1125-35-93 **Ugur G. Abdulla**, **R. Beekie*** (beeki001@umn.edu), **V. Bukshtynov**, **E. Cosgrove**, **J. Jones**, **S. Seif** and **N. Wubshet** (nwubshet13@ole.augie.edu). *Fréchet Differentiability in Optimal Control of the Stefan Problem.*

We prove Fréchet differentiability and derive the formula for the Fréchet gradient in the optimal control of the Stefan type free boundary problem for a linear second order parabolic PDE. The reaction coefficient, unknown free boundary, and boundary flux are components of the control vector. The cost functional consists of the L_2-declination of the trace of the temperature at the final moment, temperature at the fixed boundary and final position of the free boundary from available measurements. We follow a new variational formulation developed in *U. G. Abdulla, Inverse Problems and Imaging, 7,2(2013),307-340.*

In this project we use infinite dimensional calculus in Besov-Hilbert space framework. We introduce the adjoint problem as an infinite dimensional analogue of Lagrange multipliers. Through the use of sharp embedding theorems in fractional Sobolev-Besov spaces we derive the formula for the Fréchet gradient expressed in terms of the state vector and the solution of the adjoint problem. We use the Fréchet differentiability result and necessary optimality condition for the implementation of a projective gradient method in Hilbert space setting for the numerical solution of the problem. (Received July 20, 2016)