

# Institute for Imaging & Analytical Technologies

**Mission: To foster MSU's leadership roles in state-of-the-art research and education in the cognitive, life, and materials sciences and engineering, promote economic development, and create high technology employment opportunities in the State of Mississippi.**

**Infrastructure, Resources, and Facilities:**

**Imaging & Analysis Across Scales**

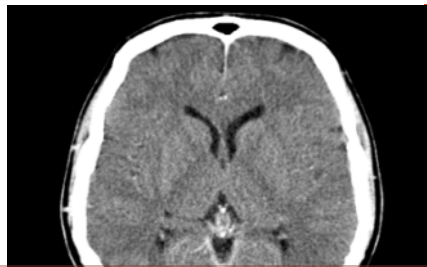
[www.i2at.msstate.edu](http://www.i2at.msstate.edu)

**Microscopy technologies & Clinical partnership technologies**

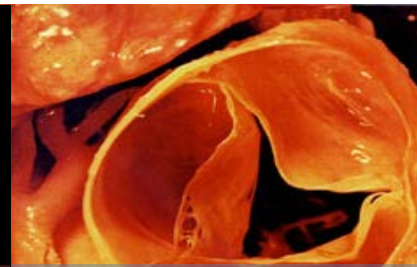


## Merger of EMC and INST

- Combines major research instrumentation into one focused organization
- Represents more than a \$7 million investment of competitive grant and MSU funding in technology-based infrastructure
- Enhances support for student, faculty and staff researchers
- Facilitates multi- and inter-disciplinary research efforts
- Moves MSU's research-success portfolio to the next level
- Facilitates instruction in the STEM disciplines
- Serves as a valuable tool for building collaborative relationships with high-tech industries and science- and technology-centered government agencies and health-related agencies
- Serves as a significant resource for the state and region's economic development efforts



Modeling head trauma  
L. Williams, J. Liao, R. Prabhu, D. Peterson  
Funded by U.S. Army & IGCB



Heart valve mechanobiology  
J. Warnock  
Funded by NSF



Effects of nanoparticle inhalation on lungs  
B. Nanduri & M. Edelman  
Funded by NSF

## Imaging and Analysis Technologies

Atomic Force Microscopy (NSF)

Scanning Electron Microscopy (NSF; ORNL, EMC)

Transmission Electron Microscopy (NSF)

X-ray Diffraction (NSF)

Confocal Laser Scanning Microscopy (EMC, MAFES, ORED)

3T Magnetic Resonance Imaging (ONR)

Electroencephalogram (ERP Lab)

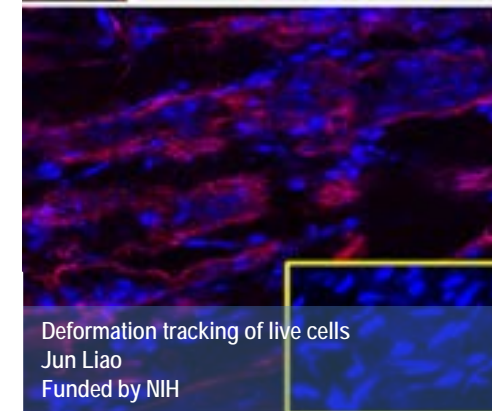
64-Slice CT (Computed Tomography)

4D Ultrasound

Linear Accelerator (IMRT, IGRT, SRS, SBRT)

## Biological Imaging Expertise

## Materials Characterization Expertise



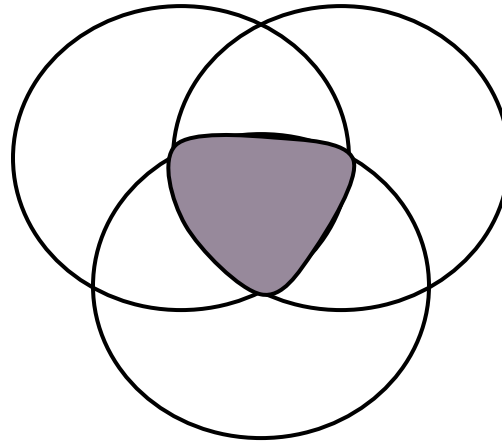
# Diverse Disciplines

## Life Sciences

- ❖ Agriculture
- ❖ Animal/Dairy
- ❖ Biochemistry
- ❖ Biology
- ❖ Diagnostics
- ❖ Kinesiology
- ❖ Pathology
- ❖ Plant

