Phase Field Modeling with Finite Element Method

Since the underlying microstructure of a material can affect its physical properties, it is important to understand the processes underlying microstructure formation in order to improve engineered materials.1 However, modeling microstructure formation is complicated by the fact that the structures are thermodynamically unstable and thus evolve over time.2 Phase field modeling has gained popularity as a technique for simulating microstructure evolution due to its ability to incorporate different thermodynamic driving forces into the model. As such, it can be used to simulate the microstructure evolution seen in such processes as solidification, grain growth, and solid-state phase transformations.2

CURRENT WORK:

Research and meetings/discussions

Topics include:

Finite element methods

Phase-field modeling

Diffusion equation

Matlab

Building Finite Element Model

Starting with one element—by hand.

TO DO:

Finite Element Method in 2D

* + Code in Matlab or R first with simple model and constant coefficients.
    - Again, but with variable coefficients.
  + Code in C.
  + Get some awesome graphics. Must wow audience.

Error analysis

Complexity analysis of code; time & space

Type up paper with some awesome equations

Format citations

1. Britta Nestler, 7 - Phase-Field Modeling, In Computational Materials Engineering, Academic Press, Burlington, 2007, Pages 219-266, ISBN 9780123694683, <http://dx.doi.org/10.1016/B978-012369468-3/50007-1>.
2. Moelans, N., Blanpain, B., & Wollants, P. (2008). *Calphad: An introduction to phase-field modeling of microstructure evolution* Pergamon Press. doi:10.1016/j.calphad.2007.11.003

Other references we’re eyeballing:

<http://www.physics.mcgill.ca/~provatas/papers/Phase_Field_Methods_text.pdf>

<http://www.ems.psu.edu/~lqc3/publications/BFromm2012Acta_Linkingphase-field.pdf>

<http://matperso.mines-paristech.fr/Donnees/data03/399-ammar09.pdf>

<https://www.comsol.com/multiphysics/finite-element-method>

<http://mooseframework.org/wiki/MooseTraining/FEM/>

<http://arturo.imati.cnr.it/~marini/didattica/Metodi-engl/Intro2FEM.pdf>