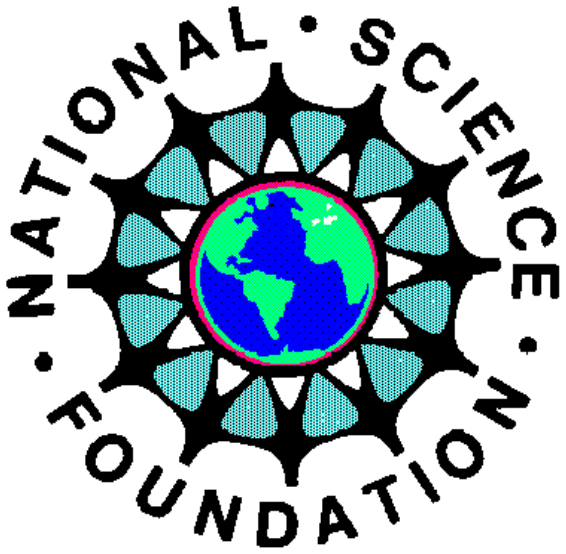
NATIONAL SCIENCE FOUNDATION

Civil and Mechanical Systems (CMS)



Jesús M. de la Garza, Ph.D.

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NSF Award Information

The National Science Foundation (NSF) funds **People, Ideas and Tools**. The focus is **knowledge at the frontiers** of **discovery, learning and innovation** in **Science and Engineering**.

NSF funding is competitive, based upon **merit-review** (typically panel review). The two main review criteria are: (1) **intellectual merit**, and (2) **broader impacts**.

This funds **research** awards (including individual investigator, group awards, centers) as well as **education** awards, **fellowships** and **major research facilities.**

The NSF web site http://www.nsf.gov provides complete access to all **award information.**

NSF Merit Review Criteria

Intellectual Merit

- Advancing knowledge and understanding
- Proposer qualifications (and results of prior work)
- Creative and original concepts
- Conception and organization
- Resources

Broad Impact

- Promoting teaching, training and learning
- Broaden the participation of underrepresented groups
- Enhance the infrastructure for research and education (facilities, instrumentation, networks and partnerships)
- Broad dissemination
- Benefits to society

Typical NSF Panel Review Meeting

Directorate for Engineering
FY 04 Budget

George E Brown, Jr.
Network for Earthquake
Engineering Simulation
$82.05M FY 00-04

