R&D 100 Awards Recognition Ceremony

Thursday, June 7, 2007
Bradbury Science Museum
Los Alamos, New Mexico

Los Alamos
NATIONAL LABORATORY
EST.1943

From the Director

I am pleased to recognize our 2007 Laboratory participants in *R&D Magazine's* annual, international R&D 100 Awards competition. The recognition Los Alamos National Laboratory receives through its participation in this competition publicly highlights the broad range of technological achievements we contribute to innovation in our nation and the world.

Our scientific discoveries and the resulting applications—applications capable of addressing global technical challenges—play an important role in shaping the future of this nation. When we work with industry to transfer our inventions and technological advances from the Laboratory to the private sector for commercial development, we strengthen our nation's economic security by enhancing industrial competitiveness.

I applaud our creative research staff for their innovative technologies and the teams of dedicated professionals who help them develop the impressive submission packages that consistently result in winning entries for Los Alamos. Our submissions, ranging from

- advanced imaging and hazardous materials detection technologies, to
- epidemiological forecasting, and
- advances in medical equipment and nanomaterials development,

highlight the Laboratory's great scientific diversity.

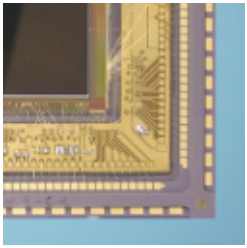
Congratulations on a job well done!

Michael R. Anastasio
Laboratory Director

The R&D 100 Awards

For the past 29 years, Los Alamos National Laboratory has submitted descriptions of its most innovative technologies to *R&D Magazine's* annual R&D 100 Awards competition. This competition is designed to honor significant commercial promise in products, materials, or processes developed by the international research and development community. Selection of the R&D 100 winners is a sophisticated process lasting nearly a full year and involving a panel of almost 50 independent technical experts who lend their expertise in evaluating the details of the product entries compared with other existing products and technologies. According to the selection panel, "The sole criterion for making the grade is demonstrable 'technological significance' compared with competing products and technologies. Features such as smaller size, faster speed, greater efficiency, and higher environmental consciousness have continued to gain importance in successful award submissions."

Los Alamos has been competing successfully for nearly three decades with many of its winning technologies developed in collaboration with private-sector companies and other scientific institutions. The Laboratory won four awards in 2006 and has received 103 awards since it began competing in 1978—more than any other national laboratory has received.



Los Alamos National Laboratory
Kris Kwiatkowski
Christopher L. Morris

Teledyne Imaging Sensors
Vincent Douence
Atul Joshi
Yibin Bai

Camera on a Chip

Our Camera on a Chip is a 2-centimeter by 2-centimeter "hybrid chip," a combination of a microelectronic chip with a 720×720-pixel array of silicon photosensors and a metal-oxide-semiconductor (CMOS) chip with a corresponding array of control-and-processing circuits. The resulting device achieves performance far exceeding that possible with either of those technologies alone. It has light-detection (quantum) efficiency of greater than 90 percent from 450 to 650 nanometers, a minimum exposure time of 50 nanoseconds, and a minimum interframe time of 300 nanoseconds. The camera can be triggered to capture frames at the times of greatest interest during a fast event or an event with changing time scales. It also stores three frames "on-chip" and is relatively insensitive to the stray radiation normally present in radiography experiments. It gives scientists a single submicrosecond imaging tool that combines 20 years of advances in silicon CMOS microelectronics and photosensor technology.

Applications

- Making radiographic movies of ultrafast phenomena, with protons (instead of x-rays) as the illuminating source
- Capturing events that start slowly but evolve rapidly, such as the behavior of slowly cooked high explosives
- Producing high-speed movies of fast processes over a wide range of visible or near-visible wavelengths

EpiCast

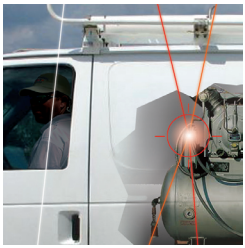
Epidemiological Forecasting Simulation Model

Los Alamos National Laboratory
Timothy C. Germann
Kai Kadau
Catherine A. Macken

Medical researchers around the globe are racing the clock to develop a vaccine to combat a deadly strain of avian influenza that could trigger a global human pandemic. While the H5N1 avian virus is highly infectious among birds, it has not yet spread among humans. However, the fear is it could soon mutate into a form that can. To help epidemiologists understand the spread and impact of the next influenza pandemic, we developed EpiCast (Epidemiological Forecasting), a software package that creates a synthetic model population based on census data, randomly assigning "virtual people" to households, workplaces, schools, and other community settings where disease transmission could occur. Each person has an individual probability for infection and can become infected or infect others. Taking advantage of EpiCast's unprecedented level of detail, epidemiologists have successfully evaluated various medical and nonmedical mitigation strategies that could be used to counter a pandemic influenza outbreak.

