

OPTICS, IMAGING
AND PHOTONICS



The Greater Rochester New York Region

THE GREATER ROCHESTER NEW YORK REGION

Made For Business...

GREATER ROCHESTER PROVIDES A DYNAMIC AND INNOVATIVE ENVIRONMENT FOR BUSINESS AND A RICH INFRASTRUCTURE FOR THE OPTICS, IMAGING & PHOTONICS INDUSTRY.

Ranked 1st for utility patents issued to companies or individuals per 1,000 workers

Metropolitan New Economy Index, 2001

Rochester boasts **2.33 patents** per 1,000 workers — The U.S. average is 0.40

Optics, Imaging & Photonics related patent technology accounts for 65% of the Top 20 patent technology classes granted in Rochester *U.S. Patent and Trademark Office*

Ranked 7th in 2004 among 125 world regions for “World Knowledge Competitiveness”

World Knowledge Competitiveness Index: Robert Huggins Business and Economic Policy Press, 2003.

Ranked 5th for Overall Innovation Capacity *Metropolitan New Economy Index, 2001*

Ranked among “America’s 50 Hottest Cities” for Business Expansions and Relocations

Expansion Management, 2004

Made for Living...

NESTLED BETWEEN LAKE ONTARIO AND THE FINGER LAKES WINE REGION IN UPSTATE NEW YORK, ROCHESTER HAS THE ASSETS OF A BIG CITY, YET THE EASE AND COMFORT OF A SMALL TOWN. IT IS A FOUR-SEASON COMMUNITY WITH AFFORDABLE HOUSING, GREAT EDUCATIONAL OPPORTUNITIES, VIBRANT URBAN LIFE AND FRIENDLY, TREE-LINED SUBURBAN NEIGHBORHOODS. YOU WILL BE PLEASANTLY SURPRISED AT THE RICHNESS OF LIFE IN ROCHESTER.

- **Very affordable housing**

Rochester’s median sales price is \$97,000 – the national average is \$160,000 *NAHB, 2002*

- **Most Livable Community** *Partners for Livable Communities, 2000*

- **One of the 10 Best Cities to Raise a Family** *Child Magazine, 2003*

- **One of 10 Best Places to Vacation** *Money Magazine, 2002*

- **Ranked 11th among 100 Metro Areas for “Least Stressful City”** *Sperling’s Best Places, 2004*

Made For You...

THE GREATER ROCHESTER REGION IS THE IDEAL COMMUNITY TO GROW A BUSINESS, RAISE A FAMILY AND ACHIEVE PROFESSIONAL AS WELL AS PERSONAL SUCCESS.

LOOK INSIDE GREATER ROCHESTER, NY...

FOR A RICH HISTORY, INNOVATIVE DISCOVERIES AND A DYNAMIC BUSINESS ENVIRONMENT
FOR OPTICS, IMAGING & PHOTONICS RELATED COMPANIES

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REGIONAL OPTICS, IMAGING & PHOTONICS COMPANIES.....	BACK COVER



OPTICS, IMAGING & PHOTONICS TAKE A CLOSER LOOK

Significant investment and infrastructure beginning in the mid-19th century has firmly rooted Rochester's economy in Optics, Imaging & Photonics. In fact, there are few, if any, locations in the world that can match Greater Rochester's capabilities and expertise.

With more than 50 leading Optics, Imaging & Photonics focused companies, renowned university programs in related fields, the emergence of a major Center of Excellence in Photonics and established business relationships in an active industry cluster, you'll begin to appreciate the power and potential that exists in the Greater Rochester Region.

Local Optics, Imaging & Photonics companies—along with area research institutions—have developed breakthrough products and technologies at the forefront of industry applications and solutions. Together, these companies and institutions bring new products to market faster.

Rochester is proud of our accomplishments and excited about the potential to deliver optics and image-based products to a wide range of industries.

GREATER ROCHESTER'S OPTICS, IMAGING & PHOTONICS INDUSTRY HAS MUCH TO OFFER:

- Component- or solution-based companies with cross industry applications and a comprehensive range of capabilities
- Cutting-edge research and innovative products
- An interactive and dynamic industry
- A cost-effective and highly talented workforce



CORNELL UNIVERSITY REPORT

A RECENT REPORT BY CORNELL UNIVERSITY REVEALS A RICH OPTICS, IMAGING & PHOTONICS INDUSTRY INFRASTRUCTURE AND A PROMISING FUTURE FOR THE GREATER ROCHESTER REGION

REPORT FINDINGS: *Optics, Imaging & Photonics: Building a 21st Century Industry in Rochester* Cornell University, 2003

A WEALTH OF RESOURCES

Rochester has the advantage of important civic, educational and cultural institutions that are unusual for a city of its size. The advantage of this “institutional infrastructure” lies in the ability of the community to respond rapidly to change and adapt to the new business environment.

SPECIALIZED DIVERSITY

Rochester retains an industry specialization with diverse markets and applications for Optics, Imaging & Photonics. This diversification is a powerful asset to the community. Rochester firms provide solutions and products across a variety of industries. This diversification insulates Rochester from the fluctuations that affect other specialized regional economies.

