SBIR/STTR
IUCRC
GOALI
PFI

# IIPStars

## Technology Areas

Advanced Materials
Biotechnology
Chemical Technology
Education and Special Topics
Information and Communication
Manufacturing
Nanotechnology

## IIP Programs

Small Business Innovation Research (SBIR): The SBIR program stimulates technological innovation in the private sector by providing seed money for high-risk, high-reward ventures.

Small Business Technology Transfer (STTR): The STTR program further expands the public–private partnership to include joint venture opportunities for small businesses and nonprofit research institutions.

Industry University Cooperative Research Centers (IUCRC): The IUCRC program develops long-term research partnerships among industry, academe, and government.

Grant Opportunities for Academic Liaison with Industry (GOALI): The GOALI program seeks to stimulate exchange of knowledge and personnel between universities and industry.

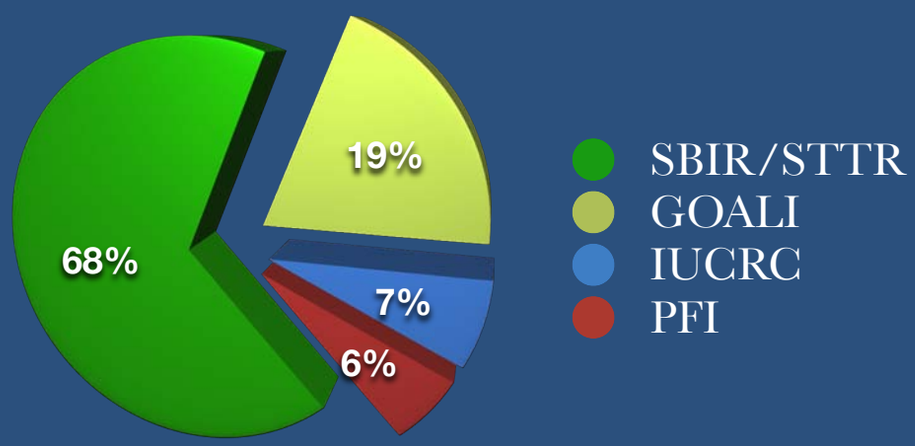
Partnerships For Innovation (PFI): PFI promotes innovations by bringing together colleges and universities, private sector businesses, not-for-profit organizations, and state and local governments to connect new knowledge created in the discovery process to learning and innovation.

## Industrial Innovation and Partnerships Mandate

The Directorate for Engineering's division of Industrial Innovation and Partnerships (IIP) serves the entire National Science Foundation by fostering partnerships to advance technological innovation, and it plays an important role in public–private entrepreneurial partnerships.

One of the strategic goals of the Engineering Directorate is to effectively invest in fundamental engineering innovation that has the potential for high impact in meeting national and societal needs. The focus of IIP is to invest in engineering research and innovation that successfully leverages federal, small business, industrial, university, state and community colleges resources. Genuine partnerships are dynamic and growing relationships based upon shared interests, trust, and an evolving technology. Successful partnerships require performance goals and benchmarks, passionate and creative leaders, and partners committed to a shared vision. Partnerships can facilitate infrastructure that sustains and nurtures innovative activity over the long term by translating discoveries from fundamental research in innovation.

## IIP Award Dollar Distribution




2010

# Advanced Materials

Materials science and engineering explore the basic structure and properties of matter down to the molecular, atomic and even subatomic levels. IIP funds research that has been unlocking the potential of materials ranging from ordinary rubber to ultra-high-density magnetic storage media.

## IIP Advanced Materials Areas of Interest:

- High-temperature materials
- Engineered structural materials
- Optical materials
- Tribological and wear resistant coatings
- Surface modifications and thin film technologies
- Electronic and magnetic materials
- Biomaterials
- Materials for sustainability

## Flexible displays for low-cost display applications

These circuit-free high-resolution displays (on left) created by Kent Displays, Inc. with NSF support can be reconfigured with a new image using a prototype image writer.

Advanced materials can outperform conventional materials with superior properties such as improved toughness, hardness, durability and elasticity. They can exhibit novel properties including the ability to memorize shape or sense and respond.

Kent Displays has developed a photo addressed flexible display (see above) that is free of any electronic circuits. The displays can be extremely low-cost, thin, and flexible. They have potential use in applications where low-cost, erasable, high-resolution images have not been possible before, such as stored value cards, ID badges, and point-of-sales signs. Kent Technologies' work on flexible displays has been funded through an STTR grant (0750379).