Assistant Director
John A. Brighton
Deputy Assistant Director
Bruce Hamilton

Senior Advisors
Mike Rocco
Priscilla Nelson

$565.13M

$51.02M

$67.17M

$68.92M

Bioengineering & Environmental Systems
Fred Heineken

Civil & Mechanical Systems
Galip Ulsoy

Chemical & Transport Systems
Esin Gulari

Design, Manufacture & Industrial Innovation
Warren DeVries

Electrical & Communications Systems
Vasu Varadan

Engineering Education & Centers
Bruce Kramer

$65.81M Academic
$103.59M SBIR

$74.58M

$134.04M

Total NSF FY04: $5,577.83M

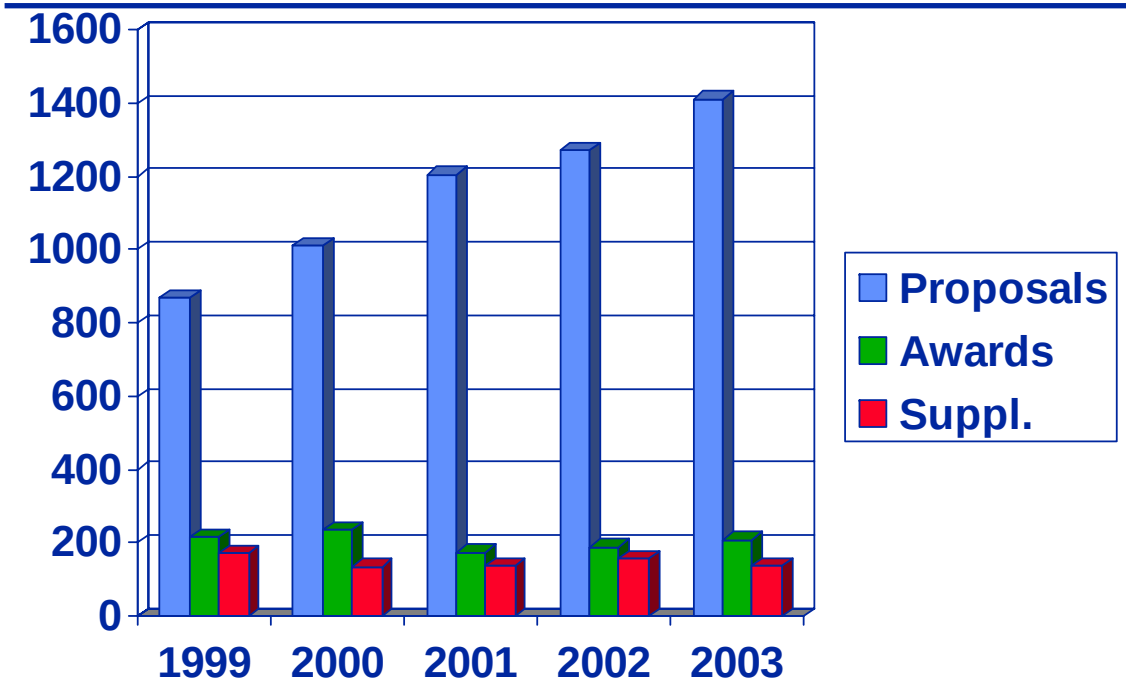
The Division of Civil and Mechanical Systems (CMS)

The **structures** and **machines** that we encounter in our daily lives are related to the areas funded by CMS, and the focus of the communities that CMS serves.

The Mission of CMS is:

- to expand the foundation of **fundamental knowledge** for the engineering profession in application to **mechanical systems** and the **constructed environment**, and
- to support the rapid development and deployment of research in service to society and to **reduce risks induced by natural and technological hazards.**