AN EXPERIENCED WORKFORCE

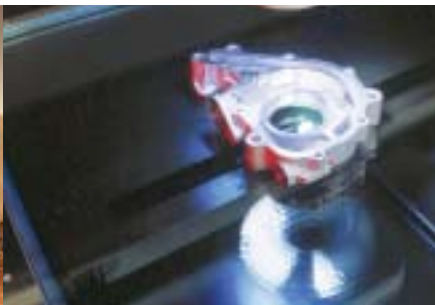
Rochester has the advantage of a concentration of people who understand the process of producing Optics, Imaging & Photonics equipment. Industry leaders in Rochester have understood for generations that the industry requires a skilled workforce, not only at the R&D stage, but also on the production line—where many innovations develop.

GROWTH OF SMALL FIRMS

Rochester’s ability to create new jobs has shifted to its vital small- and medium- sized firms. The region contains a significant number of small Optics, Imaging & Photonics firms—77% have 50 employees or less. The region has several organizations committed to building small firms and commercializing innovative ideas.

INNOVATION AND ENTREPRENEURIAL SPIRIT

A tradition of innovation and entrepreneurship, supported by institutions such as UR and RIT, has helped Rochester remain on the cutting edge of Optics, Imaging & Photonics technology while other regions have failed to keep pace with the changes in technology and the economy.



Rochester's Cutting-Edge and Award Winning Products and Solutions

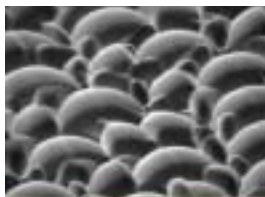
Panoramic View of Mars Brought to You by Optimax System

Images captured by the Mars Rovers were taken through lenses made in Rochester. As a contributing member to the NASA Mars Exploration team, Optimax Systems, Inc. made the camera lenses for both the *Spirit* and *Opportunity* Mars Exploration Rovers.



Engineered Diffuser Technology at RPC Photonics

RPC Photonics has developed unique manufacturing capabilities to produce precision optical surfaces for light control. RPC Photonics is the only location in the world that manufactures products such as engineered diffusers. The main purpose is to enable control of light propagation in an arbitrary fashion. Engineered diffuser technology is revolutionizing applications such as laser optics, displays and solid-state lighting. This technology was, and continues to be, developed in Rochester.



Engineered diffuser surface structure.



Illustration of light control capabilities of engineered diffusers' white LED light spread into a rectangle.



Wavefront Test at Melles Griot

At Melles Griot, transmitted wavefront performance analysis is carried out using digital phase measuring interferometry. These tests are conducted to check lens system performance on all of the company's manufactured lenses. Melles Griot designs and manufactures optical components and optical systems for industrial and scientific applications.

2004 R&D 100 AWARD

MIN-R EV MAMMOGRAPHY SCREEN-FILM SYSTEM

Eastman Kodak Co.'s Health Imaging Group

2003 PHOTONICS CIRCLE OF EXCELLENCE AWARD FOR

MAXMIRROR™ HIGH-PERFORMANCE LASER MIRROR

Semrock, manufacturer of advanced optical coatings and filters



Semrock's unique MaxMirror® is a high-performance laser mirror that covers an ultra-broad range of wavelengths. It can replace three or more conventional laser mirrors.



The Autostereoscopic Display System represents the first initiative from Kodak's New Business Ventures Group, which is responsible for commercializing breakthrough technology.



SmartScope® Flash video measurement system from the Optical Gaging Products division of QVI, showing the patented SmartRing LED illuminator.



With a numerical aperture of 1.05, the AquaCAT has produced images smaller than 100 nm, or approximately one one-thousandth the diameter of a human hair.

Stereoscopic Imaging Display System at Kodak

Kodak's Autostereoscopic Display allows for vibrant 60-inch, 3D images to be seen from three feet away—without glasses or monitor screens. At the heart of the system is a patented monocentric ball lens that provides a generous 45-degree horizontal field of view. The display technology is ideal for applications that call for prolonged viewing of detailed, 3D images such as medical evaluations or scientific analysis.

SmartScope® Flash Video Measurement System at QVI

Quality Vision International, Inc. and its member companies have developed a number of optical and illumination innovations that have advanced precision measurement technology used in manufacturing quality control. Its patented SmartRing LED illuminator extends measurement system versatility by allowing program control of illumination intensity, angle and direction. Another patented illumination technology uses a fixed array of LEDs, illuminating only those required by the position and magnification of the system optics as they move.

