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Analysis of an Error Estimate for the Asymptotic Solution of the Heat Conduction Problem in a Dilated Pipe

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Abstract : Subject of this study is the stationary heat conduction problem through a pipe filled with incompressible viscous fluid. In previous work, we observed the existence and uniqueness theorems for the corresponding boundary-value problem and within we have taken into account the effects of the pipe's dilatation due to the temperature of the fluid inside of the pipe. The main difficulty comes from the fact that flow domain changes depending on the solution of the observed heat equation leading to a non-standard coupled governing problem. The goal of this work is to find solution estimate since the exact solution of the studied problem is not possible to determine. We use an asymptotic expansion in order of a small parameter which is presented as a heat expansion coefficient of the pipe's material. Furthermore, an error estimate is provided for the mentioned asymptotic approximation of the solution for inner area of the pipe. Close to the boundary, problem becomes more complex so different approaches are observed, mainly Theory of Perturbations and Separations of Variables. In view of that, error estimate for the whole approximation will be provided with additional software simulations of gotten situation.

Keywords : asymptotic analysis, dilated pipe, error estimate, heat conduction
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