## Social Sciences

- ❖ Anthropology
- ❖ Psychology
- ❖ Sociology



## Materials Sciences

- ❖ Chemistry
- ❖ Energy
- ❖ Forest Products
- ❖ Geosciences
- ❖ Materials
- ❖ Physics

## Engineering

- ❖ Biological
- ❖ Chemical
- ❖ Civil
- ❖ Computer Sciences
- ❖ Electrical
- ❖ Industrial
- ❖ Materials
- ❖ Mechanical

From the Study: *Functional Magnetic Resonance Imaging Shows Potential for Predicting Individual Differences in Fatigue Vulnerability* (Caldwell 2004)

Pilot  
Least Fatigue  
Vulnerable



Pilot  
Most Fatigue  
Vulnerable



Individual pilots t-maps during performance of Sternberg Working Memory Test (SWMT) in the MRI scanner.

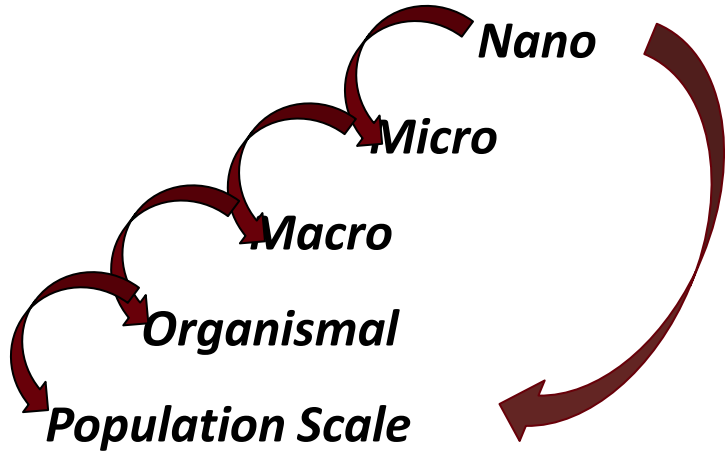


<b>Industries, Universities</b>	<p>Aurora Flight Sciences BarSiC Carl Zeiss Inc, Diversified Technologies, ERDC Vicksburg GE Aircraft Griffin Industries, General Electric Gulf States Ice-Robotics Ltd, Nissan, Toyota, Northrup-Grumman Paccar Premiere Radiology RAMS LLC, RMI, SemiSouth Laboratories, Severstal, Starkville Cancer Clinic II-VI Inc, VT Halter Marine, U.S.D.A., Weavex University of Mississippi, Jackson State University, University of Southern MS, University of Alabama University of Arkansas Office of Navy Research</p>
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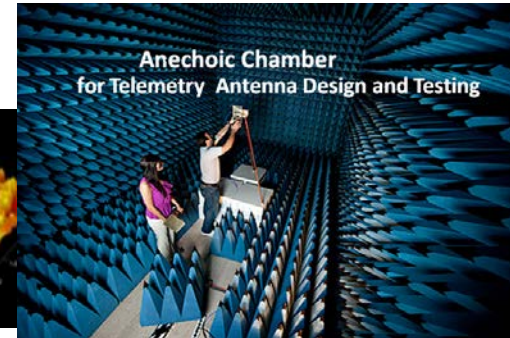
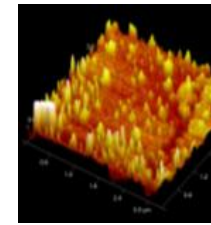
<b>College of Agriculture &amp; Life Sciences</b>	<p>Agricultural &amp; Biological Engineering Biochemistry &amp; Molecular Biology Entomology &amp; Plant Pathology Plant &amp; Soil Sciences</p>
<b>College of Business</b>	<p>Economics Information Systems</p>
<b>College of Arts &amp; Sciences</b>	<p>Biological Sciences Chemistry Geosciences Psychology Sociology, Anthropology, Social Work</p>
<b>College of Engineering</b>	<p>Aerospace Engineering Chemical Engineering Electrical &amp; Computer Engineering Mechanical Engineering Industrial &amp; Civil Engineering</p>
<b>College of Forest Resources</b>	<p>Department of Forestry Department of Forest Products</p>
<b>College of Vet Medicine</b>	<p>Pathology Clinical Sciences Basic Sciences</p>
<b>Centers / Institutes</b>	<p>Center for Advanced Vehicular Systems Institute for Clean Energy Technology Institute for Genomics, Biocomputing &amp; Biotechnology Social Science Research Center</p>