1.05 NA AquaCAT™ Immersion Objective at Corning Tropel

The Corning Tropel AquaCAT™, with a numerical aperture of 1.05, has produced images smaller than 100 nm. Numerical apertures greater than 1.0 can be achieved using immersion technology, which has the resolution benefits of a smaller effective wavelength, while extending the lifetime and infrastructure associated with 193 nm. By mid-2005, Corning Tropel will manufacture and deliver the first 1.3 NA immersion lithography objective to the semiconductor industry.

iGen3™ at Xerox Corporation

The Xerox iGen3™ Digital Production Press employs lasers and "clouds" of dry ink to build four-color images—and transfers the images to paper at speeds of up to 6,000 per hour. Extensive closed loop process controls maintain near perfect color and registration, sheet to sheet, shift to shift, machine to machine. Commercial printers and in-plant print shops worldwide use the iGen3.™



Approximately 2000 engineers from Rochester developed the iGen3™, the very latest in xerography from Xerox.

BAUSCH & LOMB ZYOPTIX™ EXCIMER Laser System



The Bausch & Lomb ZYOPTIX™ EXCIMER Laser System with the ZYOPTIX™ Diagnostic Workstation utilizes a unique combination of excimer and diagnostic technology to correct the eye's existing higher-order aberrations for optimum visual outcomes. Founded in Rochester, NY in 1853, the global eye health company is a technology leader in refractive surgery focused on innovations in wavefront diagnostic equipment and refinements in individualized treatment algorithms for more complex corrections.

Bausch & Lomb's collaboration with the University of Rochester and its Center for Visual Science has brought to market advances in laser eye surgery which today are helping people see better.

Researchers use lasers to reveal the smallest optical image ever produced.

Quantum computing has become a reality, where light has been turned into a computer design that can run certain tasks a billion times faster than today's supercomputers.

Innovative Academic Research, Discoveries and Technologies

Shaping the Optics, Imaging & Photonics Industry Future

UNIVERSITY OF ROCHESTER

Real Quantum Computing

A research team at the University of Rochester has developed a simple computer that marries the mind-boggling computing power of quantum mechanics with the ease of manipulating light. The device mimics quantum interference, an important property that makes quantum computers exponentially faster at tasks such as breaking encryption codes or searching huge databases.

Highest Optical Resolution Microscope Sees Smallest Ever Images

Researchers at the Institute of Optics have created the highest resolution optical image ever, revealing structures as small as carbon nanotubes just a few billionths of an inch across. The researchers' ultimate vision for the project is to refine the process to a point where it might revolutionize biology by identifying individual proteins on a cell's membrane. This would open the door to designer medicines that could kill harmful cells, repair damaged cells or even identify never-before-seen strains of disease.

Better Vision Through Adaptive Optics

Adapting technology originally developed by astronomers, University of Rochester scientists have developed an optical system that improves even the sight of people who have 20/20 vision by detecting subtle visual distortions. Rochester-based eye-care giant Bausch & Lomb has licensed the technology and is working with University researchers to commercialize it.

Speed of Light Slowed to a Crawl

A technique developed by Professor Robert Boyd at the University of Rochester has slowed the speed of light five million-fold—and has done so without the complex, room-filling mechanisms previously used to slow light. The new apparatus is small and, in the words of its creator, “ridiculously easy to implement.” Such a simple design will likely pave the way for slow light, as it is called, to move from a physical curiosity to a useful telecommunications tool.

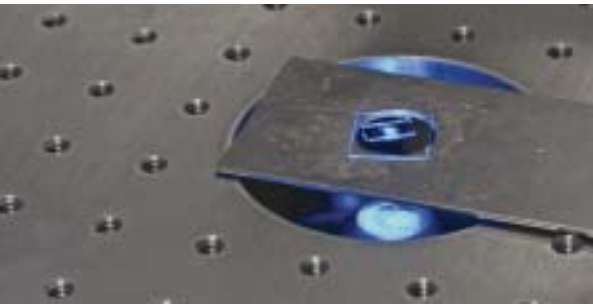
A ruby glows as it slows down light to less than one five-millionth of its natural speed.



2003 R&D 100 AWARD FOR

SUPERCONDUCTING SINGLE PHOTON DETECTOR

Roman Sobolewski, professor of Electrical and Computer Engineering at the UR



Lasers reveal the presence of pathogens using new biomedical optics for smart bandage technology.



Clean room facilities for Microsystems research at RIT.



Satellite image for specialized analysis

Smart Bandage Technology for the Biotech Industry

Imagine placing an adhesive bandage on a cut and having the bandage tell you immediately that dangerous bacteria has invaded the wound and you need to seek a doctor's help. Researchers at the University of Rochester have taken the first major step toward a bandage that will emit different colors, depending on what kind of bacteria may be present in a wound. The accomplishment is evidence that it's indeed possible to accurately identify bacteria with a silicon sensor.

ROCHESTER INSTITUTE OF TECHNOLOGY

Microsystems Research

Using a prototype 193-nanometer liquid-immersion "microstepper" tool developed by RIT, optical image resolution at the smallest-ever level is made possible. As a result, microchips can be produced with optics and light much closer to the ultraviolet range, making possible the development of smaller, faster and more powerful microchips. Circuits are 10 times smaller and more affordable than possible from conventional methods. The technology was unveiled at a workshop sponsored by International SEMATECH in Los Angeles, California in January 2004.

