Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Adjoint analyses of enhanced solidification for shape optimization in conjugate heat transfer problem KENICHI MORIMOTO, HIDENORI KINOSHITA, YUJI SUZUKI, The University of Tokyo — In the present study, an adjoint-based shape-optimization method has been developed for designing extended heat transfer surfaces in conjugate heat transfer problems. Here we specifically consider heat conduction-dominated solidification problem under different thermal boundary conditions: (i) the isothermal condition, and (ii) the conjugate condition with thermal coupling between the solidified liquid and the solid wall inside the domain bounded by the extended heat transfer surface. In the present shape-optimization scheme, extended heat transfer surfaces are successively refined in a local way based on the variational information of a cost functional with respect to the shape modification. In the computation of the developed scheme, a meshless method is employed for dealing with the complex boundary shape. For high-resolution analyses with boundary-fitted node arrangement, we have introduced a bubble-mesh method combined with a high-efficiency algorithm for searching neighboring bubbles within a cut-off distance. The present technique can be easily applied to convection problems including high Reynolds number flow. We demonstrate, for the isothermal boundary condition, that the present optimization leads to tree-like fin shapes, which achieve the temperature field with global similarity for different initial fin shapes. We will also show the computational results for the conjugate condition, which would regularize the present optimization due to the fin-efficiency effect.

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Date submitted: 29 Jul 2016 Electronic form version 1.4