

*Research and Academic Programs in
Computational Engineering and Sciences and
Computational and Applied Mathematics at the
University of Texas at Austin:
ICES and the CAM Program*



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Director, ICES

A Presentation to PITAC:
The President's Information Technology Advisory Committee
Jan 12, 2005



Overview

- **Brief History**
- **ICES Mission and Organization**
- **Endowments and Chair Searches**
- **ICES Programs**
 - Visiting Faculty
 - Postdoctoral Program
 - The CAM Program
- **ICES Faculty**
- **Infrastructure**



Brief History

- **Vision 2020**
- **Strategic Plans – CoE, CNS - 1990**
- **Private Foundation Initiative - 1991**
- **Creation of TICAM &
The CAM Program - 1993**
- **ACES Building - 2000**
- **Expanded Scope - 2003**
 - ❖ **Creation of ICES**
 - ❖ **New Centers/Chairs**



ICES Mission:

To provide the infrastructure and intellectual leadership for developing outstanding interdisciplinary programs in research and graduate study in areas of computational engineering and sciences and in information technology.

Participating Departments & Centers

4-Schools & Colleges 17-Academic Departments 77-Faculty

ENGINEERING

Aerospace Engineering & Engineering Mechanics
Biomedical Engineering
Chemical Engineering
Civil Engineering
Electrical & Computer Engineering
Mechanical Engineering
Petroleum & Geosystems Engineering

BUSINESS

Department of Management
Science & Information Systems

NATURAL SCIENCES

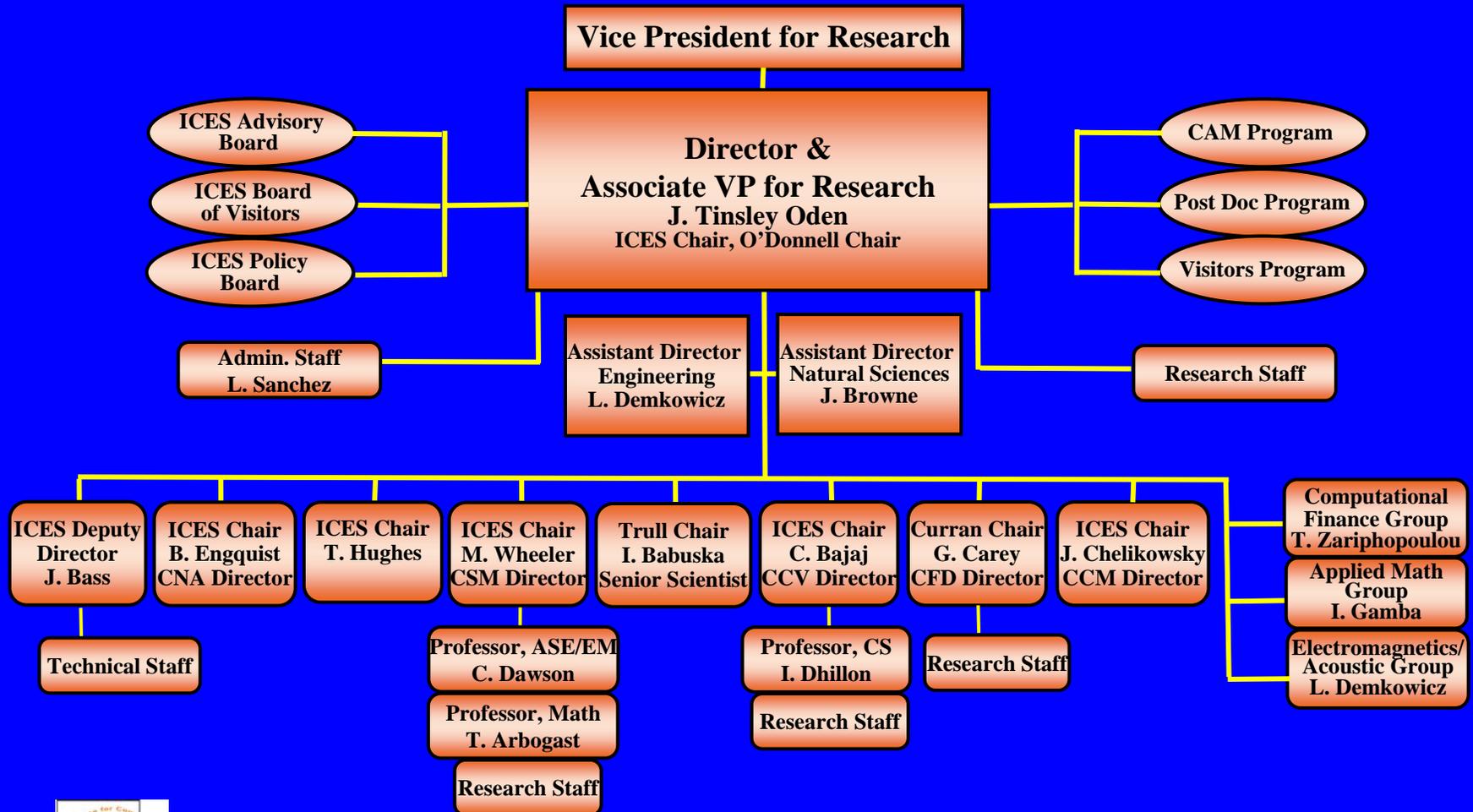
Astronomy
Chemistry
Computer Sciences
Geology
Mathematics
Physics
School of Biological Sciences