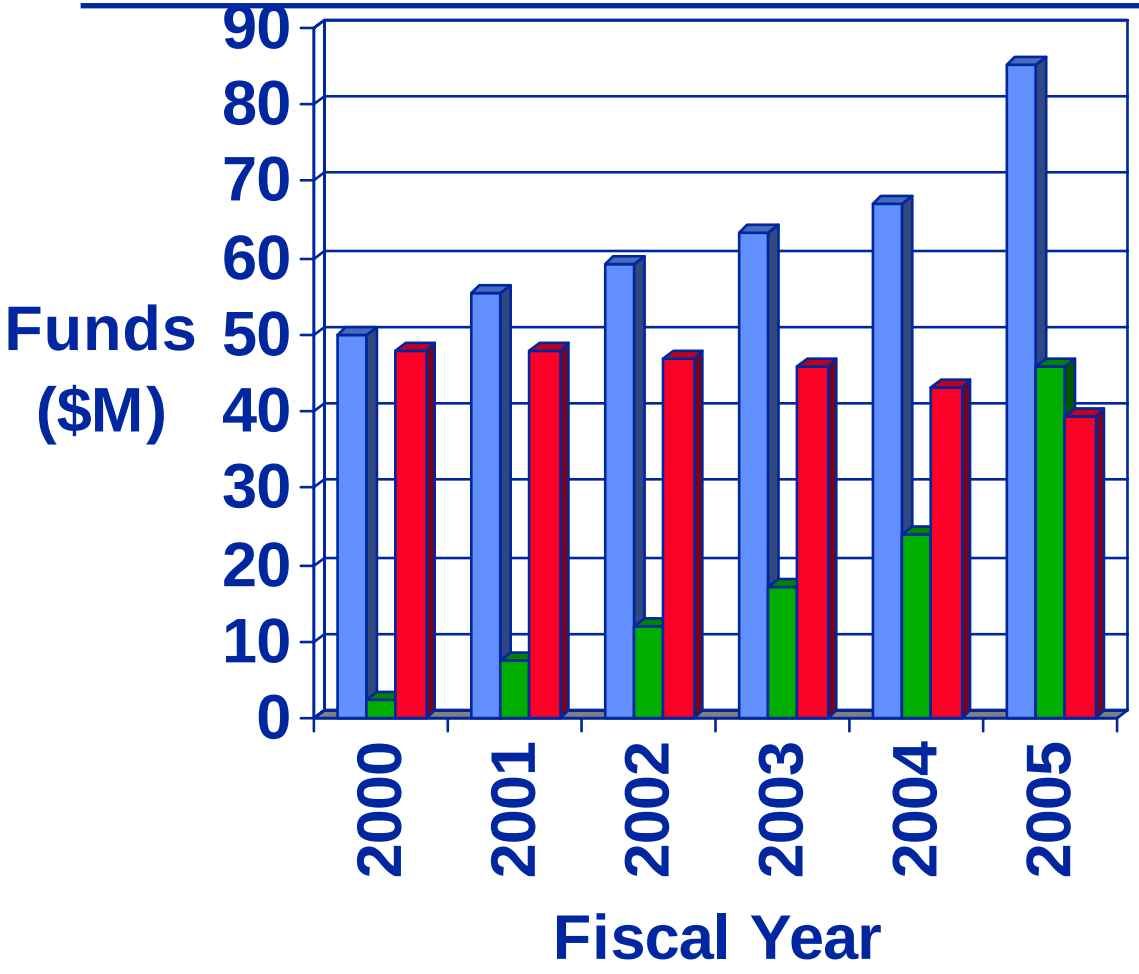
CMS Summary Statistics

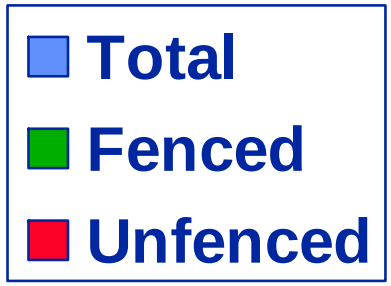


Average research award size and duration is approx. $100k/year and 3 years.

Fiscal Year	No. Res. Proposals	No. Res. Awards	Funding Rate	Supple-ments
2003	1,412	208	15%	138
2002	1,271	188	15%	156
2001	1,205	174	14%	138
2000	1,010	236	23%	135
1999	868	217	25%	173

CMS Budget Trends





- Unfenced funds include CAREER ($7.5M/yr) and internal CMS solicitations (e.g., NEES research, $5m/yr starting FY04)
- Fenced funds include $4M/yr for NEES research starting FY04 and $20M for NEES Operations starting FY05
- Separate NEES MREFC funding is $82M for FY2000 through FY2004

CMS Program Officers

Throughout the year **CMS receives proposals** that are:

- **Unsolicited**, or investigator initiated
- In response to **solicitations**, such as NSF priority areas, CAREER, MRI, ADVANCE, NSE, BE, ITR, etc.
- In response to **ENG or CMS or Interagency solicitations**, such as Sensors, NEES Research, HUD-PATH, etc.

CMS Program Officers, in addition to **working with the research communities** and **post-award oversight,** handle the complete **review processing of:**

- Unsolicited proposals in their programs, as well as **co-review and co-funding** of interdisciplinary unsolicited proposals, GOALI, EPSCOR
- **Small grants for exploratory research** (SGER), Workshop proposals, and supplements submitted to their programs
- Proposals submitted to various solicitations (e.g., interagency, NSF, ENG, CMS) through **working groups** for these cross-cutting areas.

Funding Rate

The table below provides a comparison of NSF, ENG and CMS funding rates for Research Grants during FY1999-2003

	NSF	ENG	CMS
2003	24%	17%	15%
2002	27%	22%	15%
2001	27%	20%	14%
2000	30%	23%	23%
1999	30%	27%	25%

Dwell Time

The table below shows proposal dwell times for FY2001-2003, including average dwell time, standard deviation, and percent completed in less that 6 months, 9 months,12 months and over 12 months.