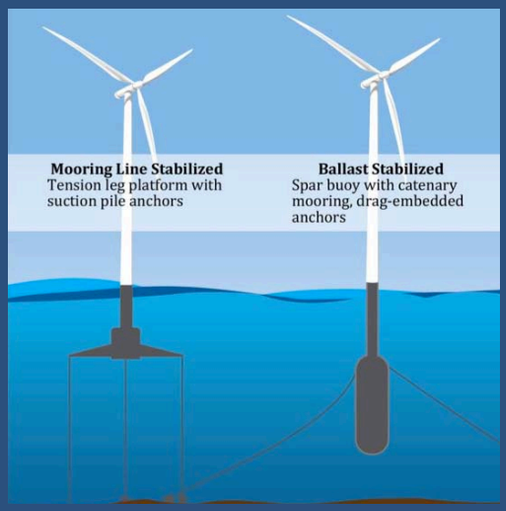
The University of Maine's Advanced Structures and Composites Center (AEWC) has developed a physical model of a floating deepwater wind platform (see below) that will test the National Renewable Energy Laboratory's (NREL) digital models. The information from these tests will significantly accelerate the development of floating offshore wind turbine platforms near US population centers on the east and west coasts. The AEWC is funded through a PFI grant (0917974).

MedShape Solutions has created a shape memory polymer that can be used for soft tissue repair in sports medicine. The initial product is designed to ease implantation during Anterior Cruciate Ligament knee reconstruction and to reduce soft tissue failure during ultimate strength testing. MedShape has been working with the Georgia Institute of Technology and is supported through an SBIR grant (0750247).

## Spotlight on Advanced Materials

### Advanced composites for offshore wind energy

This conceptualization of floating turbines using new composite technologies was designed by the University of Maine's Advanced Structures and Composites Center in conjunction with the National Renewable Energy Lab.



# Biotechnology

The early detection, prevention, and treatment of diseases such as cancer and heart disease is better today than at any other time in history as a direct result of biomedical research. Investment in biomedical research and education and training in health-related fields will provide the foundation for new therapies and diagnostics. Biotechnology research can cut across technical disciplines, biofuels, and technologies to combat bioterrorism.

Marrone Bio Innovations is creating a commercially viable biopesticide (see below) to remove invasive quagga mussels while leaving native species unharmed. Infestations of quagga mussels have lead to the loss of productivity in power plants, industrial facilities, and water treatment facilities costing billions of dollars in lost revenue. To control this non-native species, the facilities are regularly treated with chlorine or other biocides which are non-bio specific and harm the native species. Through their work under an STTR grant (0750549) Marrone Bio Innovations has created a green solution to the problem.

The University of Florida's Center for Advanced Forestry Systems (CAFS) is studying the impact of crown architecture on the growth and competitiveness of loblolly pine varieties. Loblolly pine is one of the most widely planted and commercially valuable species in the southern United States. Over the next several years CAFS will examine how varieties perform in pure and mixed blocks. Information gathered will improve our understanding of growth dynamics of loblolly pine and, potentially, how genetic resources will be deployed across the landscape. The research is funded through an IUCRC grant (0934138).

## Spotlight on Biotechnology

### Green technology for controlling invasive mussels

A researcher at Marrone Bio Innovations is applying a newly formulated material into a biobox to evaluate the effectiveness of the material in selectively killing quagga mussels. Potential commercial product prototypes are tested in bioboxes to see if they can be brought to the market.

## Biotechnology

Biotechnology is a field of applied biology that involves the use of living things in engineering, technology, medicine, and products.

### IP Biotechnology Areas of Interest:

- Agriculture and forest
- Food
- Marine and aquatic
- Biosensors
- Bioenergy
- Materials for biomedical applications
- Diagnostic assays and platforms
- Drug delivery and drug discovery
- Tissue engineering and repair
- Biomedical devices
- Omics, system biology and bioinformatics
- Bioinstrumentation and imaging technologies

# Chemical Technology

The Chemical Technologies Topic supports development and commercialization of novel technologies for a sustainable environment. Examples supporting the topic's goal are technologies that are alternatives to or lessen dependencies on petroleum, hazardous chemicals, and rare and non-renewable feedstocks; minimize harmful emissions, contaminations and waste; provide for clean water, air and soil; and enable lower energy usage, improved efficiency, selectivity and control.

## IIP Chemical Technology Areas of Interest:

- Energy storage, supply, delivery, and use
- Fuel efficiency and emission control
- Materials from recycled, biobased, and non-toxic feedstock.
- Chemical synthesis and processes based on sustainable and enviro/health friendly paradigms
- Separations, purifications and recycling
- Reactor engineering to enable sustainable outcomes
- Chemical sensors for monitoring and control

## Feedstock for the future: $CO_2$

A Carbon dioxide ($CO_2$) based plastic film created by Novomer is shown being stretched. $CO_2$, generally considered a pollutant and greenhouse gas, can be activated using specially designed catalysts to create plastics and resins.

