2007 FLC Awards

Awards for Excellence in Technology Transfer

Powertrain System Analysis Toolkit (PSAT)

Department of Energy
Argonne National Laboratory

Developed at Argonne National Laboratory, the Powertrain System Analysis Toolkit (PSAT) is a state-of-the-art flexible and reusable simulation package used to facilitate advanced vehicle (i.e., hybrid, hydrogen, and fuel cell) development. PSAT was designed to serve as a single tool that can meet the requirements of automotive engineering throughout the development process—from modeling to control.

PSAT allows users to accurately model advanced vehicle components, their control strategies, and component interactions in a systems context, thereby enabling users to conduct detailed laboratory benchmark testing of advanced components as they are being developed. PSAT provides accurate performance and fuel economy simulations, permitting automotive and truck manufacturers and their suppliers to quickly select the advanced technologies that will best meet their needs, and helping them bring their advanced vehicles to market as quickly and cost effectively as possible. Thus far, PSAT has been transferred, through licensing agreements, to more than 200 users worldwide. Among licensed PSAT users are major automakers—including General Motors, Ford, DaimlerChrysler, and Hyundai—automotive suppliers, energy companies, research institutions, and universities.

From left: Sylvain Pagerit, Aymeric Rousseau, Phillip Sharer and Bob Larsen. Not pictured: Don Hillebrand, Mike Duoba, Lee Slezak, and Max Pasquier

Contact
Aymeric Rousseau
630-252-7261
arousseau@anl.gov

Compact High Efficiency Natural Gas Liquefier

Department of Energy
Idaho National Laboratory

From left: Kerry Klingler, Dr. Mike McKellar, Dr. Dennis Bingham, Bruce Wilding, Frank Carney and Terry Turner. Not pictured: Douglas Stacy and David Anderson

Affordable energy is a key concern in the 21st century. Since the late 1980s, natural gas has become more widely available and more popular, as well as environmentally friendly. As a result, gas demand is outrunning the current supply system, causing both high prices and price volatility. According to the Department of Energy, the demand for natural gas is expected to increase 25% over the next decade.

Although most natural gas is carried from well to user as gas in pipelines, the use of liquefied natural gas (LNG) is increasing because of new applications and changing market forces in the energy industry. A typical modern, large liquefaction plant costs billions of dollars, produces 150,000+ gallons/day, uses 20-30% of its throughput to power it, and has substantial operating and maintenance costs. Consequently, there is a clear need for small, reliable, inexpensive liquefaction processes that work efficiently with untreated natural gas and that can be located close to LNG markets.

Researchers at Idaho National Laboratory (INL) have developed for the first time a liquefaction technology that is very compact, yet able to use natural gas directly from transmission lines without costly pretreatment to remove water and carbon dioxide contaminants. The INL technology produces LNG that is competitive with that produced in some of the largest facilities worldwide. The secret of INL's highly efficient technology is that it uses "free" energy from pipeline pressure letdown to liquefy the natural gas, and it incorporates a patented centrifugal solids separation step to remove frozen carbon dioxide that could clog the system.

INL recognized the far-reaching applications of this technology when it was first disclosed in 1997. In 2000, a Cooperative Research and Development Agreement (CRADA) with Pacific Gas and Electric (PG&E) and Southern California Gas Company led to the construction of a 10,000-gallon/day plant in Sacramento. Its compact size and automated operation allowed the liquefaction facility to be located within Sacramento's historic district.

In 2004 INL licensed the technology in a particular field of use to Hanover Compression LP. The INL compact high-efficiency natural gas liquefier has generated worldwide licensing interest, with inquiries from 36 countries. Representatives from many of these countries—which include Canada, Mexico, Argentina, Brazil, Peru, Chile, Kazakhstan, Thailand and Bangladesh—have visited INL or the Sacramento liquefaction facility. In 2006, the technology was honored with an R&D 100 Award recognizing the 100 most technologically significant products and advancements in the world; and it also received an FLC Far West Region Award for Outstanding Technology Development.