By supplying a diverse array of technologies for and expertise in imaging and analysis, the range of research opportunities facing MSU and our collaborative partners is truly unlimited.

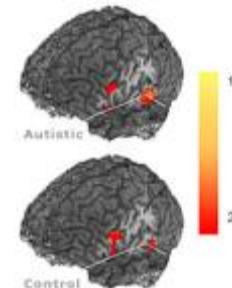
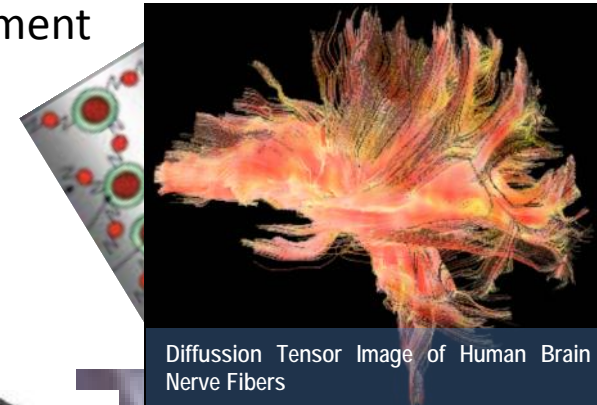


## Infrastructure



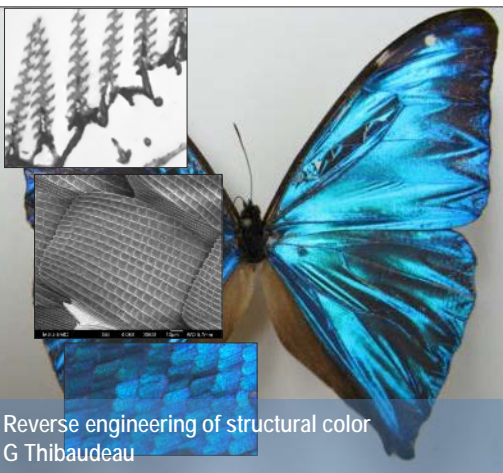
NanoScience/Technology in Nanomedicine to Intervention and Treatment

**Design and synthesize materials and nanoparticles**  
**Test toxicity & viability for use as sensors, remediation, therapy etc**  
 cellular trials  
 animal trials  
 human clinical trials  
 population studies