America's challenges in providing secure, affordable energy while addressing climate change mean that we must both make much more efficient use of energy and begin to rely on new energy sources that eliminate or greatly reduce production of greenhouse gases. The Chemical Technology topic area seeks to accelerate green-related industrial innovation in the US by leveraging high technology capabilities of small businesses.

Novomer is working on an alternative to petroleum based plastics by creating a CO2 based plastics and resins (see above). Even though carbon dioxide is a non-flammable, non-toxic and inexpensive raw material, there are few industrial chemical processes that use it. Through an exclusive license with Cornell University, Novomer has access to a family of catalysts that incorporate CO2 into materials that could be used in applications ranging from consumer packaging to metal coatings. Novomer's research has been funded by an SBIR grant (0620438).

Cool Energy, Inc. of Boulder, Colo., has created a low-temperature Stirling engine system that allows a rooftop solar system to create both heat and energy for a household. The engine, known as SolarHeart® Engine (see below), is planned to go to market in 2011 and was developed with funding from IIP's Small Business Innovation Research program (0848689). The engine has a control system that works with local weather systems to optimize the creation and storage of heat and electricity. It also has the ability to recycle exhaust gas heat from other engines and industrial processes to create electricity. Cool Energy's technology has the potential to significantly reduce household energy bills and to prevent the release of carbon dioxide.

## Spotlight on Chemical Technology

### Solar home combined heating and power system

A third-generation low-temperature Stirling engine developed by Cool Energy, Inc. was developed with NSF SBIR Phase II support. This engine is currently producing 100 Watts of electrical power and will be installed with a solar field in 2010.

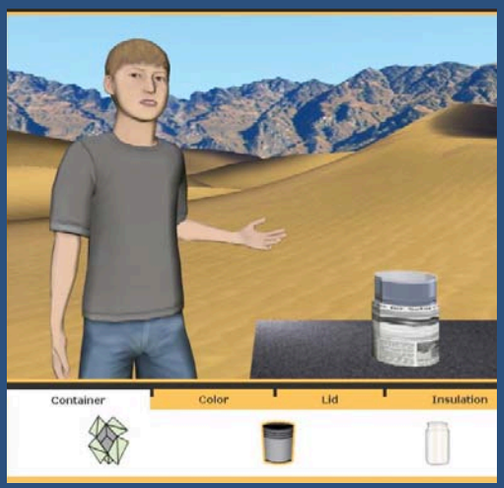
# Education and Special Topics

High-quality science, technology, engineering and mathematics (STEM) education can unleash the creativity and curiosity of our students, motivate them to understand our world, and provide them with tools to solve problems, think critically and communicate effectively. High quality STEM education is essential for not only for those who would become scientists. Only this can maintain our country's leadership in innovation and create a nation of engaged citizens who can participate in a vibrant democracy.

With STTR support (0620486), Vcom3D and TERC have completed initial development of an Authoring Tool that supports the creation of virtual, collaborative K-12 science activities in an interactive 3D world (see below). These tutors can interact realistically with their environments to perform scientific experiments as directed by students.

Lehigh University and Freedom Sciences, LLC, funded through a PFI grant (0650115), have created the Automated Transport and Retrieval System (ATRS). By seamlessly integrating robotics and automation technologies with existing mobility products into structurally unmodified vehicles, the system eliminates the need and cost of performing a vehicle conversion. Moreover, by automating wheelchair stowage and retrieval and facilitating seat-to-seat transfer between the vehicle and wheelchair, the need for an attendant is also eliminated. The ATRS thus offers a new paradigm for wheelchair users: They can independently go to and from work and run errands necessary to daily living; and they can do so with enhanced safety, lower cost, and greater freedom of choice. ATRS has received FDA approval, and is now available commercially.

## Spotlight on Education and Special Topics




### Lifelike virtual tutors to support authentic learning

Vcom3D creates Virtual Tutors who communicate in English, Spanish, or American Sign Language to engage children who could be isolated by language barriers in authentic scientific research and learning.

# Education and Special Topics

Education Applications is designed to provide tools for learning. These tools can come in many forms and often reach beyond the scope of the classroom and into the field of assistive applications and tools. Assistive tools support individuals with vision, hearing, cognitive and or disabilities.

