

MATERIALS SCIENCE AND ENGINEERING

SEMINAR

Computational Design of Materials Processes

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ABSTRACT

Some of our recent research efforts on the development of computational algorithms for the design of materials processes will be reviewed. In particular, we will present solutions to a number of mathematical problems of importance to the design of directional solidification processes that result in cast products of desired microstructures and to the design of deformation processes for shape and microstructure control.

In the first part of the presentation we will introduce ill-posed inverse problems appropriate for the design of solidification processes. A method will be discussed to calculate the thermal boundary conditions on the mold walls for directional solidification processes under the influence of buoyancy, thermocapillary and electromagnetic convection such that a desired stable solid-liquid interface growth is achieved throughout solidification. Such inverse-design problems are posed as functional optimization problems. A continuum adjoint based method for gradient computations coupled with a conjugate-gradient optimization solver and an H^1 regularization will be presented for solving this inverse problem. Such techniques provide the first step towards the design of solidification processes that result in cast products with desired microstructures.

A computational framework will be presented in the second part of this presentation to evaluate the shape as well as the non-shape sensitivity of finite thermo-inelastic deformations. Weak sensitivity equations are developed for the large thermo-mechanical deformation of hyperelastic thermo-viscoplastic materials that are consistent with the kinematic and constitutive analysis used in the solution of the direct deformation problem. The sensitivity analysis is performed in an infinite-dimensional continuum framework that accounts for the non-differentiable nature of the frictional/contact conditions. The effectiveness of these design techniques will be demonstrated by applications in the design optimization of metal forming processes.

Date: Thursday, March 29, 2001
Time: 3:30 Coffee and donuts
3:45 Seminar
Place: MSEE B012

The seminar is presented jointly with the School of Mechanical Engineering, Heat Transfer Group

PURDUE MSE