Image Enhancement Technology Brings Applications for the Security Industry

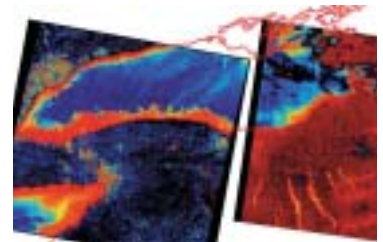
RIT is developing state-of-the-art image-enhancement technology that will benefit counter-terrorism, border patrol, law enforcement and medical fields. Using wavelet enhancement, software technology filters out unwanted detail from X-ray, radar and infrared images, enhancing desired detail in high-resolution images. Potential uses include concealed-weapons detection, through-the-wall surveillance and tumor detection.

Wildfire Detection

The U.S. Forest Service has the advantage of a new tool that identifies and locates wildfires as small as 8- to 12-inches in diameter from an altitude of 10,000 feet. Using grant money from NASA, scientists at RIT have created a prototype of this new remote sensing system for trial by the Forest Service. The project, known as the Wildfire Airborne Sensor Program (WASP), is being conducted at RIT's Chester F. Carlson Center for Imaging Science.

Specialized Analysis of Great Lakes Water Quality

Researchers at RIT are taking a close look at the Great Lakes' water quality using a combination of remote sensing imagery and modeling of lake dynamics. NASA's Landsat 7 satellite has carried the hard work of a team of RIT imaging scientists out into space. The satellite has captured high-resolution images that have allowed for continued research into the Great Lakes.



High-resolution satellite images of Great Lakes water quality.

2003 R&D 100 AWARD FOR

MEMS-BASED ADAPTIVE OPTICS PHOROPTER (MAOP)

David Williams, CEIS principal investigator and professor of brain and cognitive sciences at the UR



A Dynamic and Innovative Environment for Business

Greater Rochester provides a rich infrastructure for the Optics, Imaging & Photonics industry offering a network of support to businesses at all stages of development from early startups to Fortune 500 companies. Generous incentives are offered at the state, county and/or city/town levels. They are available individually or bundled as part of a comprehensive program.

Lumetrics Takes Kodak Technology Further to Pursue New Products and Commercial Markets

Founded in 2003, Lumetrics enhanced technology Eastman Kodak Co. originally developed to monitor its polyester film operation for thickness uniformity and applied it to production of advanced specialty films. In addition to films, Lumetrics is pursuing opportunities in optics and flexible packaging that are a direct offshoot of work with companies in the Rochester region. Lumetrics technology employs the power of light for accurate and routine analysis of materials such as specialty film, flexible packaging, plastics, coatings and optics.



Lumetrics' DI 330 OPTIGAUGE Film Thickness Measurement System employs advanced optical technology to measure coating and complete successful on-line testing with a medical films' manufacturer.

QED Technologies, a Spinoff of the University of Rochester's Center for Optics Manufacturing

In 1998, QED brought Magneto-Rheological Finishing (MRF) technology from a collaborative research program at UR to the commercial marketplace. QED Technologies is the pioneer and exclusive provider of MRF and Subaperture Stitching Interferometry (SSI)—disruptive technologies that allow customers to reach levels of precision and surface finish that have previously been considered impossible and have changed the way precision optics are manufactured. The Q22 MRF System—which was the first commercially available, deterministic, fully automatic finishing machine that the optics industry had ever seen—resulted in rapid adoption by manufacturers of high-end optics. QED earned the 2003 Optics Society of America (OSA) Engineering Excellence Award and was named a 2002 SBIR “Success Story” for the Q22 MRF System. In 2003, the company also released the first Subaperture Stitching Interferometer (SSI), another award-winning technology.



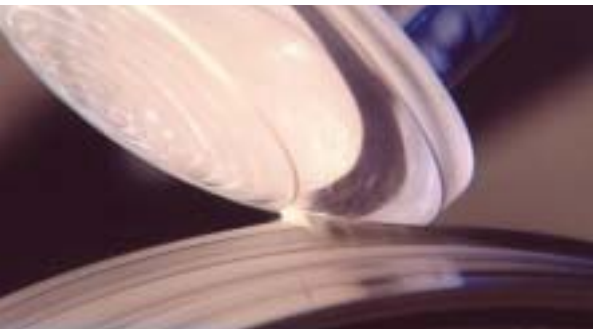
Early MRF technology allows a 50 mm hemispherical lens to be polished on the Q22-XE.



Today, the Q22-400X modified design allows for the fabrication of optics up to 400 mm in diameter.



MRF polishing on QED's award-winning Q22-Y System.



A Rich Infrastructure for the Optics, Imaging & Photonics Industry

With a 150-year history in Optics, Imaging & Photonics, the Greater Rochester Region offers an extensive network of resources that enables local businesses to overcome challenges faster, operate cost effectively and achieve a higher rate of success. Take a look at Optics, Imaging & Photonics in Rochester—and discover how quickly your business can flourish.

