

# Research Resources and Centers

## **Vice President for Research:** Arthur C. Sanderson

Research plays an integral role in Rensselaer's vision of the technological university. The discovery and application of new scientific concepts and technologies, especially in emerging interdisciplinary fields, are core goals for faculty, staff, and students. Our research programs reach across the campus, linking together departments, schools, and interdisciplinary centers, and creating opportunities for integration of research and education. Undergraduates work one-on-one with faculty members in real-world, hands-on research as part of Rensselaer's Undergraduate Research Program (URP). In addition, research drives technological entrepreneurship and commercialization, interfacing closely with the Rensselaer Technology Park and Incubator Center.

The Office of the Vice President for Research provides infrastructure and resource support for the development of research programs and projects. Support services are offered for faculty seeking research opportunities, research proposal and budget preparation, and guidance on research management and intellectual property policies. The Office coordinates major research themes and programs through interdisciplinary research centers. Links from this Web site offer overviews of these centers, reviews of major research projects and recent accomplishments, as well as information on research policies, guidelines, and infrastructure.



## **Center for Automation Technologies**

**Director:** Harry E. Stephanou

**CAT Home Page:** <http://www.cat.rpi.edu/>

The CAT has been designated since 1988 as a Center for Advanced Technology by the New York State Office for Science, Technology and Academic Research (NYSTAR).

Interdisciplinary teams of faculty, staff, and students work closely with the Center's industrial partners to conduct basic and applied research aimed at radical industrial innovations.

Research programs in the CAT are focused on microsystems and nanosystems technology and include topics such as precision motion control, distributed microrobotic systems, massively parallel microassembly, modular micropackaging processes, and their applications to microphotonic and microfluidic systems. State-of-the-art laboratory facilities enable the rapid prototyping of novel micromanufacturing processes.

**Faculty and Staff** S. Akella, K. Anderson, W. Baeslack, Y. Bellouard, T. Borca-Tasciuc, Parthi Datta, W. Huang, W.H. Lee, J. Lu, P. Mancharam, H. Merrill, G. Nagy, Yoau Peles, D. Popa, A. Sanderson, G. Saunders, H. Stephanou, D. Walczyk, B. Wales, J. Wen, J. Winston, M. Wozny

## **Center for Integrated Electronics**

**Director:** Omkaram (Om) Nalamasu

**Associate Director:** Toh-Ming Lu

**Associate Director:** Morris Washington

**CIE Home Page:** <http://www.rpi.edu/dept/cie/>

The Center for Integrated Electronics (CIE) was created to carry out industry-oriented research in electronics design and manufacturing, on-chip interconnect, and the development and utilization of electronic media. CIE emphasizes all aspects of integrated electronics and electronics manufacturing (from the chip-board-system levels) and now adds the application of electronics to create interactive learning materials which will revolutionize the way technology is used at all levels—from young child to senior citizen.

The technology areas of CIE currently include, but are not limited to, IC processing techniques, semiconductor devices, multilevel interconnect technology, optoelectronic materials and optoelectronics, broadband devices, power devices, biochips, microwave devices, terahertz devices, thermophotovoltaic devices, electronics packaging, design, modeling and simulation, design and assembly methodologies, polymer synthesis for a variety of applications, low and high dielectric constant materials, and other advanced materials, devices, and processing.

The Center's activities range from basic and applied research and education to commercialization through partnerships with industry. A complement of about 50 faculty, 100 students, and 15 full-time research staff conduct research activities incorporating projects for specific companies, as well as longer-range programmatic efforts in fundamental areas of materials processes, design, fabrication, and characterization related to integrated electronics, electronics manufacturing, and electronic media.

State-of-the-art facilities enhance research opportunities and include a Class 100 microfabrication clean room with processing capabilities both for Si and III-V base devices/circuits, and microsystems, extensive computer resources from such companies as Apple, AT&T, DIGITAL, Hewlett Packard, IBM, and Sun, and numerous state-of-the-art processing design and characterization facilities in individual laboratories. Located on the Rensselaer campus, the CIE has immediate access to expertise in a broad range of disciplines. Participants include nationally recognized faculty from Rensselaer's Schools of Engineering, Management, Science, and Humanities and Social Sciences. In addition, over 100 undergraduate and graduate students are supported annually through the CIE's programs.

