Shape Determination of Unsteady Natural Convection Fields

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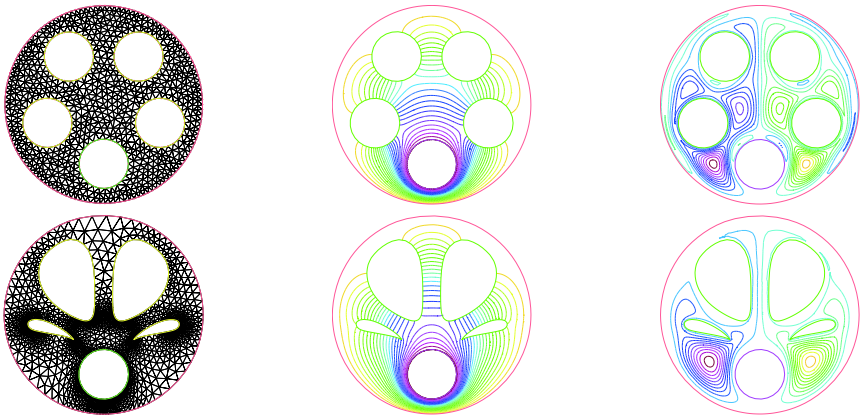
ABSTRACT

This paper presents a numerical analysis method for two shape determination problems, namely, prescribing the temperature history distribution on sub-boundaries and maximizing the discharged heat on sub-boundaries of unsteady natural convection fields. The square error integral between the actual temperature distribution and the target temperature distribution on the sub-boundaries during a specified period of time was used as the objective functional for the prescribed temperature history distribution. The shape gradients of these shape determination problems were derived theoretically using the Lagrange multiplier method, adjoint variable method, and the material derivative formulae. Reshaping was performed by the traction method[1], which was proposed as an approach for solving shape optimization problems. Numerical analyses programs for the shape determination problems were developed based on FreeFem++, and the validity of proposed method was confirmed by results of two-dimensional numerical analyses.



(a)Mesh (b)Distribution of temperature (c)Stream line

Figure 1: Numerical results: Mesh and distribution of temperature and stream line for initial shapes(upper side) and optimum shapes (lower side) for heat discharge maximization problem

REFERENCES

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