CENTERS

Institute for Advanced Technology (IAT)
Institute for Geophysics (IG)



Institute for Computational Engineering and Sciences (ICES)



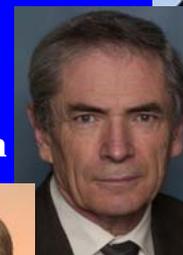
ICES Policy Board

- **Chair, Vice President for Research**
- **Director, ICES**
- **Dean, CoE**
- **Dean, CNS**
- **MaL, Engineering**
- **MaL, Natural Sciences**

Juan Sanchez



J.T. Oden



Ben Streetman



Mary Ann Rankin



Donald Paul
*Chemical
Engineering*



Peter Rossky
Chemistry



ICES Board of Visitors

➤ Outside University Leaders



William Martin
-Michigan



Ted Belytschko
-Northwestern

➤ Industry/Commercial



Robert Gochnour
- British Petroleum



Paul Messina
-Argonne National
Laboratory/Consultant

➤ Foundations:



Peter Flawn
- U Texas

➤ Government Laboratories



William Press
-Los Alamos
National Laboratory

Thomas Bickel
-Sandia
National
Laboratories
(Chairman)



**The Board of Visitors is appointed by the UT President*



ICES Advisory Board



Ivo Babuska
Trull Chair
Senior Scientist, ICES



John Boisseau
Director, TACC



Graham Carey
Curran Chair
Director, CFD Lab



Gregory Rodin
Computational Mechanics



Chandrajit Bajaj
ICES Chair
Director, CCV



James Browne
Assistant Director,
Natural Sciences



J. Tinsley Oden
Director, ICES
ICES Chair



Leszek Demkowicz
Assistant Director,
Engineering



Bjorn Engquist
ICES Chair
Director, CNA



William Beckner
Mathematics



Luis Caffarelli
Mathematics



James Chelikowsky
ICES Chair
Director, CCM



Thomas J.R. Hughes
ICES Chair



Mary Wheeler
ICES Chair
Director, CSM



ICES Research Centers & Groups

- **Center for Computational Visualization** - *Chandrajit Bajaj, Director (CS)*
- **Center for Subsurface Modeling** - *Mary Wheeler, Director (ASE/EM, Math, PGE)*
- **Center for Numerical Analysis** - *Bjorn Engquist, Director (Math)*
- **Computational Fluid Dynamics Laboratory** - *Graham Carey, Director (ASE/EM)*
- **Center for Computational Materials** – *James Chelikowsky, Director (Physics, Chem. Engr., Chemistry and Biochemistry)*
- **The Applied Mathematics Group** – *Irene Gamba, Coordinator (Math)*
- **Computational Electromagnetics and Acoustics Group** - *Leszek Demkowicz, Coordinator (ASE/EM)*
- **Computational Finance Group** - *Thaleia Zariphopoulou, Director (Math, MSIS)*
- **Planned Centers:**
 - Distributed and Grid Computing
 - Computational Life Sciences and Biology
 - Computational Geosciences



ICES Dedicated Endowments

Name of Chairs and Endowments	Holder	Value M
Computational and Applied Mathematics Chair I	Engquist (ICES)	1.93
Cockrell Family Regents' Chair in Engineering #2	Oden (ICES)	3.98
Computational and Applied Mathematics Chair in Visualization	Bajaj (ICES)	1.12
Computational and Applied Mathematics Chair III	Hughes (ICES)	2.36
Earnest & Virginia Cockrell Chair in Engineering	Wheeler (ICES)	2.17
ICES Chair in Computational Materials	Chelikowsky (ICES)	2.02
Computational and Applied Mathematics Research Innovation Endowment	ICES	2.66
ICES Faculty Fellowship Research Fund	ICES	6.03
Computational and Applied Mathematics Graduate Fellowship Fund	ICES	10.77
ICES Postdoctoral Fellows Endowment	ICES	5.14
Gerhard J. Fonken Director of High Performance Computing Endowment*	TACC-Director's Office	3.14
Peter O'Donnell, Jr. Centennial Chair in Computing Systems	ICES -Director's Office	4.98
Three New Term Chair Challenge Grant(s)**	ICES -Director's Office	3.00
* TACC ** Challenge Grants		Total = \$49.3M