Optical Society of America www.osa.org

In 1916, the Optical Society of America was founded in Rochester, NY with 30 members. Today, there are over 14,000 members worldwide and Rochester remains the largest OSA chapter.

Rochester Regional Photonics Cluster, Inc. www.rrpc-ny.org

With more than 100 members, the Rochester Regional Photonics Cluster promotes and enhances the regional Optics, Imaging & Photonics industry by fostering the cooperation of businesses, academia and government.

Associations With Strong Local Chapter Presence:

American Precision Optics Manufacturers Association (APOMA) www.apoma.org

Institute of Electrical and Electronics Engineering (IEEE) www.ieee.org

International Society for Optical Engineering (SPIE) www.spie.org

Optical Society of America (OSA) www.osa.org

Photonics Industry Association of New York (PIANY) www.pianyny.org

Society for Imaging Science and Technology www.imaging.org

**HOME TO ONE OF THE OLDEST AND LARGEST
INDUSTRY CLUSTERS IN THE WORLD**

**OPTICS, IMAGING & PHOTONICS TRAINING AND
EDUCATION BEGAN IN GREATER ROCHESTER**

OVER 150 YEARS OF OPTICS AND IMAGING HISTORY

1853 — BAUSCH & LOMB FOUNDED

1880 — EASTMAN KODAK COMPANY FOUNDED

1906 — XEROX FOUNDED

Optics, Imaging & Photonics Expertise

The Greater Rochester Region offers a high quality and diverse labor market, possessing a strong concentration of technical skills and high educational levels that are unique to a market of its size.

2004 GREATER ROCHESTER LABOR MARKET ASSESSMENT FINDINGS:

- Local employers give Rochester's workers high ratings for labor quality, productivity, work ethic, technical skills and productivity levels
- The concentration of technical and professional workers exceeds the U.S. average
- 1,760 residents per 100,000 are employed in computer and mathematical occupations (U.S. 1,335)
- 1,407 residents per 100,000 are employed in engineering/architecture (U.S. 928)

OPTICS, IMAGING & PHOTONICS ARE ENABLING TECHNOLOGIES. SINCE THEY HAVE SUCH A WIDE ARRAY OF APPLICATIONS—AND SERVE SO MANY DIVERSE INDUSTRIES—THESE TECHNOLOGIES PROVIDE EXCITING OPPORTUNITIES FOR THE GREATER ROCHESTER REGION.

INDUSTRIES SERVED:

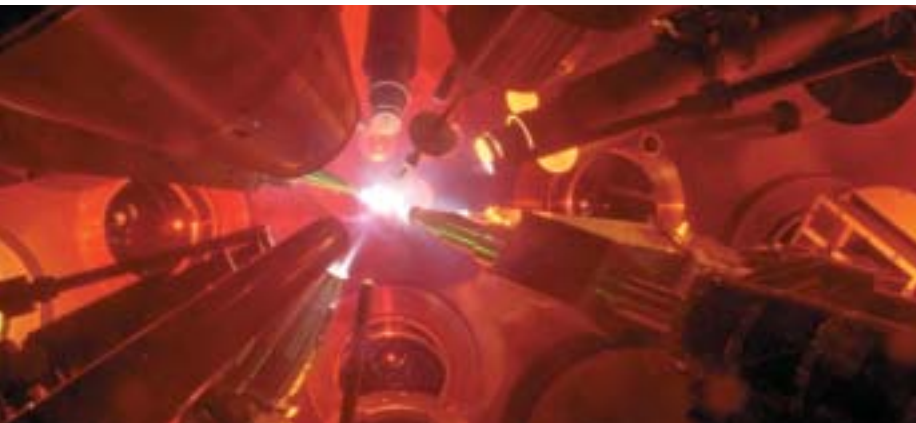
- Aerospace • Automotive • Biomedical • Film and Media
- Homeland Security/Defense • Manufacturing • Microelectronics
- Music • Printing and Publishing • Remote Sensing
- Retail • Semiconductor • Telecommunications



Precision optics manufacturing offers a wide range of capabilities, encompassing a wide range of materials and shapes including glass ceramics, single- and poly-crystalline materials, plastics, spheres, cylinders and prisms.

59% OF TOTAL MANUFACTURING
WORKFORCE EMPLOYED IN HIGH-TECH
PRECISION MANUFACTURING *CEWS, BLS, 2002*

OVER 18,000 EMPLOYED IN ENGINEERING AND
COMPUTER OCCUPATIONS *OES, Bureau of Labor Statistics (BLS), 2002*



Education Opens Doors to New Discoveries

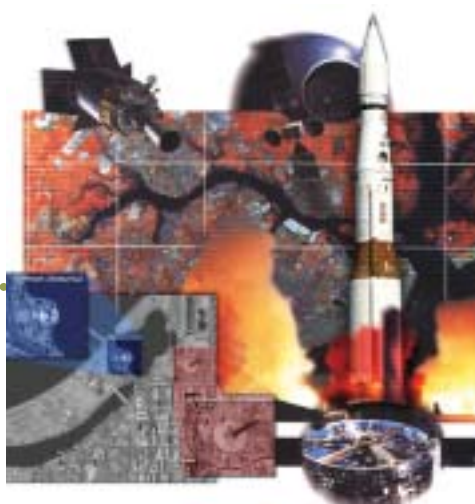
In Greater Rochester, excellent educational opportunities support new discoveries and an entrepreneurial spirit. Eighteen outstanding colleges and universities—plus three business and career schools—provide unsurpassed learning opportunities for more than 80,000 enrolled students.

