



Breakfa
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FIGHT
3-5-200



EXIT

People in Early BIE/BEM Research in USA



Frank J. Rizzo
U Washington
U Kentucky
Iowa State U
U Illinois



Thomas A Cruse
Boeing
CMU
Pratt & Whitney
SwRI
Vanderbilt U
AFRL



P. K. Banerjee
U Wales, UK
SUNY - Buffalo



Subrata Mukherjee
Cornell U





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Award Certificate
Sofie E. Leon
Best Student



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**In Honor of Professor
Mukherjee's 65th Birthday**

Two Special Issues of
Engineering Analysis with Boundary Elements
Advances in Mesh Reduction Methods

Guest Editors:
Yijun Liu
Wenjing Ye
Anh-Vu Phan
Glaucio H. Paulino



A large projection screen displaying a presentation slide. The slide has a blue background and contains the following text:

Current CMMI Research Clusters
Advanced Manufacturing

- Research leading to transformative advances in manufacturing and building technologies, with emphases on efficiency, economy, and sustainability
- Supporting programs
 - Manufacturing and Construction Equipment
 - Manufacturing Enterprise Systems
 - Materials Processing and Engineering
 - Nanomanufacturing



Discovery, learning, research infrastructure, and stewardship



$$k_j e^{ik_L k \cdot (x-X)} \tilde{L}^L(\hat{k}, X)$$

$$-k_T^2 e_{ipr} \hat{k}_p e^{ik_T \hat{k} \cdot (x-X)} \tilde{L}_r^T(\hat{k}, X) dS_{\hat{k}}$$

of the local expansion

$$\vec{X}) \tilde{M}^L(\hat{k}, Y)$$

$$\vec{X}) \tilde{M}_r^T(\hat{k}, Y) \quad (\text{M2L})$$

$$-1) P_n \left(\hat{k} \cdot \frac{\vec{YX}}{|\vec{YX}|} \right) h_n^{(1)}(k_{L,T} |\vec{YX}|)$$

the moments for the diagonal forms.



Content

- 1 Governing equations
- 2 Boundary element formulation
- 3 Fast BEM
- 4 Challenges in the development of BEM





INTRODUCTION

2



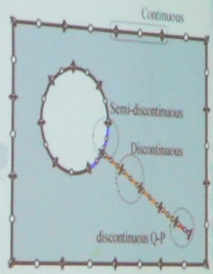
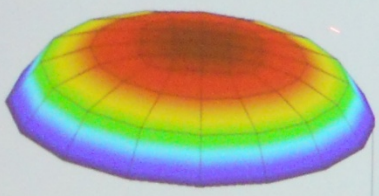
A. Frangi, BEM for modelling dissipation in MEMS

POLITECNICO DI MILANO



Some BEM advantages

- The mesh is reduced in one dimension
- Automatic satisfaction of the radiation conditions at infinity
- Ability to capture high stress gradients
- Easy implementation of elements modeling crack-tip fields in fracture



A. Sáez
UNIVERSIDAD DE SEVILLA



Boundary element methods

- ▶ Direct vs. indirect formulation
- ▶ Weakly singular vs. hypersingular boundary integral equation
- ▶ 1st kind vs. 2nd kind boundary integral equation
- ▶ Collocation vs. Galerkin discretization
- ▶ pw constant vs. pw linear basis functions (hp BEM)
- ▶ Interpolation vs. projection of given boundary data
- ▶ Adaptive vs. uniform refinement
- ▶ Direct vs. preconditioned iterative solution (construction of preconditioners)
- ▶ Acceleration (Panel Clustering, Fast Multipole, Adaptive Cross Approximation, ...)
- ▶ parallelization and domain decomposition methods
- ▶ ...



Difference between the standard BEM and Local integral equations (LIE)

Elasticity

Governing equations

$$\sigma_{ij,j}(\mathbf{x},t) - \rho(\mathbf{x})\ddot{u}_i(\mathbf{x},t) = -X_i(\mathbf{x},t). \quad (1)$$

Constitutive equation

$$\sigma_{ij}(\mathbf{x},t) = C_{ijkl}(\mathbf{x})\varepsilon_{kl}(\mathbf{x},t) = C_{ijkl}(\mathbf{x})u_{k,j}(\mathbf{x},t), \quad (2)$$

The traction vector $t_i = \sigma_{ij}n_j$

$$t_i(\mathbf{x},t) = C_{ijkl}(\mathbf{x})u_{k,j}(\mathbf{x},t)n_j(\mathbf{x}). \quad (3)$$

The weak-form of the governing equations (1)

Conventional BEM



Contents of this presentation

- Variationally-based, hybrid boundary and finite elements
- Developments for time-dependent problems
- Developments in gradient elasticity
- Dislocation-based formulations (for fracture mechanics)
- From the collocation (conventional of hybrid) boundary element method to a meshless formulation
Or: *The expedite boundary element method*





ing located at the edge of
China





Boundary Conditions in Atomistic Simulations

Jian Wang
Los Alamos National Laboratory

Collaborators:

Amit Misra, Carlos Tome, John P. Hirth
Richard G. Hoagland, Irene J. Beyerlein



This work was supported by US DOE,
Office of Basic Energy Sciences.





Microsoft PowerPoint window titled "Problem Definition".

- Objective: Reduce interior noise by applying damping treatment to the floor