	No. of Prop.	Ave. (months)	St. Dev (months)	0-6 (months)	>6-9 (months)	>9-12 (months)	>12 (months)
2003	1,542	5.40	2.96	70%	23%	5%	1%
2002	1,386	6.30	6.40	66%	23%	7%	4%
2001	1,357	7.55	5.95	51%	31%	10%	9%
2000	1,081	6.57	2.90	52%	31%	14%	4%
1999	927	7.11	3.99	45%	37%	12%	6%

Proposal dwell times in CMS have significantly improved during FY2001-2003 despite increase in proposals and decrease in staff.

CMS Priority Areas

- **Network for Earthquake Engineering Simulation (NEES)**
  - MREFC project, FY00 through FY04, $82M
  - NAE study, NRC report, NEES brochure
  - Operations, FY05 through FY14, $20M/yr proposal under review
  - NEES Research solicitation ($9M/yr), 115 proposals under review
- **Nanomechanics**
  - Approximately 40% of 400 mechanics/materials related proposals are now in the nano area
- **Sensors and sensor networks**
  - FY03 funding was $45.6M for NSF, $27.3M for ENG, and $5.1M for CMS
- **Hazards and hazard response, infrastructure (e.g., structures, construction management), biomechanics, energy and environment, transportation, mechatronics, etc.**

CMS Golden Nugget: Workshops for Faculty Diversity in Civil and Mechanical Engineering

PI – Norma Jean Mattei, University of New Orleans (CMS-0305673)

A 3 day workshop held in September 2003 at NSF for "The Advancement and Retention of Under-represented Engineering Educators" (WEE). This is the fourth such workshop supported by CMS during the past 8 years. The WEE workshop brought together approximately 70 tenure-track faculty and doctoral students from under-represented groups. They were joined by more experienced faculty mentors and program managers from several federal agencies including NSF, ARO, DARPA, FHWA, NASA and ONR. The workshop provides information on a range of topics, selected by workshop participants, aimed at helping junior faculty succeed in their careers

CMS Research Programs

Program Directors for the **Five Research Programs**:

- **Dynamic System Modeling, Sensing & Control**
  Program Directors: Shih-chi Liu (sliu@nsf.gov) and M. (Tomi) Tomizuka (mtomizuk@nsf.gov)
- **Solid Mechanics and Materials Engineering**
  Program Directors: Ken Chong (kchong@nsf.gov) and Yip-Wah Chung (ychung@nsf.gov)
- **Structural Systems and Engineering**
  Program Directors: P. (Bala) Balaguru (pbalagur@nsf.gov) and Steven McCabe (smccabe@nsf.gov)
- **Geotechnical and GeoHazards Engineering**
  Program Directors: Juan Pestana (jpestana@nsf.gov) and Richard Fragaszy (rfragasz@nsf.gov)
- **Infrastructure and Information Systems**
  Program Directors: Jesus de la Garza (jgarza@nsf.gov) and Dennis Wenger (dwenger@nsf.gov)

Program Directors for the **One Major Research Equipment and Facilities Construction (MREFC) Project**:

- George E. Brown, Jr. **Network for Earthquake Engineering Simulation** (NEES) Program Directors: Joy Pauschke (jpauschk@nsf.gov) and Vilas Mujumdar (vmujumda@nsf.gov)

CMS Represents NSF as a NEHRP (**National Earthquake Hazards Reduction Program**) Agency Galip Ulsoy (aulsoy@nsf.gov)

1631 Information Technology and Infrastructure Systems (ITIS)
Jesus M. de la Garza, Program Director

jgarza@nsf.gov (703) 292-7791

Information Technology and Infrastructure Systems

- It creates scientific and engineering knowledge for the intelligent renewal of civil infrastructure by promoting broad application of advanced information technologies to condition assessment, deterioration, and asset management sciences.
- It creates scientific and engineering knowledge for the intelligent design, construction, maintenance, operation and decommissioning of civil infrastructure.

Cross-cutting Areas:

- ITR
- CAREER
- NEESR
- USDOT

Golden Nuggets: Advanced sensor-based project control on construction sites

Burcu Akinci et al., CMU, ITR Award 0121549

- ✓ Laser scanning and embedded sensing allows faster, easier, and more thorough collection of site information, and thus have the potential to help identify defects during construction.