ACES Building

- **ACES Building provides space allocations for:
ICES, CS, ECE, and TACC**
- **ACES is an interdisciplinary research facility. No graduate or undergraduate classes are held in the building.**
- **Office & Lab assignments are made for < 5 years.**
- **ICES space renewal is subject to review by the Policy Board.**
- **Space renewal is based on**
 - **Research Productivity**
 - **Extramural Funding**
 - **Programmatic alignment of research with the ICES mission**



The CAM/CES Program

➤ **Ph.D. and M.S. in Computational and Applied Mathematics**

➤ **Management: CAM Graduate Studies Committee**

- **Chair: Todd Arbogast, Dept. of Mathematics**
- **Graduate Advisor: Clint Dawson, Dept. of ASE/EM**
- **Graduate Coordinator: Luci Garcia, ICES**

➤ **Qualification Areas**

- **Area A: Applicable Mathematics**
- **Area B: Numerical Analysis and Scientific Computation**
- **Area C: Mathematical Modeling and Applications**

Potential Area C expansions: Biology, Bio-Medical Engineering and Sciences, Chemistry, Physics of Materials, Geosciences, Astrophysics

➤ **The CAM Graduate Fellowship Program**

➤ **CES Option**

- **Draws students from engineering, all areas of sciences, and mathematics**
- **Focuses on research topics combining or transcending traditional disciplines**
- **Each student assigned a faculty mentor at the beginning of their studies**
- **Program of study includes classes, seminars, and research**



CAM Program Statistics 03-04

- **44 Students Enrolled**
- **24 Students from US**
- **20 International Students**
- **8 CAM Fellows**
- **Previous Degrees from 49
Different Universities**



- **4** – Completed CAM Ph.D.
- **11** – Entered Program last Fall
- **6** – Passed written qualifying exams
- **4** – Passed Oral Exams
- **4** – Defended Dissertation Proposal
- **2** – Withdrew
- **9** – Co-authored scientific articles
- **3-6** – Expected to finish this year



Some Employers of Recent CAM Graduates

- **AdaptCo, Texas**
- **Hostway Corporation, Illinois**
- **Lawrence Livermore National Laboratory, California**
- **Lucent Technologies, New York**
- **Renaissance Technologies Corp., New York**
- **Sandia National Laboratories, New Mexico**
- **Schlumberger Austin Product Center, Texas**
- **Tibco Software Inc., California**
- **Chalmers University, Sweden**
- **North Carolina State University**
- **State University of New York Buffalo**
- **University of California, Berkeley**
- **University of Chicago**
- **University of Pittsburgh**
- **University of Texas at Austin**
- **Yale University**



CAM Faculty & Departments

77 Faculty - 17 Departments

Orly Alter (Biomed Eng)

Ivo M. Babuska (ASE/EM/Math)

Kenneth S. Ball (ME)

Roger T. Bonnezaze (Chem Eng)

James C. Browne (CS)

Luis A. Caffarelli (Math)

Alan K. Cline (CS)

Leszek F. Demkowicz (ASE/EM)

Donald S. Fussell (CS)

John E. Gilbert (Math)

John J. Hasenbein (ME)

David M. Hillis (IB)

Loukas F. Kallivokas (CE)

P. T. Konstantopoulos (ECE)

John E. Luecke (Math)

Michael P. Marder (Physics)

Daene C. McKinney (CE)

Tessie J. Moon (ME)

Gregory J. Rodin (ASE/EM)

Kamy Sepehrnoori (PGE)

Jack B. Swift (Physics)

Efstathis Tompaidis (MSIS)

Karen Uhlenbeck (Math)

Mikhail M. Vishik (Math)

Mary F. Wheeler (ASE/EM/PGE)

Aristotle Arapostathis (ECE)

Chandrajit L. Bajaj (CS)

Eric B. Becker (ASE/EM)

Patrick L. Brockett (MSIS)

Michael D. Bryant (ME)

Graham F. Carey (ASE/EM)

James W. Daniel (Math)

Inderjit Dhillon (CS)

Irene M. Gamba (Math)

Oscar Gonzalez (Math)

Linda J. Hayes (ASE/EM)