## Education and ecial Topics Areas of erest:

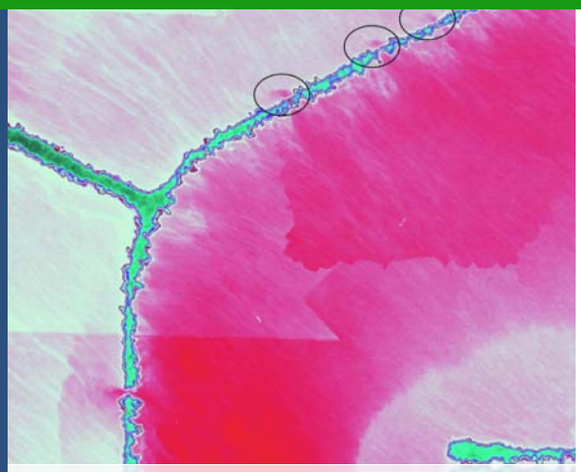
- Teaching and learning
- Entrepreneurship enterprise
- Assessment
- Assistive Technologies

# Information and Communication

Innovations across the Information and Communications Technology field can range widely. IIP supports hardware as well as software innovations. Considering the two ends of the spectrum, device innovations will typically employ unique physical phenomena for their competitive advantage and be embodied in hardware, whereas innovations in services will typically be more architectural in nature and be embodied in software.

## IIP Information and Communication Areas of Interest:

- Services
- Applications
- Systems
- Components
- Devices



## Improving disaster response

A thermal image, captured by Rochester institute of Technology's Wildfire Airborne Sensing program (WASP) sensor, shows the warmer water flow through various northwest sections of a dike-system — a potential breach and subsequent disaster.

Advances in information technology (IT) are driving economic growth, making our businesses more productive, transforming the conduct and analysis of science and engineering, and improving our lives through a rich set of personalized, convenient, affordable services. IT has improved personal lives and personal connections through research into fields such as broadband services, the wireless spectrum and GPS.

Rochester Institute of Technology (RIT) with the University at Buffalo the runs the Information Products Laboratory for Emergency Response (IPLER) which has as its mission the creation of a disaster management chain of response. This chain of response comprised of technology, policy, and business development incubators will facilitate interaction between academe, the private sector and public responders. One such effort consists of state-of-the-art sensing products (see above) in hydrologic models. Their work is being funded by a PFI grant (0917839).

Researchers at the NSF Center for High-Performance Reconfigurable Computing (CHREC) at the University of Florida have developed an innovative new machine, Novo-G (see below), the world's most powerful reconfigurable computer (RC) for research. Conventional computers feature fixed-logic technologies that are relatively inefficient in speed and energy due to their "one size fits all" philosophy. The architecture of an RC machine adapts with reconfigurable logic to match the needs of each application. Making the most of the hardware can lead to dramatic increases in performance with decreases in energy, cooling, size, and cost. CHREC's work on Novo-G has been funded through an IUCRC grant (0642422).

## Spotlight on Information and Communication

### Novo-G: reconfigurable supercomputing for the new decade

Reconfigurable computing (RC) is a new and potentially superior paradigm of computing, and Novo-G is an innovative machine at unprecedented scale for RC. Research results from Novo-G are enabling new avenues of research on super computers.

# Manufacturing

The Manufacturing topic addresses innovations that improve the efficiency and competitiveness of the nation's manufacturing sector. Finding innovative ways to handle information is now manufacturing's chief concern. With NSF's help, American manufacturers are making the changes necessary to stay competitive in a marketplace increasingly dominated by e commerce, while at the same time honoring the traditional core of manufacturing's purpose: the innovation of new technologies and products for an expectant public.

## IIP Manufacturing Areas of Interest:

- Processes
- Machines and equipment
- Modeling and simulation

## Manufacturing

U.S. leadership in manufacturing is essential for a robust economy. In a broad context, manufacturing-related R&D encompasses innovation in existing methods or processes; improved education and training of competent work force with the aim of getting maximum benefit from existing or new methods or processes; or wholly new processes, machines or systems.

M4 Sciences has created a new manufacturing tool for mechanical drilling of meso-scale holes (shown below) with support from an STTR grant (0822879). The new technique helps fill the demand for creation of smaller parts and features with enhanced performance capabilities. In biomedical applications, medical devices must be small so as to be "minimally invasive". In electronics, the size of the components dictates the overall system size, while in automotive and aerospace sectors, efficiencies associated with increased strength-to-weight ratios are key drivers. Many products in these sectors incorporate small, complex features including meso-scale holes with length-to-diameter aspect ratios typically greater than ten.