This research is developing:

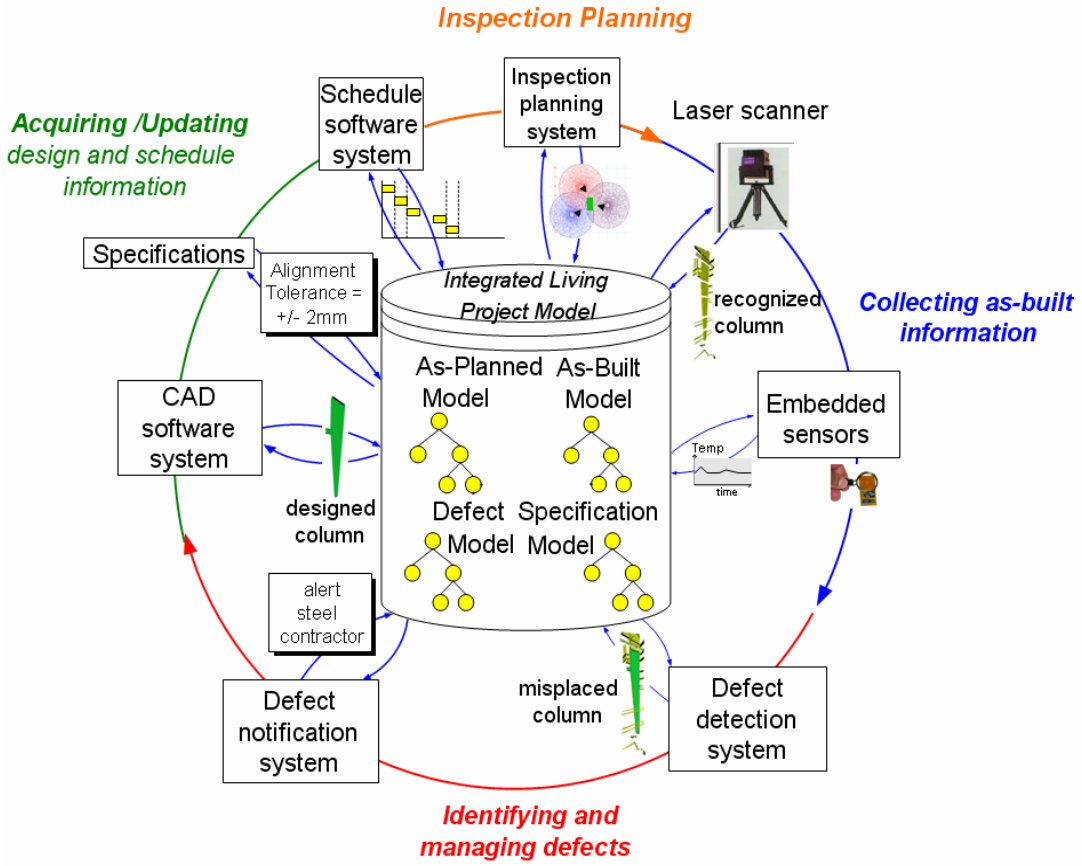
✓ *Approaches* for inspection planning to identify types of sensors to be utilized;

✓ *Strategies* for scan planning to maximize the recovery of 3D data from a scene with minimal sensor placements;

✓ *Algorithms* for object recognition to identify objects in a scene;

✓ *Representation* approaches to integrate design and as-built information;

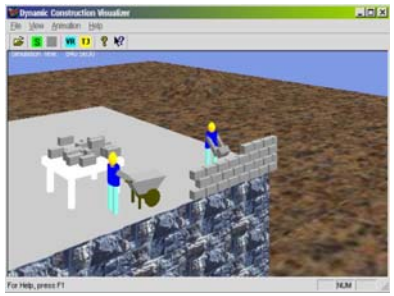
✓ *Formalisms* for automated defect detection which reason about technical specifications.