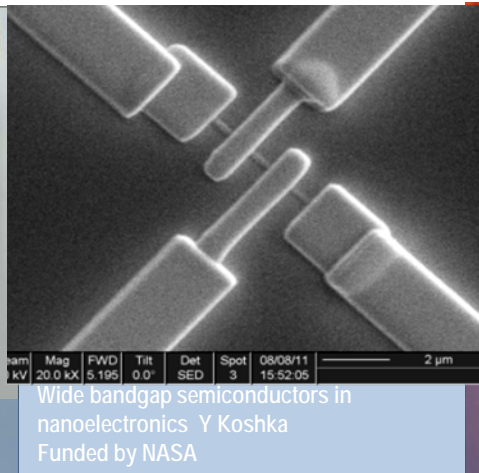


**Expertise:**

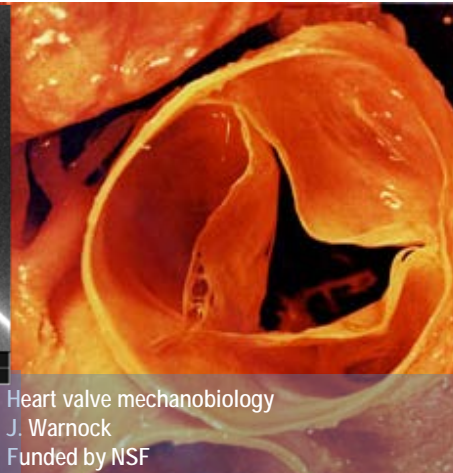
***Material science/engineering: material imaging, characterization, analysis, simulation, applications.***



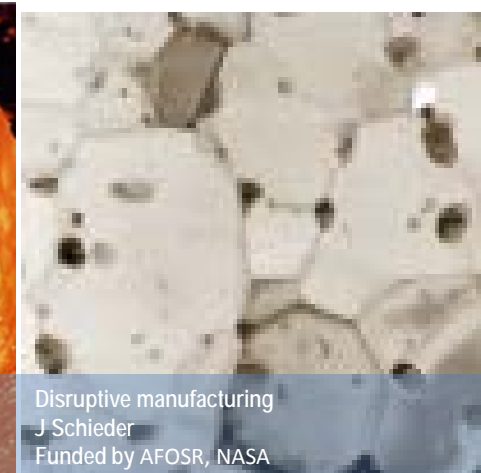
Reverse engineering of structural color  
G Thibaudeau



Wide bandgap semiconductors in nanoelectronics  
Y Koshka  
Funded by NASA



Heart valve mechanobiology  
J. Warnock  
Funded by NSF



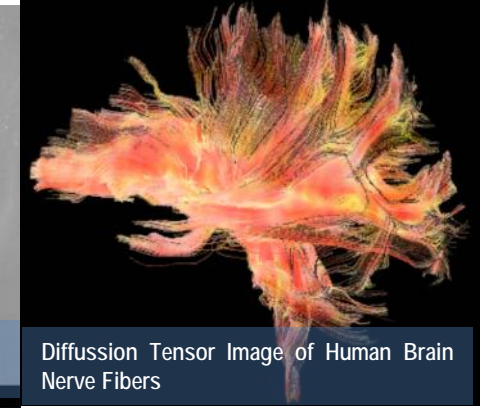
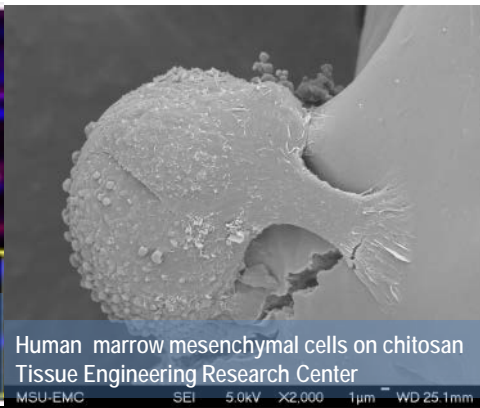
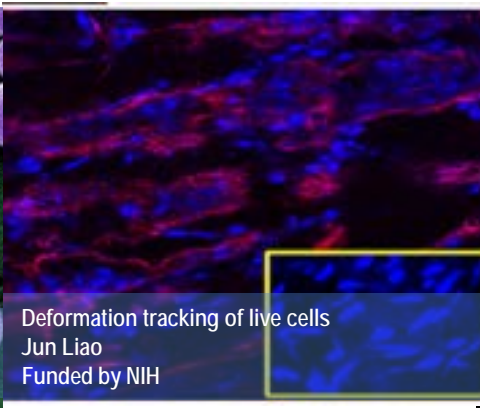
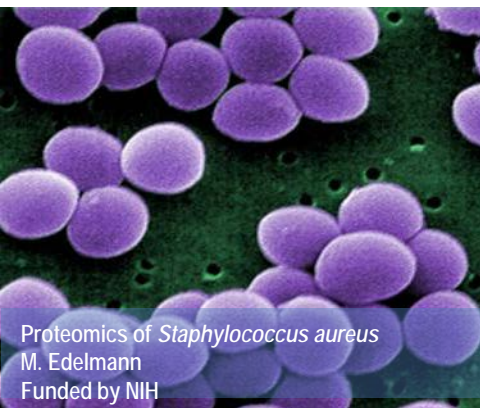
Disruptive manufacturing  
J Schieder  
Funded by AFOSR, NASA