### Major Programs

**Center for Advanced Interconnect Systems Technologies** The research plan in CIE's Center for Advanced Interconnect Systems Technologies (CAIST) focuses on finding innovative, creative, and competitive ways to maximize interconnection performance. The research involves the development of new materials, processes, simulation, modeling, and fabrication techniques for high-performance and reliable interconnections. The goal of CAIST is to investigate, test, and prototype new concepts, from the device-to-system approach, that provide attractive options for significantly upgrading the performance of interconnections into the 21st century.

**Center for Microcontamination Control** The Center for Microcontamination Control is an NSF Industry/University Cooperative Research Center with Research sites at the Northeastern University, the University of Arizona, and Rensselaer. The UA site was established in 1989 and has research in high-K dielectric contamination, bacterial contamination, and ultrapure water (UPW) research. The RPI site was established in 1998 and has research in CMP and electrochemical planarization. As a sponsor, KLA-Tencor has contributed a KLA-2135 Defect Inspection Station, providing a unique capability to detect submicron defects on 8-inch patterned wafers. Northeastern University established a site in 2002 with research in nano and microscale particle removal.

**Center for Power Electronics Systems** The Center for Power Electronics Systems (CPES), sponsored by the National Science Foundation and established in 1998, is a national Engineering Research Center (ERC), which envisions enhancing the competitiveness and growth of the power electronics industry by developing an integrated system approach with Integrated Power Electronics Modules (IPEMs). The goal of CPES is to improve the quality, reliability, and cost effectiveness of power electronics systems by ten-fold at the end of the expected 10-year life span. Virginia Institute of Technology administers this Center; and the five-university consortium consists of Rensselaer, Virginia Tech, University of Wisconsin-Madison, North Carolina A & T, and University of Puerto Rico at Mayaguez.

**Focus Center at New York** This program investigates radical alternatives and new concepts leading to new solutions that will enable the U.S. semiconductor industry to transcend known limits on interconnections that would otherwise decelerate or halt the historical rate of progress toward gigascale integration

(GSI). This program is part of the nationally distributed Interconnect Focus Center (IFC) administered from Georgia Institute of Technology. The five-member university consortium consists of Rensselaer, SUNY-Albany, Georgia Tech, MIT, and Stanford. Rensselaer's efforts focus on multiple layers of active devices ("3-D Chips"), optical interconnects, and fundamental materials and process characterization and modeling.

**Center for Broadband Data Transport and Technology** IBM Corporation endows this interdisciplinary Rensselaer center, which involves faculty from the Schools of Engineering and Science, SUNY Albany, Cornell University, City College of New York, and affiliated IBM researchers. The center's primary mission is to conduct research in optical and electrical data transport, switching, and processing to enable future generations of information technology systems. The center is also involved in educating a new generation of students and postdocs for broadband data transport science and technology. The center operates the Internet Accessible Remote Laboratory (visit <http://nina.esce.rpi.edu/shur/broadband>).

**Affiliated Faculty** P. Ajayan, B. Ishwara, R. Bizios, T. Borca-Tasciuc, T. Cale, P. Chow, N. DePaola, J. Dordick, D. Duquette, P. Dutta, J. Fish, J. Flaherty, I. Giaever, B. Gill, R. Gutmann, R. Kane, R. Kersting, G. Korniss, Y. Lecoz, L. Levinson, J. Lu, T.M. Lu, A. Maniatty, J. McDonald, D. Millard, S. Murarka, S. Nayak, A. Ostrogorsky, R. Parsons, P. Persan, C. Picu, J. Plawsky, G. Ramanath, G. Rymaszewski, C. Ryu, A. Sanderson, J. Senkevich, M. Shephard, L. Schowalter, M. Shur, D. Siegel, G. Slack, R. Spilker, D. Spooner, C. Steinbruchel, J. Sun, G.C. Wang, M. Washington, X.C. Zhang, Y. Zhao

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**Postdoctoral Associates** V. Hardikar, R. Iverson, V. Prasad, J.G. Rajagapolan

## Rensselaer Nanotechnology Center

**Director:** Richard W. Siegel

**Home Page:** <http://www.rpi.edu/dept/nsec>

The Rensselaer Nanotechnology Center provides a major resource to advance the scientific promise represented by nanotechnology as well as providing new interdisciplinary research programs to educate new generations of students. Research areas of the Center include advanced materials and coatings, biosciences and biotechnology, nanoelectronics, and nanosystems. Nanotechnology uses clusters of molecules and atoms to make nanometer (billionth of a meter) size building blocks for new materials. These blocks have different properties than larger sizes of the same materials, such as electrical conductivity, optical properties, and mechanical strength. These materials can therefore be used for many new applications. The Center will focus on creating novel materials and devices that could create more effective drug delivery systems in the human body, result in stronger and more durable plastics, enable high capacity energy and information storage devices, and produce flame-retardant plastics for planes and automobiles, as well as other important applications.