The University of Rochester and Rochester Institute of Technology specialize in training highly skilled professionals in cutting-edge research in allied fields. Monroe Community College offers technical training in optics and photonics unmatched anywhere in the U.S.

The region surpasses national education attainment levels—and is ranked as a “top ten” community for education by Forbes and Places Rated Almanac.

ROCHESTER SURPASSES NATIONAL EDUCATION ATTAINMENT LEVELS:

- 44.4% of 18- to 24-year-old residents are enrolled in college (U.S. 34%)
- 27.1% of area residents 25 years of age and older have at least a Bachelor's degree (U.S. 24.5%)
- 31.9% of area residents between the ages of 25 and 35 have attained a Bachelor's degree or higher (U.S. 27.5%) *U.S. Census Bureau, 2000*



RANKED 6TH AMONG THE TOP 50 METRO AREAS FOR
DEGREES GRANTED IN SCIENCE AND ENGINEERING

Metropolitan New Economy Index, 2001



UNIVERSITY OF ROCHESTER

www.rochester.edu

Greater Rochester is known for its historic and innovative role in imaging and optics—in large part stemming from the work over past decades by the nationally recognized researchers at the University of Rochester (UR).

Beyond basic research, the University encourages the advancement of its scientists' discoveries through programs designed to turn basic analysis into commercial benefits for the community. Alumni of the University's School of Engineering and Applied Sciences' have created 29 companies in the Rochester area over the past two decades, generating tens of millions of dollars in salaries annually. University-based consortiums, such as the Center for Electronic Imaging Systems, Microelectronics Design Center and the new Center for Institute Ventures, are specifically designed to help bring University scientists and business leaders into collaborations.

- **University of Rochester Research:** In fiscal 2003, the University of Rochester attracted \$308.1 million in research grants, up 22% from \$252.7 million a year ago
- **University of Rochester ranked 6th in licensing revenue among U.S. institutions.** At \$42 million, the University of Rochester ranked among the top academic institutions in the nation in earning revenue from the research of university scientists and engineers during FY2002

Association of University Technology Managers, 2003

INDUSTRY RELATED R&D CENTERS AND CORE FACILITIES

UR and the Institute of Optics house many smaller optics centers and labs to support a variety of optics activities: the Center for Quantum Information; the Nano-Optics Center; an Electron Microscopy facility for photonics; a facility in Molecular Beam Epitaxy for photonics, plus UR just received funding for a new effort in applications of slow light.

Institute of Optics

Founded in 1929 as the nation's first program of higher education in the field of optics, the Institute of Optics has offered continuing optics education for industrial engineers since 1931 and has granted 55% of the nation's Bachelor's, Master's and Doctoral degrees in optics. The Institute serves as the focal point of the University of Rochester's extensive optics research that spans the disciplines of biology, physics, astronomy, chemistry, computer science and medicine.

- **1929—Established the first optics degree programs at the BS, MS and Ph.D. levels**
- **Granted over 55% of all Optics degrees in the U.S.**

Expanded Optics and Biomedical Engineering Facility Underway

A new 100,000-square-foot building will house scientists studying both optics and biomedical engineering with many opportunities for collaboration. The \$30 million facility will include a new proposed technology-transfer program, called the Center for Institute Ventures, which will help produce local high-tech, spin-off companies.



The Omega laser, the most powerful ultraviolet laser in the world, fires on its target with more than 100 times the power in the entire national power grid.

Laboratory for Laser Energetics

The University of Rochester's Laboratory for Laser Energetics (LLE) is home to Omega, the world's most powerful laser, which scientists from around the nation use in their quest to develop nuclear fusion as a reliable energy saver source. LLE's laser system also allows scientists to conduct experiments that are important to increased understanding of U.S. nuclear weapons in the absence of testing.

Center for Adaptive Optics

The University of Rochester is an integral member of the National Science Foundation's Science and Technology Center for Adaptive Optics. The scientists and engineers in its laboratory are primarily focusing their efforts on the development of ophthalmic instrumentation equipped with adaptive optics, with the ultimate goal of commercialization.

Biomedical Optics

Biomedical optics is one of four areas of specialization available to students in UR's Department of Biomedical Engineering (BME). Biomedical optics lab research is focused on exploring a variety of problems such as tissue spectroscopy, fluorescence photobleaching, plus a new way to gather more information from microscopy images, called fluorescence anisotropy.