**Impact Related to Materials Research:**

- Nanoscale/Microscale mechanical testing, device and material development, detection/assessment of cracks and deformation in hard materials
- Nanoscale/Microscale imaging to identify relationships of elements and materials; macroscale modeling of materials
- Imaging for design and development of novel materials and novel applications

## Expertise

***Life Science: basic and applied biological imaging, analysis, simulation, and applications.***



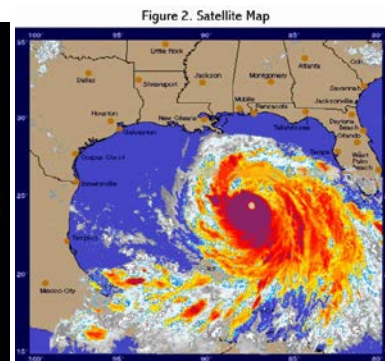
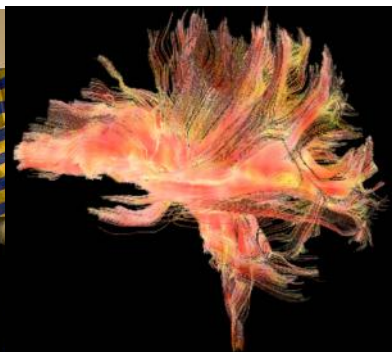
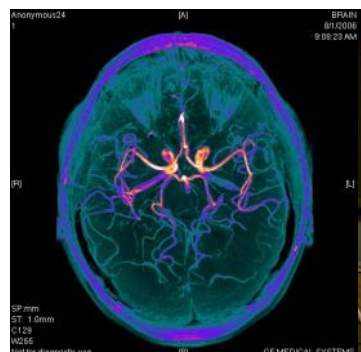
## Impact Related to Health Research:

- Nanoscale mechanical testing, device and material development, detection/assessment of injury in soft materials and deformation in hard materials
- Nanoscale imaging to identify host/pathogen relationships; macroscale modeling of organs
- Imaging for diagnosis, surgical planning and intervention; Learning and skill acquisition to social and environmental effects on cognition



## Expertise:

**Neuroscience:** clinical sciences, human factors, threat/risk perception, implications for decision making, applied image processing, materials design.



## Impact Related to NeuroScience and Cognition:

- Relate imaging results to behavioral results in meaningful way
- Imaging results used to inform and improve training, employee selection, interface design
- Imaging results inform decision, presentation and training
- Developing and improving the research quality of image processing in MR applications
- Design/Fabrication of MR-compatible Materials & Devices

Driving,  
Law Enforcement,  
Military, Weather,  
At-Risk Children

Diagnostics,  
Surgical &  
Treatment  
Planning,

# Education/Outreach

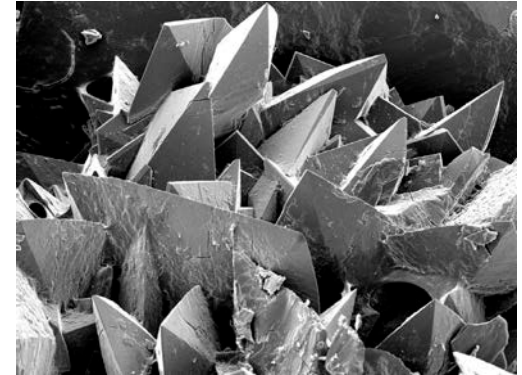
Sample of the diverse education/outreach activities that I<sup>2</sup>AT is involved in.

