

A level set simulation of dendritic solidification of multi-component alloys¹

Nicholas Zabaras
Materials Process Design and Control Laboratory
Sibley School of Mechanical and Aerospace Engineering
188 Frank H T Rhodes Hall
Cornell University
Ithaca, NY 14853-3801

A level set method combining features of front tracking methods and fixed domain methods is presented to model three-dimensional microstructure evolution in the solidification of multi-component alloys. Phase boundaries are tracked by solving the multi-phase level set equations. Diffused interfaces are constructed from these tracked phase boundaries using the level set functions. Based on the assumed diffused interfaces, volume-averaging techniques are applied for energy, species and momentum transport. Techniques including fast marching, narrow band computing, parallel computation using domain decomposition and adaptive meshing are utilized to allow simulation of physically realistic systems. In closing, we will discuss a number of mathematical and computational issues related to multiscale solidification modeling and design and the role that uncertainty plays in such systems.

¹ Presented at the 'Computational and Applied Mathematics Seminar' (hosts D. Xiu and Jie Shen), Purdue University, West Lafayette, IN, September 22, 2006.