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*Inverse Free Boundary Problems for the Parabolic PDEs.*

We present a new variational formulation of the inverse Stefan problem, where some of the coefficients of the PDE or some boundary data on the fixed boundary is missing and must be found along with the temperature and free boundary. Optimal control framework is employed where missing data and free boundary are the components of the control vector and optimality criteria consists of the minimization of  $L_2$ -norm deviations from the available measurement of the temperature and available information on the phase transition temperature on the free boundary. In a recent paper *U.G. Abdulla, Inverse Problems and Imaging, 7,2(2013),307-340* well-posedness in Sobolev spaces framework and convergence of the method of lines is proved. In this work we introduce full space-time discretization and prove the convergence of discrete optimal control problems to the original problem both with respect to cost functional and control. We also prove Frechet differentiability, Pontryagin type maximum principle and implement iterative gradient method in Hilbert spaces. (Received September 16, 2014)