

# **NSF Workshop On the Emerging Applications and Future Directions of the Boundary Element Method**

**September 1-3, 2010**

**The University of Akron (Near Cleveland, Ohio, USA)**

## **Summary**

This workshop composes of a two-day short course on the basics of the boundary element method (BEM) and a one-day symposium on the emerging applications and future directions of the BEM. Researchers around the world and students across the US, including both graduate and undergraduate students, will be invited to participate in this workshop. The workshop will be held on the University of Akron campus (in the suburb of Cleveland, Ohio, USA) from September 1-3, 2010.

The rapid development of the BEM in the last decade has significantly broadened the applications of the BEM. Many emerging research problems such as multi-scale and large-scale modeling of advanced materials, structures, fluids, and MEMS/NEMS related to bioengineering and alternative energy applications can now be tackled by the BEM effectively thanks to the advances of the various fast solution methods. There is an urgent need of retraining researchers, engineers and students, especially those in the US, on the recent developments in the BEM and its emerging applications, to help further advance the research and applications of the BEM.

The workshop will start with a two-day short course for students, researchers and engineers on the fundamentals of the boundary integral equation (BIE) formulations in applied mechanics, the BEM solution techniques, the basics of the Green's functions, the new symmetric Galerkin formulations, and the new fast multipole method for solving the BEM systems of equations. Following the short course, a one-day symposium will focus on discussions of emerging applications and future directions of the BEM. Six invited speakers will open the topics and lead discussions on various important directions in BEM research and applications. Scholarships will be given to 15 students from US universities to support them for participating this workshop. A competition of poster presentations for students will also be held.

This workshop will bring leading researchers around the world to the US to discuss the emerging applications and discuss the future directions of the BEM, help training a new generation of students who will be interested and motivated in research in the BEM, and connect US researchers and students with those from other countries and from national labs and industries to collectively advance the research, development and education in the BEM, which has emerged as a viable numerical method in computational science and engineering.

## Plan for Workshop

### Tentative Agenda

#### Day 1: Short Course on the BEM

**Two Tutorials:**

Morning: Introduction to the BEM (Subrata Mukherjee)  
Open discussions

Afternoon: Basics of the Green's functions (Ernie Pan)  
Open discussions

Evening: Student poster competition

#### Day 2: Short Course on the BEM (Continued)

**Two Tutorials:**

Morning: Symmetric Galerkin BEM (Len Gray and Alok Sutradhar)  
Open discussions

Afternoon: Fast multipole BEM (Yijun Liu)  
Open discussions

Evening: Student poster competition

#### Day 3: Symposium On the Emerging Applications and Future Directions of the BEM

**Six Invited Talks** (40 minutes for each talk, followed by discussions):

- BEM in modeling of MEMS (Attilio Frangi, Italy)
- BEM in solving Helmholtz equations (Martin Schanz, Austria)
- BEM in elastodynamics (Naoshi Nishimura, Japan)
- BEM in fracture mechanics (J. Dominguez, Spain) --- To be confirmed
- BEM and ACA method (Olaf Steinbach, Austria)
- Boundary meshfree methods (J. Sladek, Slovak) --- To be confirmed

**Other Topics for Discussions and the Lead Persons:**

- BEM research in Europe (Marc Bonnet) --- To be confirmed
- BEM research in Mainland, China (Zhenhan Yao) --- To be confirmed
- BEM research in Taiwan (J. T. Chen) --- To be confirmed
- BEM research in Brazil (Ney A. Dumont) --- To be confirmed
- BEM research in government research labs (Vinod Tewary) --- To be confirmed
- BEM applications and industry needs (Ravi Raveendra) --- To be confirmed

## **International Advisory Committee**

Dr. J. T. Chen, National Taiwan Ocean University, Taiwan  
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## **Organizing Committee**

Dr. Alex Cheng, University of Mississippi  
Dr. Mitch Denda, Rutgers, The State University of New Jersey  
Dr. Len Gray, Oak Ridge National Laboratory  
Dr. Yijun Liu, University of Cincinnati (Co-Chair)  
Dr. Subrata Mukherjee, Cornell University  
Dr. Ernie Pan, University of Akron (Co-Chair)  
Dr. Anh-Vu Phan, University of South Alabama  
Dr. Thomas J. Rudolphi, Iowa State University  
Dr. Tim Wu, University of Kentucky

## **Participants and Scholarship Awards**

Scholarships will be given to 15 graduate or undergraduate students from US universities to support them to participate this workshop. The scholarship awards will be selected by the Organizing Committee. Researchers from national labs and engineers from industries will also be recruited for their participations in this workshop to help promote the BEM, broaden the applications, and connect the students with potential future employers.

## Dissemination of the Results from the Workshop

A website will be developed for this workshop that will include all the lecture and presentation materials for free download. A detailed review article on the state-of-the-art and future directions of the BEM is planned and will be prepared by the Organizing Committee members and the invited speakers at the workshop. This review article will be submitted to *Applied Mechanics Review* or *EABE* in six months after the conclusion of the workshop. Dr. Yijun Liu and Dr. Ernie Pan will coordinate the efforts in preparing this review article.

## Sponsors

The US National Science Foundation  
Program of Mechanics of Materials  
Division of Civil, Mechanical and Manufacturing Innovation (CMMI)  
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