Research Enterprise at IUPUI - From Discovery to Innovation

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IUPUI

INDIANA UNIVERSITY–PURDUE UNIVERSITY INDIANAPOLIS

IUPUI Research

Vision:

To be the best urban research university by conducting world-class research, scholarship, and creative activities that develop knowledge and contribute to the economic growth and social advancement of Indiana and the nation and benefit humanity as a whole.

Mission:

To develop and expand innovative research programs that align well with institutional mission and strategic plan, address important national and global needs, and through technology transfer and commercialization noticeably support the economic development of Indiana and the nation.
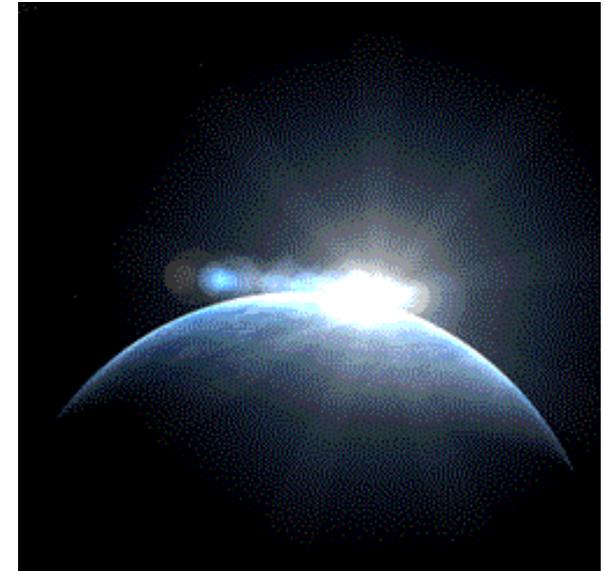
Major Initiatives

Translating Research Into Practice (TRIP)

- Launched in 2007
- Takes knowledge generated from scientific inquiry and humanistic scholarship and transforms it into practices and solutions that improve people's lives, benefit industry, and contribute to social well being and economic growth
- Some Examples:
  - Geriatrics Education Network of Indiana (GENI), improving quality of care for older adults
  - Novel targeted therapies for effective treatment of breast cancer
  - ANGEL Learning, one of the fastest growing IT companies in Indiana commercializing educational learning tools
  - Advanced Virtual Manufacturing Laboratory (AVML), developed with industrial partner Advanced Science and Automation Corp., provides virtual training and education on high-tech Computer Numerically Controlled (CNC) machines.

Major Initiatives

Signature Centers Initiative

- Launched in 2006
- Supports interdisciplinary collaboration from across campus to build nationally and internationally known research centers of excellence
- 2006 – 2007 "Round 1 Centers"
  - Binational/Cross-Cultural Health Enhancement Center
  - Center for Advanced Studies in Hearing, Perception and Language
  - Center for Assessing, Understanding, and Managing Pain
  - Center for Bio-Computing
  - Center for Computational Diagnostics
  - Center for Earth and Environmental Science
  - Center for Family Violence Prevention, Education and Research
  - Center for Regenerative Biology and Medicine
  - Center for the Study of Religion and American Culture
  - Cellular Therapy, Hematopoietic Stem Cell Transplant Center
  - Consortium for Health Policy, Law, Bioethics
  - Institute for Research on Social Issues
  - IUPUI Center for Mathematical Biosciences
  - PREGMED: Pharmacogenetics and Therapeutics Research
  - Randall L. Tobias Center for Leadership Excellence
  - Richard G. Lugar Center for Renewable Energy
  - Service Learning Collaborative
  - Tobacco Cessation and Biobehavioral Center

IUPUI INDIANA UNIVERSITY–PURDUE UNIVERSITY INDIANAPOLIS

Richard G. Lugar Center
for Renewable Energy

Major Initiatives

Signature Centers Initiative

- 2007 – 2008 "Round 2 Centers"
  - Android Science Center
  - Assertive Community Treatment Center
  - Biomechanics and Biomaterials Research Center
  - Center for Atopic Dermatitis
  - Center for Health Geographics
  - Center for Membrane Biosciences
  - Indiana Center for Systems Biology and Personalized Medicine
  - Institute of Intrinsically Disordered Proteins
  - Transportation Active Safety Institute
  - Vascular and Cardiac Center for Adult Stem Cell Therapy

IUPUI Research Enterprise Support

Research Development

- Programs & Resources for Faculty, Students, Centers, Institutes
  - Center for Research and Learning
  - Internal Funding Programs
  - Other

Research Administration

- Office of Research Administration
  - Grant & Contract Services
  - Compliance Services
  - Other

Research Linkage To Community

- Solution Center
  - Community partnerships through research, internships, & business assistance

Technology Transfer

- Indiana University Research & Technology Corporation (IURTC)
  - Office of Technology Transfer
  - Indiana University Emerging Technologies Center (IUETC)