Rochester Center for Brain Imaging

Watching the human brain in action is the goal for scientists at the new Rochester Center for Brain Imaging. Its centerpiece is a new MRI system with a resolution far better than MRIs normally used in standard clinical situations. The new machine will use a 3.0 Tesla magnet twice the strength of those in standard machines. Only about 30 such MRIs exist in the nation.

Center for Optics Manufacturing

Machines that can grind ultra-precise optics into shapes once considered prohibitively expensive are now a reality, thanks to researchers at the University of Rochester's Center for Optics Manufacturing. New conformal grinders create optics in shapes never before possible, and the revolutionary magnetorheological finishing technology uses a fluid to grind optics with unprecedented flexibility.

University of Rochester Medical Center

The University of Rochester School of Medicine and Dentistry ranks in the top 25% of medical schools in the most recent National Institute of Health (NIH) rankings. Many of its researchers benefit from the University's long history of expertise in optics, stretching across traditional disciplinary lines to refine ultrasound imaging, magnetic resonance imaging and even spectroscopic detection of pathogens.

Center for Visual Science

The Center for Visual Science (CVS) is the preeminent center in the world for the complete study of vision from the cornea to the brain. It consists of more than 25 laboratories where researchers from diverse backgrounds study all aspects of vision such as the encoding of patterns of light by neurons in the retina, to the interaction between visual perception and memory.



ROCHESTER INSTITUTE OF TECHNOLOGY

www.rit.edu

Internationally recognized as a world leader in career-oriented and professional education, Rochester Institute of Technology (RIT) enrolls more than 15,000 students in a wide range of technical programs. The university has a strong record of partnering with industry and government on applied research and in preparing students for technical and professional careers. With its applied research focus, and its strong emphasis on workforce development for emerging industries, RIT is uniquely positioned to be a tremendous resource to Rochester-based companies.

- RIT founded and offers the only Imaging Science Ph.D. and Microsystems Engineering Ph.D. programs in the U.S.
- RIT produced the first Imaging Science Ph.D. graduate in 1993

INDUSTRY RELATED R&D CENTERS AND CORE FACILITIES

RIT has 36 research and teaching laboratories dedicated to specialized areas of imaging science including electronic imaging, digital image processing, remote sensing, medical imaging, color science, optics and chemical imaging.

The School of Photographic Arts and Sciences

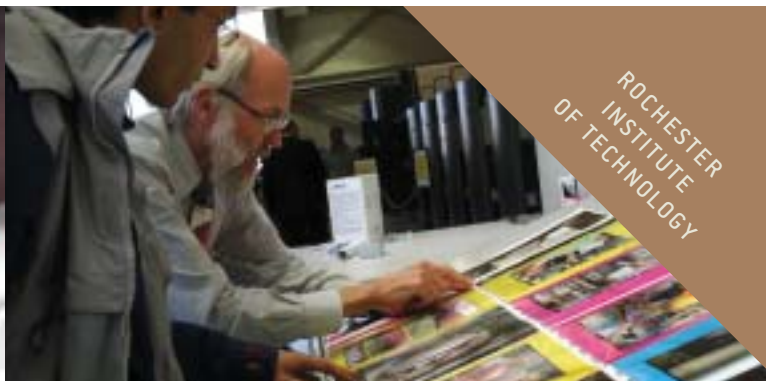
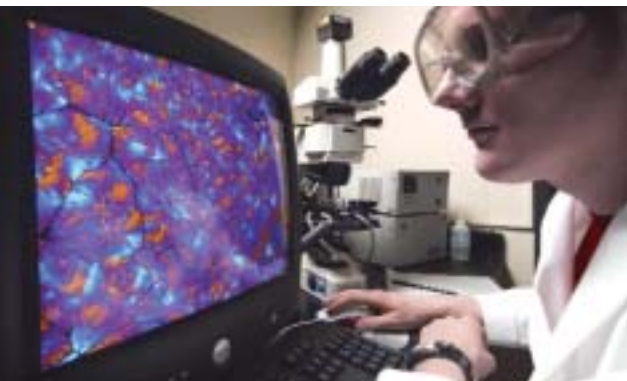
This school offers a rich and extraordinarily diverse environment to develop creative possibilities afforded by the study of photography, science and fine art. More than 900 undergraduate and graduate students immerse themselves in new photographic imaging technologies, exploring disciplines ranging from traditional silver halide to cutting-edge digital and electronic manipulation.

Chester F. Carlson Center for Imaging Science (CIS)

Offering the nation's only B.S, M.S. and Ph.D. degrees in imaging science, scientists at CIS conduct research for corporate and government sponsors in the areas of remote sensing, color science, medical imaging, visual perception, digital image processing and document restoration.

The Visual Perception Laboratory in the Chester F. Carlson Center for Imaging Science at RIT aims to further the understanding of *high-level visual perception*.





The Munsell Color Science Laboratory is one of the world's premier academic laboratories dedicated to the science of color. Activities include education and research in areas of color perception, color measurement, color formulation, and color reproduction.