Applications

- Obtaining realistic preparation and response data for policy makers and health officials to develop mitigation strategies to counter potential pandemics
- Modeling potential bioterrorist attacks to enable development of preparation and response strategies
- Simulating alternative models such as social epidemics (trends in crime and drug use), idea adoption behaviors, etc.



Los Alamos National Laboratory
Christopher L. Morris
Charles C. Alexander
Jeffrey D. Bacon
Konstantin N. Borozdin
Rick Chartrand
Deborah J. Clark
Camilo J. Espinoza
Andrew M. Fraser
Mark C. Galassi
Jacqueline S. Gonzales
Jesse Andrew Green
Nicolas W. Hengartner
Gary E. Hogan
Mark F. Makela
Jason J. Medina
Patrick McGaughey
John Christopher Orum
Fawn E. Pazuchanics
William Priedhorsky
Richard C. Schirato
Larry J. Schultz
Michael J. Sossong

University of South Carolina
Gary S. Blanpied

Passport Systems, Inc.
Alexei V. Klimenko

Muon Tomography Scanner

Our muon tomography scanner uses ambient cosmic-ray muons as the radiographic probe to scan cargo for high-density threat materials such as uranium or plutonium. The scanner plots the incoming muons' initial trajectories, then registers all outgoing muons on the opposite side and correlates them to the first measurements. The software compares the muon-track plots and notifies the operator when it determines that outgoing muons have been deflected by a dense object within the scanner. The complete scan and data analysis are conducted in less than one minute—allowing customs officials to maintain border security without impeding commercial traffic flow.

Applications

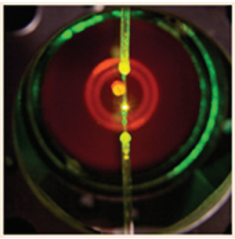
Our muon tomography system can scan

- tractor-truck trailers at border-crossing points, and
- cargo containers as they are unloaded at port facilities and airport cargo terminals.

Cities and high-security installations can also use these scanners to provide highly selective protection of their geographic area and people.

Muon tomography scanners will greatly increase border security against nuclear threat materials by

- detecting unshielded materials via their emissions and density,
- detecting shielded materials via their density without additional radiation dose, and
- performing the scan quickly without additional risk to personnel.



Los Alamos National Laboratory
Steven W. Graves
Gregory Goddard
Robert Habbersett
John C. Martin
Mark Naivar

Acoustic Cytometry Systems
Gregory Kaduchak (former Los Alamos employee)
Kristin Martinez
Michael Ward (former Los Alamos employee)

Portable Acoustic Cytometer

The Portable Acoustic Cytometer is the world's first truly portable and affordable flow cytometer. Our instrument uses acoustic waves instead of a complex fluidics system to focus the cells into a tight stream for analysis. Acoustic focusing concentrates the cells as they are focused and gives the cells more time in the laser beam, making possible both greater throughput and greater sensitivity. Our cytometer's capabilities surpass those of conventional flow cytometers without the complex and expensive components that drive up their size, complexity, and cost. In addition, our instrument eliminates the need for large volumes of purified water, a scarce resource in many parts of the world. The Portable Acoustic Cytometer brings the diagnostic power of high-performance flow cytometry to more researchers and healthcare providers around the world.

Applications

The Portable Acoustic Cytometer can be used for any of the analyses currently done with conventional flow cytometers in research and clinical laboratories:

- High-throughput screening of potential new drugs
- Typing blood cancers and analyzing compatibilities for tissue transplants
- Screening for cancer markers or infectious agents
- Monitoring cell populations and subpopulations to assess patients' responses to anti-retroviral or chemotherapy drugs

Los Alamos National Laboratory
Lakshman Prasad
Sriram Swaminarayan

RaveGrid

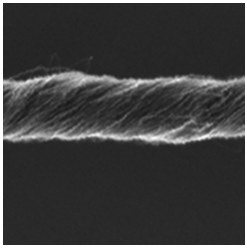
Raster-to-Vector Graphics for Image Data

RaveGrid software converts a digital image represented by pixels to a "vector" image represented by polygons. (Such a vector image is far easier to scale or process than a pixel image.) On a Pentium IV laptop with 1 GB of RAM, RaveGrid vectorizes an image containing up to 20 megapixels at a rate of 0.5 megapixel per second. RaveGrid also compresses an uncompressed pixel image as it vectorizes the image, typically reducing storage requirements by a factor of 4. RaveGrid can also identify objects in an image from specified criteria such as size, shape, or color. RaveGrid is compatible with the new scalable vector graphics (SVG) standard of the World Wide Web Consortium as well as with the Encapsulated Postscript (EPS) format.