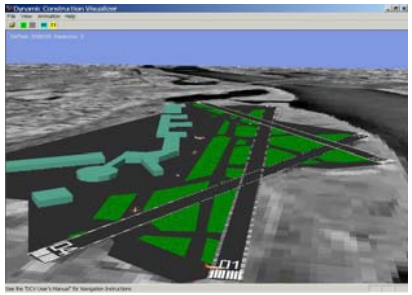


Golden Nuggets:
Dynamic Immersive and Interactive Visualization of Construction Operations

Julio C. Martinez, Virginia Tech, ITR Award 0113890

- ✓ This research has developed ways to describe animated 3D worlds that show how construction operations were/can be carried out, using a text animation description language and references to CAD drawings. The text is written out by end-user programmable software such as Discrete-Event Simulation systems.
- ✓ The 3D animation language allows people to navigate and immerse themselves in this virtual world.
- ✓ In the world of operations analysis, the ability to see a 3D animation of an operation that has been simulated allows for three very important things:
  - ✓ 1) Model verification
  - ✓ 2) Model validation
  - ✓ 3) Model communication



Maturing and Emerging Areas

Maturing Areas:

- Infrastructure Asset Management
- Intelligent Transportation Systems

Emerging Areas:

- Fully automated and integrated project management across all life-cycle phases
- Civil infrastructure systems in a national security context

1638 Infrastructure Systems Management and Hazard Response
Dennis Wenger, Program Director

dwenger@nsf.gov (703) 292-7014

Infrastructure Systems Management and Hazard Response

- Engineering and Social Science Research on Mitigation, Preparedness, Response and Recovery of Infrastructure Systems under Disaster Conditions
- Transportation Research on ITS, modeling, network design, etc.

Cross-cutting areas:

- Human and Social Dynamics (HSD), Leader of Risk Area
- Multidisciplinary Research on Critical Infrastructure and Related Systems (MRCIRS)
- Joint Solicitation with Department of Transportation
- Roundtable on Disasters, National Academy of Sciences
- International Working Group, Subcommittee on Disaster Reduction
- National Earthquake Hazard Reduction Program (NEHRP)
- Subcommittee on Disaster Reduction
- National Disaster Education Coalition

1635 Infrastructure Materials and Structural Mechanics
P. N. Balaguru, Program Director

pbalagur@nsf.gov (703) 292-7020

Infrastructure Materials and Structural Mechanics

Program supports research to advance the knowledge base on: creation and application of advanced structural materials; repair, retrofit, and rehabilitation of structural components; and durability of structural materials and components, including effects derived from interaction with the natural and constructed environment. The program supports research on application of new technologies for performance monitoring and nondestructive condition assessment of structures; development and constitutive characterization of new construction materials; and the behavior of infrastructure materials and structural components, and application of sensor technologies for monitoring and improving materials.

Cross-cutting areas:

Hazard Mitigation, Solid Mechanics, Geotech and Systems, Sensing,DMR,USDOT, HUD/PATH

1637 Structural Systems and Hazard Mitigation of Structures
Steven L. McCabe, Program Director

smccabe@nsf.gov (703) 292-7003

Structural Systems and Hazards Mitigation of Structures

Program focuses on experimental, analytical and computational research on design and performance enhancement of structural systems. The program supports research on new technologies for improving the behavior and response of structural systems subject to natural hazards; fundamental research on safety and reliability of constructed systems and of indoor environmental conditions; innovative developments in analysis and model based simulation of structural behavior and response including soil-structure interaction; design concepts that improve structure performance and flexibility; and application of new sensing technologies and control techniques for structural systems.

Hazard mitigation has traditionally focused on natural events including earthquake and wind. Threats from accidental blast as well as terrorist attack also are being studied and of great interest to PI's. Fire is a significant hazard that deserves more activity – proposals and funding support.