**Affiliated Faculty:** P. Ajayan, Y. Akpalu, G. Belfort, B. Benicewicz, R. Bizios, T. Borca-Tasciuc, J. Crivello, J. Dordick, R. Doremus, D. Duquette, G. Dvorak, J. Fish, S. Garde, P. Hajela, L. Interrante, R. Kane, P. Keblinski, S. Khumar, N. Kortakar, Toh-Ming Lu, J. Moore, O. Nalamasu, S. K. Nayak, R. Ozisik, P. Persans, L. Peters, C. Picu, G. Ramanath, C. Ryu, L. Schadler, L. Schowalter, M. Shepard, M. Shur, R. W. Siegel, J. Stegemann, J. Stenken, M. Tomozawa, G. C. Wang, M. Washington, R. Wright, X. C. Zhang

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**Visiting Scholars:** S. Chao, S. Curran, A. Ellis, T. Sleboda

**Administrative Staff:** D. Belser, H. Langley, N. Rysedorph, P. Stryjek

## Scientific Computation Research Center

**Director:** Mark S. Shephard

**SCOREC Home Page:** <http://www.scorec.rpi.edu/>

The Scientific Computation Research Center (SCOREC) has been established as a focal point for research and development of advanced computational techniques and to provide graduate-level training in scientific computation. The goal of SCOREC is to develop high performance computing strategies that can be used to further knowledge in science and engineering to improve understanding of physical phenomena, provide new modeling and simulation techniques, and support computational experimentation.

SCOREC's research activities are organized into faculty-headed programs. Four are focused on the development of generalized computational technologies for the advancement of multiscale systems engineering. They are the programs for adaptive scientific computations, parallel computation, automated modeling, and multiscale computational techniques. Four research programs are concerned with the development of computational techniques for specific application areas and include programs for biomechanics analysis methods, multiscale flows, nanoscale materials modeling, and device process to performance modeling.

SCOREC's computing facilities include 64 and 48 processor parallel clusters, an 8 processor SGI ONYX2 with Infinite Reality graphics, and an extensive integrated workstation environment including Sun, SGI, IBM, and Apple workstations. An active Partners Program, currently consisting of ten governmental agencies and seven companies, supports SCOREC.

### Affiliated Faculty

K. Anderson, T. Cale, C. D. Carothers, S. De, J. Fish, J.E. Flaherty, S. Garde, K. Jansen, P. Hajcla, M.H. Holmes, P. Keblinski, A. Maniatty, D.R. Musser, S. Nayak, C. Picu, M.S. Shephard, R.L. Spiller, B.K. Szymanski, M. Zeghal

### Research Associates

W.J. Schroeder

### Research Engineers/Scientists

C. Dupre, R. Wentorf

### Post Doctoral Research Associates

W. Chen, N. Chevaugeon, D. Datta, S. Kocak, S. Lankalapalli, Y. Luo, Jens Mueller, K. Pinchedez

## The Academy of Electronic Media

**Home Page:** <http://www.academy.rpi.edu>

Electronic media is an integral part of all aspects of society, yet with all the potential offered by today's electronics and computing we have only begun to scratch the surface of how we may use technology to improve our lives. The mission of the Academy of Electronic Media (Academy) is to fundamentally challenge and expand the way electronic media impacts people, and the way people relate to electronic media and technology. The Academy combines artistic and technological expertise to investigate basic IT research in the areas of dynamic data access/utilization (e.g. animation, video, multimedia, etc.), collaborative computing environments, 2-D/3-D visualization/modeling, user I/O interactivity programming, and electronic media scalability/platform adaptation. At the Academy, developing interactive electronic media that stimulates multiple senses to better understand, visualize, and express ideas is part of daily work.

### Academy Staff:

D. Millard, Director; W. Brubaker, Programming Director; K. Carlson, Production Coordinator; D. Slattery, Associate Director; J. Valerio, Project Manager; A. Yu, Systems Administrator