Contact
David Anderson
208-526-0837
david.anderson@inl.gov

MESA: Measuring Enzyme-Substrate Affinities

Department of Energy
Los Alamos National Laboratory

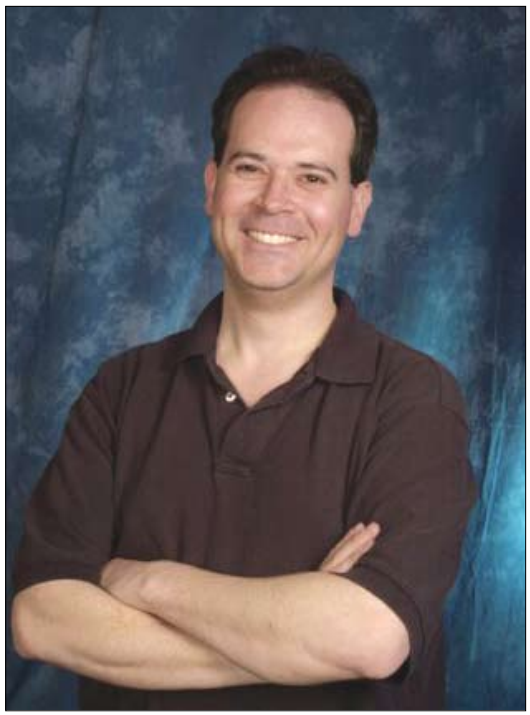
Today's high drug-development failure rate—the primary cause of the high cost of new drugs—is driven by the industry's inability to measure more than an infinitesimal number of drug-protein interactions at one time. Now, MESA (measuring enzyme-substrate affinities) technology, developed at Los Alamos National Laboratory (LANL), makes it possible to measure a very large number of these interactions very quickly. The resulting early detection of toxicity will save hundreds of millions of dollars in drug development costs.

MESA enables researchers to screen drugs for binding to proteins without the need for any fluorescent labels, which are as large as most drug molecules. Adding fluorescent labels leads to drugs with poor performance and many side effects. MESA images drug-protein binding using the natural X-ray fluorescence intrinsic to unlabeled drug molecules.

To commercialize the technology, Dr. Benjamin Warner, co-inventor of MESA, took an entrepreneurial leave of absence from LANL to found Caldera Pharmaceuticals, which acquired $7 million in private financing and licensed the MESA technology. Using MESA, Caldera is striving to save the $40-billion-a-year drug discovery industry billions of dollars by shortening the testing process and weeding out potentially dangerous drugs before they reach expensive clinical trials. To meet market demand, Caldera is currently developing a relatively inexpensive XRFlow machine that combines MESA with solution measurement for use by the pharmaceutical and biomedical research industry. Caldera has a working prototype of its new XRFlow device and plans to introduce XRFlow to the market in early 2008. Caldera is also developing its own pharmaceutical pipeline by finding new uses for existing drugs.

Every drug that successfully undergoes clinical trials costs $200 million or more in direct costs because so many trials fail. MESA will enable failure-prone drugs to be eliminated before costly animal and clinical trials begin. In addition, adverse drug reactions kill approximately 100,000 hospitalized patients annually and cause serious side effects in another 2.2 million people in the United States. MESA will enable physicians to prescribe the right drug from the start by screening patients for their likely response to specific drugs.

With the development of MESA, a 2005 R&D 100 Award winner for the lab, LANL has spun out a viable startup with a bright future based on its valuable contribution to the pharmaceutical industry.