Multidisciplinary Undergraduate Research Institute (MURI)

- Launched in 2005
- Multidisciplinary team research experience for undergraduate students
- Open to undergraduates from all disciplines on IUPUI campus
- Faculty and research mentors from the School of Engineering and Technology
- Provides valuable experience to undergraduate students seeking professional positions upon graduation or planning to pursue advanced degrees of interest to industry
- Industry sponsorships are welcomed for funding of MURI teams on topics of interest to industry

Biomedical Engineering

- **Major Research Resources:**
  - Biomechanics and Biomaterials Research Center (Signature Center)
  - $3 Million in external funding: NIH, Foundations, Industry

- **Main Areas of Current Research:**
  - Orthopedic Biomechanics and Molecular Engineering
  - Cardiovascular Biomechanics and Electrophysiology
  - Neuroscience and Neural Engineering
  - Imaging

- **Major Research Results and Innovations:**
  - Faculty publish over 60 peer reviewed journal papers, annually
  - More than 10 patents filed in past 5 years

Electrical & Computer Engineering

Engineering Better Lives:
Electrical and Computer Engineering

- Major Research Resources:
  - Driving Simulator Laboratory: Drive Safety DS-600c Driving Simulator, STISIM WT 2000 Driving Simulator, CompuMedics physiological data acquisition system
  - Pattern Recognition and Biometrics Laboratory: IRIS camera and recognition system, finger print recognition system, vehicle recognition system
  - DSP and Visual Communication Laboratory: DSP and multimedia development hardware and software tools
  - Intelligent Systems and Control Laboratory: real-time motion and motor control testbed, computational intelligence tools, Intelligent power grid interconnect testbed
  - Micro- and Nano-Electronics and VLSI Laboratory: Mentor Graphics Tools for VLSI and ASIC Design, Synopsis EDA software

- Main Areas of Current Research:
  - Controls and intelligent systems: computational intelligence and applications, control of hybrid vehicles, intelligent power and grid interconnect controller, power control of wireless communication systems, discrete event systems

Electrical & Computer Engineering

- ## Main Areas of Current Research (cont'd):
  - Communications and DSP: signal/video/image processing, visual communications, speed recognition and processing
  - Computer engineering: biometrics, wireless networking, data and computer security, sensor network, computer architecture
  - Transportation active safety: sensor/data fusion, controls, human factors in semi-autonomous driving, sleepy and fatigue driving
  - Microelectronics, VLSI design and nano-electronics
  - Bio-electrical engineering: medical imaging, medical and diagnostic devices and systems, heath service research

- ## Major Research Results and Innovations:
  - Integrated interconnect controller for distributed generation system
  - Non-cooperative IRIS recognition system
  - Vehicle identification system and software tool

Mechanical Engineering

- Major Research Resources:
  - Renewable Energy: Fuel cell testing facility, Battery Testing facility
  - Manufacturing: Advanced Virtual Manufacturing Training facility, CNC machine center, Sensors and Inspection facility
  - Combustion and Propulsion: Combustion Diagnostic System, Wave Rotor Sealing Testing Rig, Single-Channel Internal Combustion Wave Rotor
  - Computational Engineering: High Power Computing Facility
  - Dental Biomechanics: Orthodontic Treatment Simulators, 3D Laser Scanner, and Orthodontic Force Testers
  - Mechatronics and Intelligent Systems: Steer-By-Wire System Bench, Rapid Control Prototyping Machine, Hardware-In-Loop Bench

Mechanical Engineering

Engineering Better Lives:
Mechanical Engineering

- ## Main Areas of Current Research:
  - Biomechanics: Orthodontic Treatment Optimization
  - Computational Engineering: Application of CFD, Parallel Computing, Multi-scale Modeling
  - Combustion and Propulsion: Development of Wave Rotor Technology
  - Design and Advanced Manufacturing: Virtual Manufacturing Training Simulators, Machining Optimization
  - Renewable Energy: Fuel Cell Technology, Hydrogen Storage, Battery Technology
  - Materials: Self-healing Polymer, Rubber, Nano-materials
  - Mechatronics and Intelligent Systems: Fault Tolerant Control of Automotive Systems, Advanced Engine Control and Diagnostics, Large-Scale System Modeling and Simulation

- ## Major Research Results and Innovations:
  - Wave Rotor Technology
  - Advanced Virtual Manufacturing Training facility
  - Plug-in Hybrid Electric Vehicle Technology
  - Fuel Cell Membrane Technology

Engineering Technology

- **Major Research Resources:**
  - Construction Materials Characterization Laboratory
  - Renewable Energy Laboratory
  - Rapid Prototyping System
  - Auto Identification Laboratory
  - Automation Laboratory