Cross-cutting Activities:

NSF programs: ITR and CyberInfrastructure, NEES and NEESR, NSF/GEO, NSF/INT, CAREER, Sensors, GOALI, EPSCoR

ANSS (USGS), Security (OSTP and DHS), FHWA, E-Defense (Japan), European Commission

1639 Sensor Technology for Civil and Mechanical Systems
Shih-Chi Liu, Program Director

sliu@nsf.gov (703) 292-7017

Sensor Technologies for Civil and Mechanical Systems

Supports research on acquiring and using sensed information about civil and mechanical systems to improve their safety, reliability, cost, and performance. This includes research that extends the knowledge base for development of advanced sensors for solution of problems related to system identification and characterization, and for implementation of real time autoadaptive system performance capabilities that use the sensed information. Examples of research areas to be supported include innovative developments in sensor technologies, scalable/modular signal processing techniques and embedded microprocessor,analytical strategies for CMS monitoring, and active noise and vibration control technologies.

Cross-cutting areas:

Describe here interactions with other agencies, priorities, initiatives, other programs, CAREER, etc.

1636 GeoEnvironmental Engineering and GeoHazards Mitigation

Juan Pestana, Program Director

jpestana@nsf.gov (703) 292-7004

GeoHazards Mitigation Component:

- geotechnical earthquake engineering and strong ground motions,
- scouring, tsunamis (both earthquake and non-earthquake generated),
- landslides and debris flows, forest fires, droughts and floods.

GeoEnvironmental Engineering Component:

- physical, chemical, thermal and biological processes affecting the properties of geologic materials and thus controlling contaminant transport in surface and subsurface flow.
- remediation and containment of contamination.

Significant synergy with: Geomechanics and Geotechnical Systems (1634) & Structural Systems and Hazards Mitigation of Structures (1637), NEESR, NOAA.

Cross-cutting areas: Environmental Engineering and Technology (BES); Hydrologic Sciences (EAR/GEO); Geophysics (EAR/GEO).

Joint activities:

CAREER, GOALI, Major Research Instrumentation (MRI), Math, Biocomplexity in the Environment (BE), CI & ITR, Nano Science & Engineering (NSE).

1634 Geomechanics and Geotechnical Systems
Richard J. Fragaszy, Program Director

rfragasz@nsf.gov (703) 292-7011

Geomechanics and Geotechnical Systems

- **Soil & Rock Mechanics and Dynamics, Foundation Engineering, Earth Structures, Groundwater Hydrology and Mining Engineering**
  - Constitutive and Numerical Modeling
  - Laboratory, Centrifuge & Field Experimental Investigations
  - Site Characterization
  - Sensor development and utilization

- **Current Concentrations**
  - Urban Geotechnical Construction (excavations and tunneling)
  - Unsaturated Soil Mechanics
  - Micromechanics (especially imaging techniques)

- **Cross-cutting Areas**
  - Deep Underground Science & Engineering Laboratory (DUSEL)
  - Diversity Issues and Predominately Undergraduate Institutions (PUIs)
  - Information Technology Research (ITR)
  - Partnering with GEO Directorate (EAR Division)

1644 George E. Brown, Jr. Network for Earthquake Engineering Simulation

Joy M. Pauschke and Vilas Mujumdar, Program Directors

jpauschk@nsf.gov (703) 292 7024 and vmujumda@msf.gov (703) 292-7262

Goal

- Improve understanding of effect of earthquakes on building and infrastructural systems through collaborative research

Construction Period (FY 2000 – FY 2004)

- $81.8 million plus additional $1.1 million from EPSCoR
- 18 cooperative agreement awards

Operation Period (FY 2005 – FY 2014)

- Consortium incorporated January 2003
- Extensive community input over two-year period
- Proposal submitted October 2003 and under review for FY2005 – FY 2009

Research

- NEESR Program Solicitation NSF 03-589
- 115 proposals submitted January 2004
- Available funding: $9 million (FY 2004) to $20 million (FY 2014)

1630 Mechanics and Structures of Materials (MSM)
Ken P. Chong, Program Director

kchong@nsf.gov (703) 292-7008

Mechanics and Structures of Materials

Supports research on computational, theoretical, analytical and experimental solid mechanics, biomechanics, and nanomechanics; model based simulation and constitutive models; and the link of microstructure to nano-, meso- and macro-scale structural behavior. The program also supports experimental and analytical research on deformation, fatigue, and fracture and underlying nano- and micro-structural states and their origin, transformation and evolution.

