IOWA STATE UNIVERSITY
Department of Mechanical Engineering

Database of Exact Solutions and Applications in Diffusion

Kevin Cole
Mechanical and Materials Engineering
University of Nebraska

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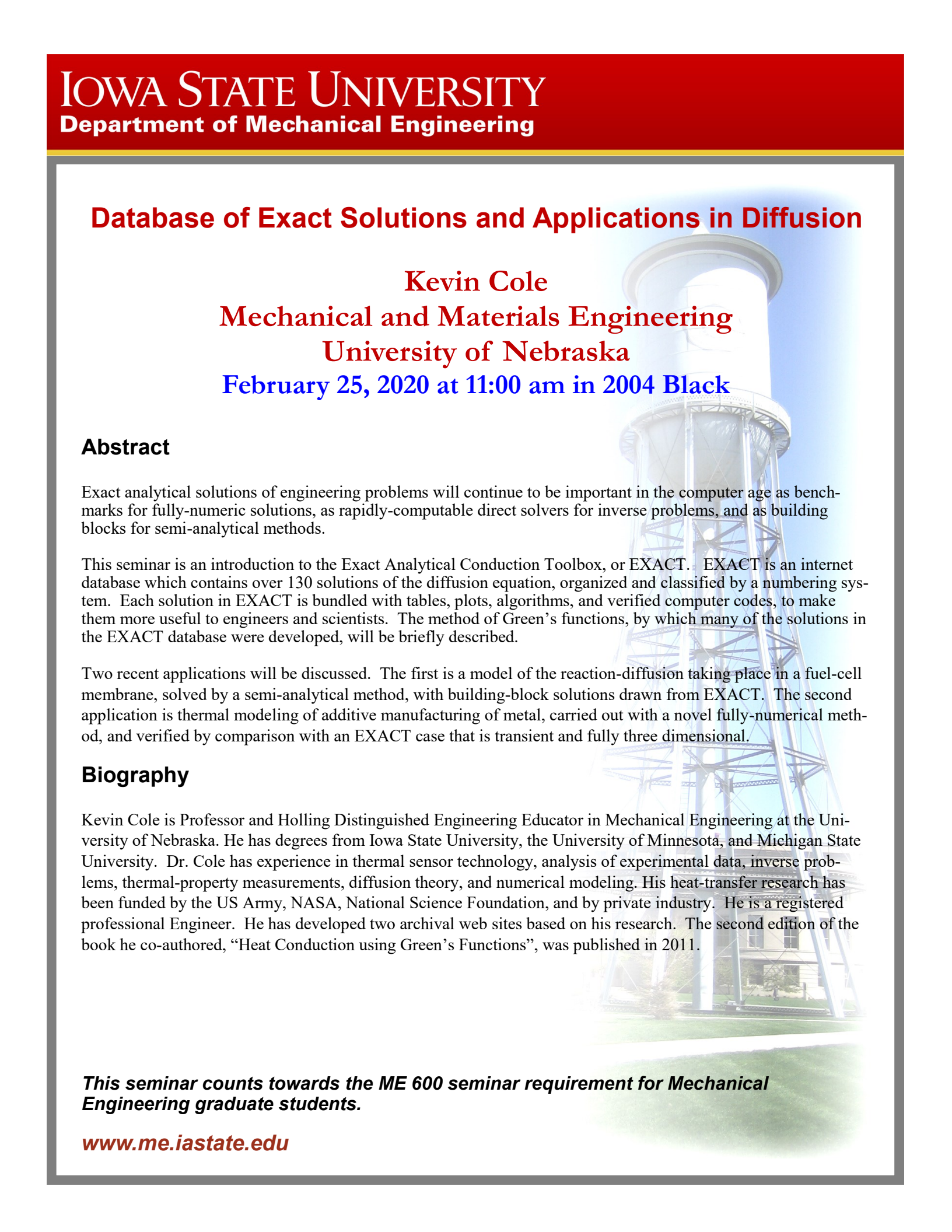

Abstract

Exact analytical solutions of engineering problems will continue to be important in the computer age as benchmarks for fully-numeric solutions, as rapidly-computable direct solvers for inverse problems, and as building blocks for semi-analytical methods.

This seminar is an introduction to the Exact Analytical Conduction Toolbox, or EXACT. EXACT is an internet database which contains over 130 solutions of the diffusion equation, organized and classified by a numbering system. Each solution in EXACT is bundled with tables, plots, algorithms, and verified computer codes, to make them more useful to engineers and scientists. The method of Green's functions, by which many of the solutions in the EXACT database were developed, will be briefly described.

Two recent applications will be discussed. The first is a model of the reaction-diffusion taking place in a fuel-cell membrane, solved by a semi-analytical method, with building-block solutions drawn from EXACT. The second application is thermal modeling of additive manufacturing of metal, carried out with a novel fully-numerical method, and verified by comparison with an EXACT case that is transient and fully three dimensional.

Biography

Kevin Cole is Professor and Holling Distinguished Engineering Educator in Mechanical Engineering at the University of Nebraska. He has degrees from Iowa State University, the University of Minnesota, and Michigan State University. Dr. Cole has experience in thermal sensor technology, analysis of experimental data, inverse problems, thermal-property measurements, diffusion theory, and numerical modeling. His heat-transfer research has been funded by the US Army, NASA, National Science Foundation, and by private industry. He is a registered professional Engineer. He has developed two archival web sites based on his research. The second edition of the book he co-authored, "Heat Conduction using Green's Functions", was published in 2011.

This seminar counts towards the ME 600 seminar requirement for Mechanical Engineering graduate students.

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