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A meshless solution of binary alloy solidification

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This paper explores the application of the mesh-free Local Radial Basis Function Collocation Method (LRBFCM) [1] in solution of coupled heat transfer and fluid flow problems associated with solidification of a binary alloy. The involved temperature, velocity, species and pressure fields are represented on overlapping sub-domains through collocation by using multiquadrics Radial Basis Functions (RBF). The involved first and second derivatives of the fields are calculated from the respective derivatives of the RBF's. The energy and momentum equations are solved through explicit time stepping. The pressure-velocity coupling is calculated iteratively, with pressure correction, predicted from the local continuity equation violation [2,3]. The solution procedure is demonstrated in simulation of solidification of 8 wt % Pb-Sn alloy and 5 wt % Sn-Pb alloy in rectangular cavity at conditions, defined in [4]. The numerical examples include studies with different uniform discretization and its influence on final macrosegregation map. The solution is assessed by comparison with the reference results of the finite volume and finite element method. The advantages of the method are simplicity, accuracy and straightforward applicability in non-uniform node arrangements. The methodology will be use in complementing our heat transfer model [5] of the continuous casting of steel.

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