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Finite Volume Method for Simulating the Resistance for Heating of a Rectangular Metal Sheet

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Abstract

The Finite Volume Method (FVM), as many other numerical methods, can be applied to obtain the numerical solutions for the systems that are governed by the conservation laws. Generally, it is an extremely difficult or impossible task to find out the analytical solutions for many PDE models in 2-D or higher dimensional spaces. This research was conducted to simulate the heat transfer of a rectangular metal sheet using Finite Volume Method. The electric current is supplied to a copper rod, which perfectly touches the given rectangular piece of metal by one end. According to the resistance of the copper rod the heat is generated and then it flows through the piece of metal. Electric potential satisfies the Laplace equation, then the heat generation term can be calculated for each grid point on the copper rod. A structured mesh was used for the whole domain. Thermal conductivity, specific heat capacity and electrical resistivity are considered to be temperature dependent physical quantities. By applying conservation law of energy, the power balance equation is derived and then the Finite Volume Method was used to solve this equation numerically for all grid points on the mesh. Method of manufactured solutions can be used as a programme and method verification technique for this problem. The results show that the temperature near the middle of the copper rod is higher than all other grid points.

Key words: *Finite volume method, structured mesh, Method of manufactured solutions*

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