Solving an inverse coupled conjugate heat transfer problem by an adjoint approach

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ABSTRACT

Conjugate Heat Transfer (CHT) occurs when heat is transferred between a fluid and a solid and may be solved in a partitioned manner where separate solvers are used for both domains. Partitioned methods require the use of coupling iterations between solvers and exchange of boundary conditions at the interface to reach the exact solution where temperature and heat flux are continuous between the two domains [1].

In this work we look at an inverse problem related to a flat plate put in thermal contact with a fluid. The temperature at the bottom wall of the plate is unknown and needs to be inferred from the temperature measured at the interface with the fluid which is at the top of the flat plate. We solve the inverse problem using a gradient based approach. An objective function is defined as the difference between the measured interface temperature and an interface temperature obtained from an imposed bottom wall temperature. The objective is satisfied when the unknown bottom wall temperature is equal to the imposed temperature.

The gradient of the objective function is obtained through an adjoint approach. It requires the differentiation of the partitioned CHT method, which is achieved through algorithmic differentiation. The results show that the adjoint method can effectively be used to solve inverse problems and pave the way for tackling shape optimization problems involving CHT.

REFERENCES

[1] Tom Verstraete and Sebastian Scholl *Stability analysis of partitioned methods for predicting conjugate heat transfer*. International Journal of Heat and Mass Transfer, 101 (2016), pp (852-869).