Modeling heat transport in patients undergoing hyperthermia using the Finite Cell Method in a deal.ii framework
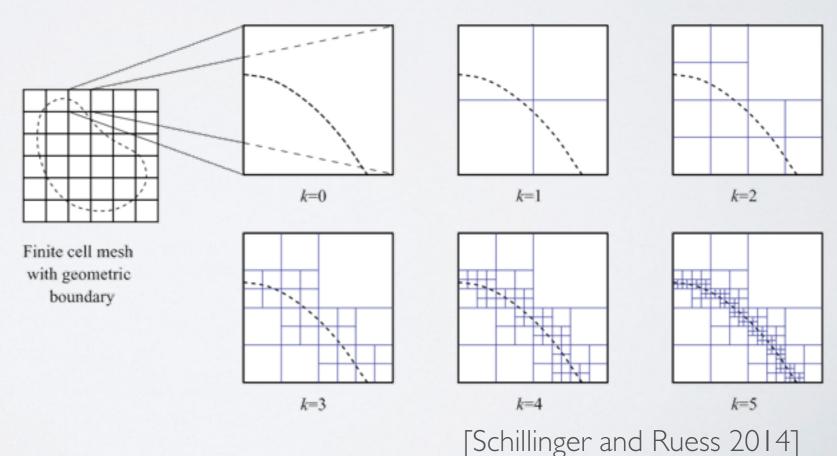
deal.ii workshop 2015 - Lisa Polster

THE FINITE CELL METHOD [Parvizian et al. 2007, Düster et al. 2008]

[Schillinger and Ruess 2014]

- fictitious domain

- higher-order basis functions
  (on coarse regular grid)

- adaptive integration

- weak imposition of
  boundary conditions

Finite cell mesh
with geometric
boundary

$k=0$ $k=1$ $k=2$

$k=3$ $k=4$ $k=5$

[Schillinger and Ruess 2014]

HYPERTHERMIA IN CANCER TREATMENT

- uses electro-magnetic waves to increase temperature in tumor region prior to radiation therapy

- higher sensitivity to radiation

- improved outcome

[Dr. Sennewald Medizintechnik GmbH 2015]

EXTENSION OF DEAL.II

- adaptively refined mesh for integration

- efficient algorithm for capturing the boundary

- weak imposition of boundary conditions (e.g. Nitsche's method)

Goal: Use as much as possible that is already available in deal.ii

LITERATURE

J. Parvizian, A. Düster, E. Rank, Finite cell method—h- and p-extension for embedded domain problems in solid mechanics, Computational Mechanics 41 (2007) 121–133.

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D. Schillinger and M. Ruess, The Finite Cell Method: A review in the context of higher-order structural analysis of CAD and image-based geometric models, Archives of Computational Methods in Engineering (2014)1-65.

Dr. Sennewald Medizintechnik GmbH, http://sennewald.de/de/ (08/02/2015).