- **Main Areas of Current Research:**
  - Systems Modeling
  - Trenchless Technology for Underground Infrastructure
  - Pipeline Engineering
  - Watershed Management
  - Infrastructure Assessment

Engineering Technology

- Main Areas of Current Research (cont):
  - Lean and 6-Sigma Healthcare Engineering
  - Lean and 6-Sigma Manufacturing
  - Alternative Energy Solutions
  - Fuel Cell Design
  - Solar Cell Design
  - Electrochemical Systems
  - RFID in Healthcare Facilities
- Major Research Results and Innovations:
  - Lower Cost Fuel Cells
  - Safer Healthcare Environment
  - More Efficient Healthcare Delivery

Computer, Information, and Leadership Technology

- Major Areas of Research Focus

    - STEM Education in K-12 and Collegiate Environments
    - Workforce and Employee Engagement
    - Networking and Security
    - Online Course Development and Delivery
    - Leadership Development and Supervisory Management
    - Sustainability in Organizational Settings
    - Teamwork

Design & Communication Technology

- Major Research Resources:

    - Architectural Technology (ART): Sustainable building practices, Green Methods in construction

    - Computer Graphics Technology (CGT): Implementation of graphics courses to diverse populations, Instructional delivery methods, Engagement with student research in Study Abroad opportunities

    - Interior Design (INTR): Building and space design for aging populations

    - Technical Communications (TCM): Instructional delivery methods online

Design & Communication Technology

Technology That Drives the Future:
Design and Communication Technology

- Main Areas of Current Research:

  - ART: Global Design Studio projects in New Orleans' Broadmoor district, and Indonesia
    - Methods for delivering courses online to diverse populations in the USA, Canada and Indonesia
    - Improvement in courses to reflect current Green practices

  - CGT: 10 research reports generated by students who participated in CGT Study Abroad and funded by UROP
    - CGT Study Abroad Program expanded in Poland to include research needs of public and business practitioners
    - New delivery methods implemented online

  - INTR: Environmental Simulation of Lighting Perception conducted with the Advanced Visualization Lab and the CAVE Virtual Environment at the School of Informatics

  - TCM: New delivery methods researched for online delivery

Design & Communication Technology

- Major Research Results and Innovations:

  – ART: New buildings being constructed in New Orleans and Indonesia using diverse materials and meeting Green standards

  – CGT: New course delivery techniques now added to several classes which implement online delivery of materials

  – INTR: New courses topics now added to curriculum as a result of research in lighting practices and aged population needs

  – TCM: Courses online now available in greater numbers

Music & Arts Technology

- Major Research Resources:

  – Donald Tavel Digital Arts and Technology Research Center
  – Telematic Performance Laboratory – Internet2 Collaborations in the Arts
  – Digital Audio and Electronic Music Composition Studio
  – Digital Keyboard Laboratory – Computer-based Instruction
  – Distance Learning Music Classrooms – Real-time Video-streaming of Graduate Courses
  – Digital Performance Recital Hall (with Surround-Sound, 3-D Projectors, Audio and Video Recording and Production) for Internet-based Collaborative Performances.

Music & Arts Technology

- Main Areas of Current Research:

  - Research in Music Therapy
    - Pain Mediation of Cancer Patients through Music
    - Music Listening Applications to reduction of Menopause Symptoms

  - Telematic Performance on Internet-2
    - Transmission latency related to music performance
    - Shared bandwidth between video/stereo-audio transmission

  - Development of Digital Music Library - Variations Project
    - Digitized music resources for on-line music course development
    - On-line music course evaluations of audio and video resources

  - Music performance evaluation through pitch-detection software
    - Instructional Music Software Development with pitch-detection

  - Distance and On-Line Curriculum Development in Graduate Program
    - Internet2 and the Performing Arts Initiative

Music & Arts Technology

Music and Arts Technology

- Major Research Results and Innovations:

    - Internet-2 Music Initiative (State of Indiana Collaborative)
    - NIH Funded Research in Music Therapy – Pain Interventions
    - Telematic Performances on the ArtsGrid
    - International Music Technology Conference and Workshop (18 Years)
    - Live Video-Streamed Graduate Courses and On-Line Degree (1st in USA)
    - Computer-based Music Assessment (Pitch-detection Software)

Conclusion

- Through the development of world-class research and innovative educational programs, IUPUI is well positioned to become one of the top urban research universities, with major impact on the economic growth and social advancement of Indiana and the nation.

- The IUPUI areas of priority in engineering & technology research include:
  - Renewable Energy
  - Advanced Manufacturing
  - Controls and Intelligent Systems
  - Biomechanics and Biomaterials

- Centers of excellence in areas of priority include:
  - Richard G. Lugar Center for Renewable Energy
  - Transportation Active Safety Institute
  - Biomechanics and Biomaterials Research Center