K-12 Outreach	
Mississippi Schools (Public, Private, Home School)	11-12 grade students
Teacher Enhancement Programs	7-12 STEM teachers
Teachers for Competitive B.S. (distance learning capstone)	7-12 STEM teachers
MSU/MSMS Research Partnership	11-12 grade students
University Outreach	
Undergraduate Course Work	Undergrad
Research Experience for Undergraduates	Undergrad
Graduate Course Work	Graduate students
Graduate Fellows in K-12; Research Experience for Teachers	Graduate students/Te
Maymester I <sup>2</sup> AT Capability Overview	Faculty and Post-doc
Visiting Faculty Researchers/Faculty Candidates	Faculty
Industry Outreach	
Materials Industries (e.g. II-VI, SemiSouth, WeaveX)	Interns, Employers, S
Life Science Related Industries (e.g. Memphis Zoo, Gulf-Coast Inst, USGS, Veterinary Medicine)	Interns, Employers, Students
Health Related Industries (e.g. Cancer Center, Premiere Imaging, Specialty Veterinary Clinic )	Interns, Employers, Students



# SERVICE: Provide Critical Services to the Community and the State

Making imaging and analytical equipment available for research, development and quality control to regional materials, agricultural, and health-related industries

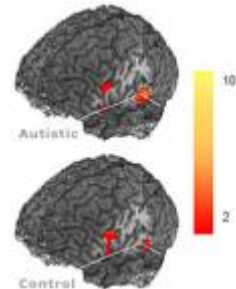


Making biological imaging equipment available for research, diagnostic and therapeutic use to physicians and veterinarians



Training a high-tech workforce

Recruiting high-wage jobs to Mississippi

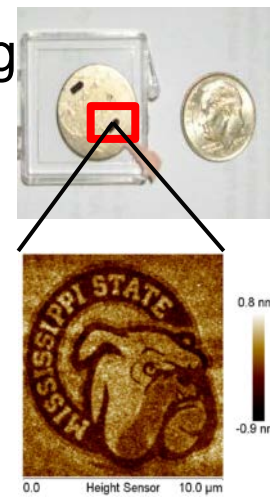


# Promote Economic Development

As a world leader in state-of-the-art research, education, and service provision in the areas of

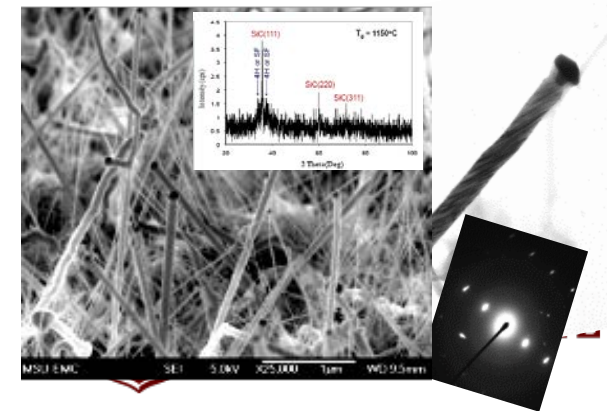


- Materials science/engineering
- Materials characterization
- Biological imaging
- Veterinary medicine
- Biomedical engineering
- Cognitive neuroscience



Catalyst for University/Industry Partnerships

Magnet for high-tech industries and federally funded research projects



# Expansion to Serve Materials Characterization Needs of the Larger Research Community



- Critical Need Defined
- Business Plan Created
- University Support
- Industry Support (LOS)
- RTC Support
- Strategic Planning
- Working Groups
- Listening to Industry Needs

Site Plan - MSU Incubator & II-VI Buildings  
Scale: 1"=80'-0"

Floor Plan - Analytical Research Addition  
Scale: 5'-0" Grid 7,150 SF

# Next Steps

What can the I<sup>2</sup>AT do to meet the characterisation needs of regional industry?

What can the I<sup>2</sup>AT do to foster and sustain mutually productive industry/university partnerships?

How can we help promote MSU, our resources and expertise to partner with, attract, and retain industry to the State.

**NANO-BULLY**