Applications

RaveGrid enables

- image scaling to the pixel resolution of a particular digital display or Web-page layout;
- image compression to reduce image-storage or bandwidth requirements;
- encryption of vectorized images in text files;
- image searches in large databases or on the Internet; and
- automatic analysis of reconnaissance or surveillance images.



Los Alamos National Laboratory
Yuntian T. Zhu
Paul N. Arendt
Raymond F. DePaula
Qingwen Li
Dean E. Peterson
Chris Sheehan
Xeifei Zhang
Lianxi Zheng

CNT Technologies, Inc.
Robert O'Leary
Timothy G. Clapp
P. Douglas Kirven

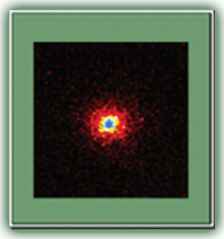
Super CNT Fibers

Spun from carbon nanotubes—the strongest, stiffest material known—our Super CNT Fibers have one-tenth the density and four to five times the specific strength (strength per density) and specific stiffness (stiffness per density) of the best carbon fibers now used to make advanced structural composites. We achieve this superior performance by spinning Super CNT Fibers from ultralong (~1 millimeter) carbon nanotubes that have only two walls and a hollow center, giving them low density. The use of Super CNT Fibers will ultimately increase the fuel efficiency of commercial aircraft by reducing aircraft weight and increase the stealthiness of combat aircraft by reducing aircraft radar cross-section. The use of these fibers will also reduce space-launch costs by reducing the weight of rockets and spacecraft, and improve sports-equipment performance by reducing weight and increasing strength and stiffness.

Applications

Super CNT Fibers will enhance the performance of the advanced carbon-fiber structural composites used in

- aircraft,
- spacecraft,
- automobiles, and
- sports equipment.



WAIL

A Groundbreaking Approach to Ground-Based Cloud Probing

Los Alamos National Laboratory
Anthony B. Davis
Thomas Hale
Cheng Ho
Steven P. Love

Colorado State University
Igor N. Polonsky
(former Los Alamos employee)

WAIL—Wide-Angle Imaging Lidar—is a ground-based lidar system specifically designed for probing dense clouds. Like standard lidar, WAIL uses a vertically aimed pulsed laser to illuminate the atmosphere and a receiver to collect the laser photons that are scattered back to Earth. Because its receiver collects only those photons that strike the cloud base and travel straight back along the beam, standard ("on-beam") lidar reveals primarily a cloud's height. In contrast, WAIL works "off-beam." Its receiver collects photons that have scattered throughout the entire cloud and have returned from large distances beyond the incident beam. Therefore, WAIL's signal carries information from deep inside the cloud, and users can infer cloud thickness and mean opacity in addition to height.

Applications

- Probing clouds to increase our understanding of their role in the global climate system and hydrological cycle
- Assessing how clouds and fog affect atmospheric visibility for aviation safety
- In the future, environmentally supporting troops confronted with fog, dust, sand, smoke, and other impediments to visibility
- Also in the future, probing any strongly scattering medium in the environment such as turbid coastal waters, sea ice, snow, icy moons such as Jupiter's Europa, and so on

Los Alamos National Laboratory R&D 100 Award Winners 1978–2006

1978
- Diamond Machining of Optics
- Electronic Identification System
- Electronic Device for Treating Tumors—Hyper Thermic Cancer Treatment

1980
- Wee Pocket Radiation Detector
- Portable Multichannel Analyzer

1981
- Radio Frequency Quadrapole Linac

1982
- WC Field Computer System

1983
- Transuranic Waste Assay System

1984
- Superconducting Magnetic Energy System

1985
- BHTP—A Unique Scintillation Compound

1986
- Aurora Laser Beam Alignment System

1988
- Optical Microrobot Single-Cell Manipulator/Analysis System
- Nuclear Material Solution Assay System
- 32-Stepper Motor Position Controller
- Mobile Beryllium Monitor
- HTMS Reference Electrode
- Oriented, Highly Anisotropic Conducting Polymer
- Photoinjector for RF Linac Accelerators
- Lattice Gas Algorithm

1989
- Fourier Transform Flow Cytometer
- Noncontact Superconductor Screening
- Conductive Lattices

1990
- Broadband (ABB) Mw Absorption Spectrometer for Liquid Media
- Coolahoop
- Fast Agarose Gel Electrophoresis (FAGE)
- New Class of High-Temperature Structural Materials
- Solid-State Nitrogen Dioxide Sensor

- Universal Process for Fingerprint Detection
- Upconversion Solid-State Laser

1991
- Semi-Insulator Detector
- Optical High-Acidity Detector
- Resonant Ultrasonic Inspection (RUI)
- Single Molecule Detector