The Pennsylvania State University and the Georgia Institute of Technology have collaborated under a IUCRC grant (0541678) to create a model that will create digital simulation of "rare events" ranging from 500-year floods to structural fatigue cracking. The project is focused on designing fatigue-resistant materials by running "virtual experiments" that are much less costly and time consuming then their physical counterparts. Their research will assist in accelerated use of new or improved fatigue-resistant alloys in a range of applications such as aerospace, motor vehicles, and railroads.

## Spotlight on Manufacturing

### Modulation-assisted Machining

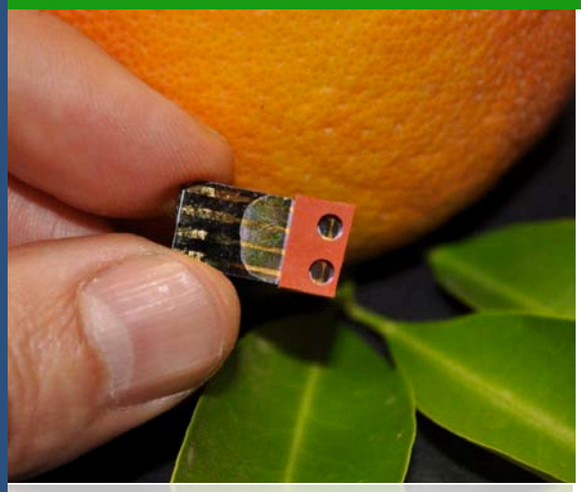
M4 Sciences is commercializing a new machine tool system, called TriboMAM, to enable Modulation-assisted Machining (MAM) technology in computer controlled machines. The company's research is translating discoveries from Purdue University that were supported by an NSF grant (0115467).

# Nanotechnology

Work in nanotechnology encompasses the systematic understanding, organization, manipulation, and control of matter at a submicroscopic scale from a fraction of a nanometer to around 100 nanometers. Novel materials, devices, and systems with their building blocks designed on the scale of nanometers open up new directions in science, engineering, and technology with potentially profound benefits to the economy and society.

## IIP Nanotechnology Areas of Interest:

- Nanomaterials
- Nanomanufacturing
- Nanoelectronics and active nanostructures
- Nanotechnology for biological and medical applications
- Instrumentation for nanotechnology



## Very early detection of citrus greening

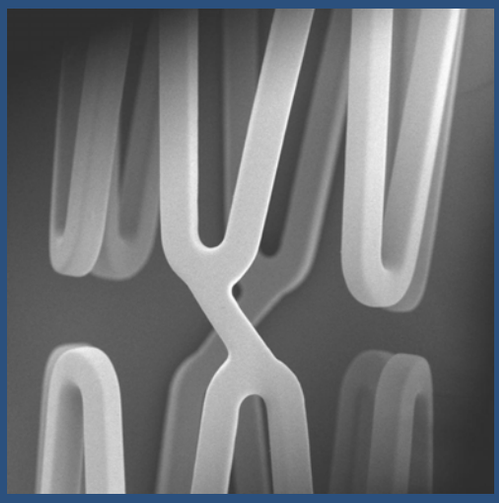
A clustered nanoscale biosensor was developed by ISCA Technologies for very early detection of huanglongbin, a citrus greening agent. The same sensors can detect a wide range of pathogens.

With the capacity to control and manipulate matter at the nano scale, science, engineering, and technology are realizing revolutionary advances in areas such as individualized pharmaceuticals, new drug delivery systems, more resilient materials and fabrics, catalysts for industry, and order-of-magnitude faster computer chips.

Nanocopoeia has created a novel drug delivery system using nanoparticle coatings on medical devices (shown below). Nanocopoeia's ElectroNanospray technology allows drugs, polymers and other chemicals to be transformed into nanoparticles that can be applied to the surface of implantable medical devices. Benefits include super adherence to complex surfaces, the high uniformity, and the ability to engineer the rate of release. The ElectroNanospray work was originated at University of Minnesota and has been developed with support from an SBIR grant (0620563).

Sand 9 is creating a nanomechanical resonator technology for passive and active devices in wireless applications. Their work focuses on engineering nanomechanical band-pass filters in the microwave frequency range. The devices have the potential to offer lower-power, smaller-size, wider-bandwidth, and lower-cost alternatives to the incumbent technologies. This approach to discrete passive components could enable the next generation of cell phones to expand their functionality by increasing power, efficiency, and the number of frequency bands. Sand 9's research has been supported by an SBIR grant (0848716).

## Spotlight on Nanotechnology

### Drug-delivering nanoparticle coatings on medical devices

Nanocopoeia has created a technique for coating medical devices with nanoparticles to deliver drugs to a precise location in the body. The image is a scanning electron microscopic view of a stainless steel coronary stent coated with drug and polymer nanoparticles using the ElectroNanospray process.