature probes required to obtain the temperature profiles with sufficient accuracy is very high and expensive. Therefore, other less intrusive techniques are employed where each point that characterizes the server temperature profile is obtained by solving differential equations through simulation methods, simplifying data collection techniques but increasing the time to obtain results. In order to reduce these calculation times, complicated and slow computational fluid dynamics simulations are replaced by simpler and faster finite element method simulations which solve the Burgers‘ equations by backward, forward and central discretization techniques after simplifying the energy and enthalpy conservation differential equations. The discretization methods employed for solving the first and second order derivatives of the obtained Burgers‘ equation after these simplifications are the key for obtaining results with greater or lesser accuracy regardless of the characteristic truncation error.

Keywords : Burgers' equations, CFD simulation, data center, discretization methods, FEM simulation, temperature profile
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