Lab for Advanced Spectral Sensing (LASS)

The mission of LASS is to educate trained specialists and conduct advanced research in the field of spectral remote sensing and the fusion of multi-source data sets into a valuable information product.

Lab for Imaging Algorithms and Systems (LIAS)

The Laboratory for Imaging Algorithms and Systems applies the "science of imagery" to bring information contained in images to the user. LIAS is a cross-disciplinary collaborative focused on applied algorithm research, software system prototyping and advanced processing hardware for imaging applications.

Lab for Astrophysics and Photonics (LAPP)

This group is interested in the development of new solid-state imagers for use in ground-based astronomy, space based systems, medical imaging and remote sensing.

Photonics Research Laboratory

Research in the Photonics Research Laboratory (PRL) focuses on micro- and nano-optics and photonics devices, optical MEMS, modular optical components and subsystems plus optical fiber communication and sensing. Currently active projects include photonic crystal couplers and multiplexers, micro-optical amplifiers and optical switches.

Liquid Immersion Nanolithography Lab

Microsystems liquid immersion nanolithography research is a key aspect of RIT's applied research programs—and is the foundation of the new microsystems science and engineering Ph.D. program.

Munsell Color Science Lab (MCSL)

MCSL is one of the world's premier academic laboratories dedicated to research and education in color science.

Ultrasound Imaging Laboratory

Ultrasound imaging is a mode of imaging based on the interaction of high-frequency sound waves with different materials. While the main focus is on medical applications of ultrasonography, the lab is also involved in industrial applications for thin films, coatings and paper.



MONROE COMMUNITY COLLEGE

www.monroecc.edu

Monroe Community College (MCC) is the first higher education institution in the nation to create a two-year degree program for training technicians to work in the optical industry.

For Optical Systems Technology, MCC offers an A.S.S. degree, several certificate programs and corporate training courses tailored to individual company needs. Established in 1963, MCC's Optical Systems Technology program has received national and international recognition.

Cooperative transfer programs to University of Rochester and Rochester Institute of Technology offer continuing optics education to MCC students. The college offers apprentice and company-sponsored scholarship programs to foster additional workforce training relationships. Plus, optics faculty provides industry-relevant training in applied optical technology to firms such as Xerox and Eastman Kodak Co.

The Optical Technology Laboratories contain state-of-the art equipment for students to gain valuable hands-on experience. MCC's comprehensive optics program includes manufacturing and electronics, design and function of optical components, optical instruments and experimental techniques.

MCC's ongoing interaction with industry produces an up-to-date program that remains responsive to local business needs—it exemplifies Rochester's long history of university-industry partnerships.

- 1963 — Monroe Community College offers the 1st Associates degree in the U.S. for training Optical Systems technicians
- MCC offers technical training in optics and photonics that is unmatched anywhere in the U.S.

INDUSTRY PARTNERSHIPS PAVE THE WAY FOR A CUTTING-EDGE CURRICULUM THAT IS RESPONSIVE TO LOCAL BUSINESS NEEDS.



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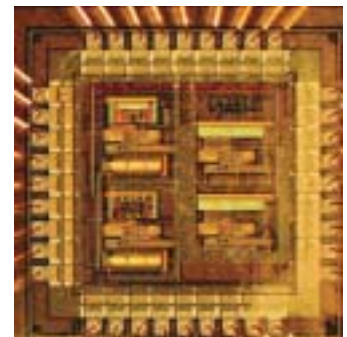
The Infotonics Technology Center, a collaborative industry, university and government initiative, is designed as a world-class photonics and microsystems Center of Excellence. Infotonics accelerates innovative microsystems commercialization through dedicated fabrication and packaging capability and strategic partners. The goal is to reduce the financial risk frequently associated with the development process and increase the probability of commercial success. Featuring thousands of feet of cleanroom space, the facility is capable of fabricating, packaging and testing micro devices to be interconnected with the macroscopic world.

Center for Electronic Imaging Systems and Microelectronics Design Center

www.ceis.rochester.edu

The Center for Electronic Imaging Systems (CEIS) is a New York State sponsored Center for Advanced Technology devoted to promoting economic development in the Greater Rochester Region and New York State. CEIS carries out its mission by developing and transferring technology to industry for commercialization and by educating the next generation of leaders in the fields of electronic imaging and microelectronics design.

The Microelectronics Design Center (MDC) links faculty at 12 New York State universities to improve the current condition in microelectronics circuit design research, enabling the development of new and improved integrated circuits.



CEIS researchers designed this noise calibration CMOS imaging circuit to evaluate noise for CMOS imagers.

IT Collaboratory

<http://www.rit.edu/ff858www/>

The IT Collaboratory was established by the New York State Office of Science, Technology and Academic Research (NYSTAR) as a Strategically Targeted Academic Research Center (STAR). It is an RIT-led research collaboration between RIT laboratories, the University at Buffalo's Institute for Lasers, Photonics and Biophotonics and the NYS College of Ceramics at Alfred University. The mission of the IT Collaboratory is to create key technologies, knowledge and capabilities to design and integrate next generation information technology systems.

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