Cross-cutting areas:

- Nano Science and Engineering [NER, NIRT, NSEC, NSEE – NCLT,…]
- Durability initiative [FHWA, AFOSR, DMII, BES, DMR…]
- NSF-SANDIA [eng. sciences for modeling and simulation]; NIST - ATP
- BES [QSB; tissue eng., heart valves durability]; FDA [scholar-in-residence]
- NNIN; IGERT; ITR, MATH, MSERC
- CAREER, INT, GOALI,…
- RPI MULTI-SCALE PROJ. [CMS, DMII, EEC, DMS]

1633 Surface Engineering & Materials Design (SEMD)
Yip-Wah Chung, Program Director

ychung@nsf.gov (703) 292-7476

Surface Engineering & Materials Design

- Microstructure design and control from micro to nanoscale
- Properties and performance of materials and surfaces for novel applications in civil and mechanical components and systems; biomedical applications
- Coatings and advanced surface treatments; tribology
- Simulation and computational materials engineering

Cross-cutting areas:

- Nanoscale science and engineering
- Joint activities with IGERT, IUCRC, DMR, DMII and international programs
- CAREER, GOALI, EPSCoR

1632 Dynamic Systems and Control (DSC)
Masayoshi Tomizuka, Program Director

mtomizuk@nsf.gov (703) 292-7012

Dynamic Systems and Control (DSC)

Supports research to establish fundamental advances in the understanding of time varying phenomena underlying system dynamic behaviors, including acoustics and vibrational responses. The program also supports research that leads to advances and novel developments in control system technologies and strategies with broad applicability to both mechanical and civil systems.

Cross-cutting Areas:

Sensors and sensor networks; Interactions between the Mathematical Science and Engineering; Dynamic Data Dependent Applications Systems; CAREER

1631 Information Technology and Infrastructure Systems (ITIS)
Jesus M. de la Garza, Program Director

jgarza@nsf.gov (703) 292-7791

Revisited focus for ITIS

	Model dev.	IT	Sensors	HSD	MRI	NEESR
Transportation Engineering						
Infrastructure Asset Management						
Construction (as a noun)						

1631 Information Technology and Infrastructure Systems (ITIS)
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- **Upcoming Deadlines**
  - **HSD: March 30, 2004**
  - **CAREER: July 21, 2004**
  - **Unsolicited: December 1, 2004**
  - **NEESR: December 8, 2004**
  - **MRI: January 27, 2005**
  - **Sensors: 2004 under consideration**
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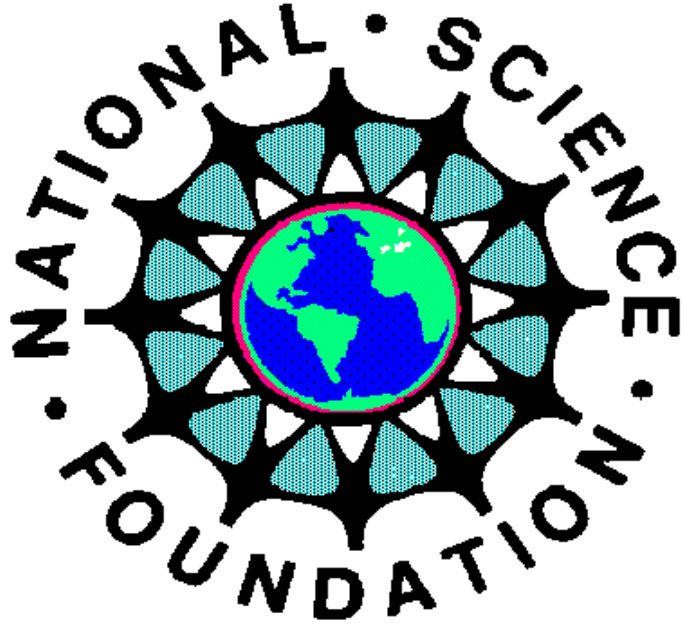
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