Rui Huang (ASE/EM)

Timothy Keitt (IB)

Calvin Lin (CS)

Dmitrii E. Makarov (Chem/Biochem)

William Mark (CS)

Mark E. Mear (ASE/EM)

Philip J. Morrison (Physics)

Ehud I. Ronn (Finance)

Paul R. Shapiro (Astronomy)

Harry L. Swinney (Physics)

Carlos Torres-Verdin (PGE)

Robert A. van de Geijn (CS)

Tandy Warnow (CS)

Robert E. Wyatt (Chem/Biochem)

Thaleia Zariphopoulou (MSIS)

Todd J. Arbogast (Math)

Ross Baldick (ECE)

William Beckner (Math)

Alan C. Bovik (ECE)

Steven Bryant (PGE)

Elliott W. Cheney (Math)

Clinton N. Dawson (ASE/EM)

Charles N. Friedman (Math)

Vijay K. Garg (ECE)

Robin R. Gutell (IB)

Robert W. Heath Jr. (ECE)

Thomas J. Hughes (ASE/EM)

Hans A. Koch (Math)

Rafael de la Llave (Math)

Edward M. Marcotte (Chem/Biochem)

Richard A. Matzner (Physics)

Lauren A. Meyers (IB)

J. Tinsley Oden (ASE/EM)

Peter J. Rossky (Chem/Biochem)

Panagiotis Souganidis (Math)

John L. Tassoulas (CE)

Jack S. Turner (Physics)

Philip L. Varghese (ASE/EM)

John C. Wheeler (Astronomy)

Jack X. Xin (Math)



Visiting Faculty Fellowship Research Fund

Established in 1993, the program was created to fund visits by outstanding national and international researchers and scholars in Computational and Applied Mathematics and Computational Engineering and Sciences for periods ranging from two weeks to one year:

- ❖ To work with faculty and students on ongoing research problems
- ❖ To lecture on new research developments
- ❖ To enhance the stature and visibility of the CAM/CES program
- ❖ To enhance the ICES research environment



Visiting Faculty Fellowship Research Fund (continued)

Visiting Faculty Fellowships

1996 – 97	17 visitors
1997 – 98	26 visitors
1998 – 99	30 visitors
1999 – 00	24 visitors
2000 – 01	39 visitors
2001 – 02	40 visitors
2002 – 03	47 visitors
2003 - 04	44 visitors

Hosted top researchers from the
U.S. and the following countries:

Argentina	Greece
Australia	Israel
Austria	Italy
Brazil	Korea
Canada	New Zealand
China	Norway
Czech Republic	Poland
France	Russia
Germany	Spain
Great Britain	Switzerland



ICES Postdoctoral Fellows Program

- Purpose is to fund outstanding postdoctoral students in areas relevant to ongoing research at ICES
- Fellows expected to work under the supervision of one or more ICES faculty for one-two years, with a stipends of approximately \$60,000 per year (plus benefits and a travel allowance)
- Preference for U.S. citizens, but qualified foreign students are considered
- Applications are reviewed before April 1 (Fall semester) and before October 1 (Spring semester)
- 2004-2005 – Number of Applicants: 62



ICES Faculty & Staff Metrics

Metric	03-04
Refereed Journal Articles Published and Accepted/Submitted	194/53
Other Articles and Reports/Books	177/18
Presentations Plenary/Keynote/Lecture	15/7/295
Medals and Prizes/ Other Honors	3/46
Membership in Technical Committees	197
Editorial Boards	115
CAM Students Supervised/Graduated	35/4
Postdoctoral Fellows	5
ICES Visitors Hosted	44
Research Proposals Submitted/Accepted/Rejected	53/26/11
Current Proposal Award Amounts	\$25,172K
Industrial & Non-Profit Collaborations – Contract Amounts	\$2,175K



ICES Faculty & Research Scientists

31 – ICES Faculty Participating In R&D Activities

10 – Math 8 – ASE/EM 4 – CS 1 – PGE, ECE, Physics, ChE, Chemistry....