1992
- Thermal Neutron Multiplicity Counter
- Plastic Laser Dye Rods
- Cryogenic Diamond Turning
- Portable Laser Spark Surface Mass Analyzer (PLASSMA)
- Zeeman Refractive Index Detector
- Animated Display of Inferred Tongue, Lip, and Jaw Movements During Speech

1993
- Selenium-Based Reagents for the Evaluation of Chiral Molecules
- Phase-Sensitive Flow Cytometry
- Ultrafast Infrared Spectrometer
- Mini Elastic Backscatter Lidar

1994
- Ultrasensitive Ultrasonic Transducer
- Telemetric Heat Stress Monitor
- Optical Biopsy System
- Lattice Boltzmann Permeameter
- Directed Light Fabrication of Complex Metal Parts
- Bartas Iris Identification

1995
- The Indigo-830
- ARS Chemical Fill Detector
- Hydride-Dehydride Recycle Process
- HIPPI-SONET Gateway
- Microsensor for VOCs
- Polymer Filtration System

1996
- TRACER (Transportable Remote Analyzer for Characterization & Environmental Remediation)
- PLASMAX (Plasma Mechanical Cleaner for Silicon Wafers)

1997
- Falcon: Breakthrough Software for Simulating Oil Reservoirs
- Rapid Size Analysis of Individual DNA Fragments
- ASR Detect—Diagnostic Method for Analyzing Degrading Concrete
- Dry Wash
- Plasma Source Ion Implantation for Enhancing Materials Surfaces
- High Performance Storage

1998
- Cyrax™—Portable, 3-D Laser-Mapping and Imaging System
- Low-Smoke Pyrotechnics
- SOLVE—Creating 3-D Pictures of Protein Molecules from X-Ray Diffraction Spots
- Underground Radio

1999
- Acoustic Stirling Heat Engine
- Atmospheric Pressure Plasma Jet
- CHEMIN: A Miniaturized X-Ray Diffraction and X-Ray Fluorescence Instrument
- PREDICT—A New Approach to Process Development
- Real-Time, Puncture-Detecting, Self-Healing Materials
- REED-MD: A Computer Code for Predicting Dopant Density Profiles in Semiconductor Materials
- The Sulfur Resistant Oxymitter 4000™

2000
- ANDE: Advanced Nondestructive Evaluation System
- Electroexploded Metal Nanoparticles

2001
- Free-Space Quantum Cryptography
- SCORR—Supercritical CO_2 Resist Remover
- Tandem-Configured Solid-State Optical Limiter

2002
- GENIE: Evolving Feature-Extraction Algorithms for Image Analysis
- HDF5 – Hierarchical Data Format

2003
- CARISS: Integrated Elemental and Compositional Analysis
- BASIS: High-Confidence Biothreat Detection and Characterization
- FIRETEC: A Physics-Based Wildfire Model
- Flexible Superconducting Tape
- FlashCT™
- Green Destiny
- PowerFactoRE: A Suite of Reliability Engineering Tools for Optimizing the Manufacturing Process
- Super-Thermite Electric Matches

2004
- Clustermatic
- Confocal X-Ray Fluorescence Microscope
- mpiBLAST: A High-Speed Software Catalyst for Genetic Research
- Plasma-Torch Production of Spherical Boron Nitride Particles
- 10-Gigabit Ethernet Adapter: Speed Really Changes Everything

2005
- CartaBlanca
- MESA: Measuring Enzyme-Substrate Affinities
- nanoFOAM: A Metal-Nanofoam Fabrication Technique
- NESSUS

2006
- ENABLE: Energetic Neutral Atom Beam Lithography/Epitaxy
- Green Primaries: Enviro-Friendly Energetic Materials
- MICHELLE: A Software Tool for Three-Dimensional Modeling of Charged-Particle-Beam Devices
- PixelVizion: An NPU-Embedded Visualization Accelerator for Large Data Sets
- Trident

R&D 100 Awards Sponsorship

The Technology Transfer (TT) Division serves as the link for technology transfer and Laboratory collaborations with private industry, universities, government agencies, and other national laboratories. TT matches Laboratory scientific and technical talent, expertise, and facilities with research and development endeavors in external sectors for the advancement of national security, technological innovation, and economic competitiveness.

As part of our commitment to the transfer of technology beyond the Laboratory, TT coordinates Laboratory participation in the annual R&D 100 Awards competition. In collaboration with technical staff and a dedicated, professional publications team from the Information Resource Management Division, TT submits the Laboratory's most innovative technologies to the R&D 100 review panel.

Contact information:

For information about R&D 100 participation, contact:

Kim Sherwood
(505) 665-1305
ksherwood@lanl.gov

For information about licensable technologies, contact:

John Mott, Ph.D.
(505) 665-0883
jmott@lanl.gov

For information about TT, visit us on the Web at:

www.lanl.gov/partnerships