- Todd Arbogast - Applied Mathematics
- Ivo Babuska – Numerical Mathematics
- Chandrajit Bajaj - Computer Graphics
- Jon Bass – Computational Mechanics
- William Beckner - Mathematical Physics
- Roger Bonneau - Micromechanics
- James Browne - Software Engineering
- Steven Bryant - Petrophysics
- Luis Caffarelli - Non-linear Analysis
- Graham Carey - Fluid Dynamics
- James Chelikowsky – Comp. Materials
- Clint Dawson - Subsurface & Surface Flows
- Rafael de la Llave - Dynamical Systems
- Leszek Demkowicz - EM/Acoustics
- Inderjit Dhillon - Data Mining
- Bjorn Engquist – Applied Mathematics
- Irene Gamba - Mathematical Physics
- Robert Heath - Wireless Communications
- Thomas Hughes - Computational Mechanics
- David Littlefield - Impact Dynamics
- Michael Marder - Fracture Mechanics
- Mark Mear – Micromechanics
- J. Tinsley Oden - Computational Mechanics
- Serge Prudhomme – Multi-scale Modeling
- Gregory Rodin - Micromechanical Modeling
- Peter Rossky - Chemical Physics
- Panagiotis Souganidis - Stochastic Analysis
- Robert Van de Geijn - Parallel Computing
- Mary Wheeler - Mathematical Modeling
- Jack Xin - Hearing Sciences
- Thaleia Zariphopoulou - Mathematical Finance



ICES Faculty Evaluations

To help remove traditional obstacles to interdisciplinary programs, departments and colleges with faculty participating in ICES research activities or the CAM Program are required to follow the procedures below:

1) The performance of each faculty member will be evaluated by a faculty committee representing ICES and the CAM Program. The committee will assess the individuals' contributions in teaching, research and other activities relevant to ICES and the CAM Program.

2) The Dean's Salary Advisory Committee, or Promotion Advisory Committee, will review both the departmental and ICES/CAM evaluations and recommendations and advise the Dean on whether or not contributions to ICES and CAM programs have been given appropriate weight.



ICES Seminar Series

- **Twice Weekly Series**
- **~ 50 Seminars this Past Year**
- **Video Taping Program initiated in 2004**
- **Taped Seminars will be posted on the new ICES website**



Calderbank



Tezduyar



Burnett



Taylor



Moser



Carter



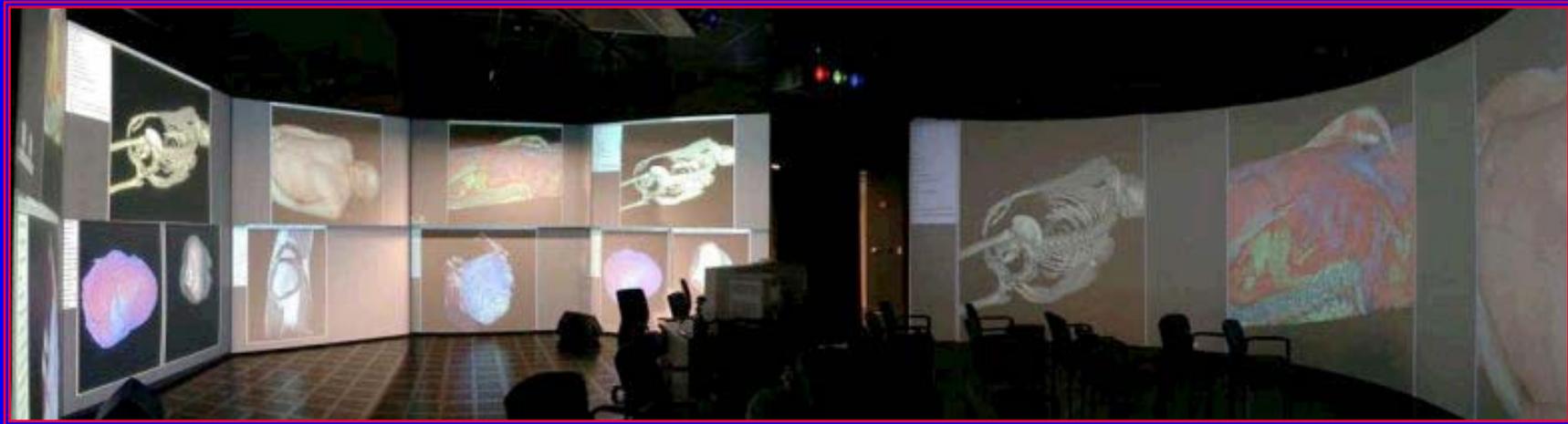
Ghattas



ACES Building & Facilities



Visualization Laboratory



ICES Distributed Computing Labs (Clusters)



BEVO
90-Processors



COWBOY
64-Processors



BBROX
32-Processors



CEREBRO
18-Processors
64 -BIT



COMPAQ
162-Processors



Tera-Scale Computing Systems

Maintained by TACC at Pickle Research Center



**IBM Power 4
224-Processor**

*TACC is also a mid-range resource center in NSF
NPACI and a partner in the TeraGrid project.*



**Cray-Dell Power Edge
1024 Processors**

**Ranked 28 in US Top500
Ranked 8 in US Academic**