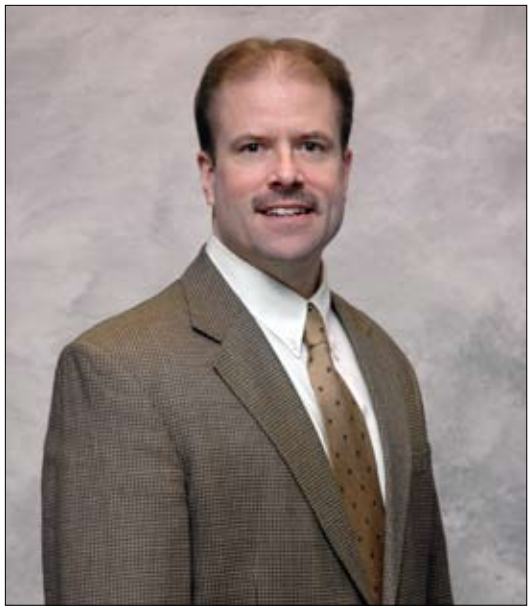


Dr. Benjamin Warner
Not pictured: Dr. Anthony Burrell, Dr. George Havrilla, Dr. Cris Lewis, Dr. Cynthia Mahan, Dr. Grace Mann, Dr. Thomas McCleskey, Dr. Thomasin Miller, Dr. Edel Minogue, and Dr. Cyndi Wells

Contact
Dr. Benjamin Warner
505-661-2420
warner@caldera-pharmaceuticals.com

Advanced Process Engineering Co-simulator

Department of Energy
National Energy Technology Laboratory



Dr. Stephen Zitney

The Advanced Process Engineering Co-Simulator (APECS), developed at the National Energy Technology Laboratory (NETL), is an innovative software tool that the process and energy industries are using to meet aggressive performance, economic, and environmental targets for some of the most sophisticated and expensive production plants in the world. APECS allows the industries to better understand and optimize overall plant performance with respect to complex thermal and fluid flow phenomena by combining best-in-class process simulation and computational fluid dynamics (CFD) software with high-performance computing and interactive, immersive, 3-D plant walk-through virtual engineering software. Using APECS, these industries can also address the challenge of designing next-generation plants to operate with unprecedented efficiency and near-zero emissions, while operating profitably amid cost fluctuations for raw materials, finished products, and energy.

The tools used by NETL to transfer the APECS technology to the private sector include a DOE-funded cooperative R&D project and agreement among NETL; Fluent, the world's leading supplier of CFD software and services; Aspen Technology, a major supplier of process simulation software; West Virginia University; and Alstom Power, a major worldwide industrial player in equipment and services for power generation.

To facilitate additional APECS R&D and technology transfer, NETL recently launched the Collaboratory for Process & Dynamic Systems Research (CPDSR). Organized by NETL in partnership with Carnegie Mellon University, the University of Pittsburgh and West Virginia University, the main objective of the CPDSR is to accelerate development of process systems engineering methods and tools for fossil energy applications. As a result of successful technology transfer efforts, APECS is used worldwide today by engineers and researchers in the process and energy industries, as well as academia, national laboratories, and other research entities. In the chemical industry, process engineers are using APECS to optimize the performance of chemical production plants by analyzing the impact of complex reactor mixing and fluid flow phenomena on overall plant product quality and yield.

In the U.S. and United Kingdom power industries, cycle engineers are routinely employing APECS technology to develop competitive power plant solutions with significantly reduced development costs and technical risk. At NETL, system analysts are applying APECS to reduce the time, cost, and technical risk of developing high-efficiency, near-zero emissions power plants such as the coal-fired, gasification-based plant in the $1 billion, 10-year DOE FutureGen R&D Initiative.

Contact
Dr. Stephen Zitney
304-285-1379
stephen.zitney@netl.doe.gov

Hybrid Solar Lighting

Hybrid solar lighting is a dramatic improvement over conventional approaches to bringing sunlight into buildings. The hybrid solar lighting system illuminates the interior spaces of buildings by means of tandem solar and electric lighting sources. The system uses a lightweight, roof-mounted collector to concentrate visible sunlight into a bundle of plastic optical fibers that are routed to multiple "hybrid" luminaires within the building. These luminaires blend the natural light with artificial light to maintain a constant level of room lighting. Hybrid solar lighting reduces the cost of lighting in commercial buildings and delivers other significant benefits associated with natural lighting.

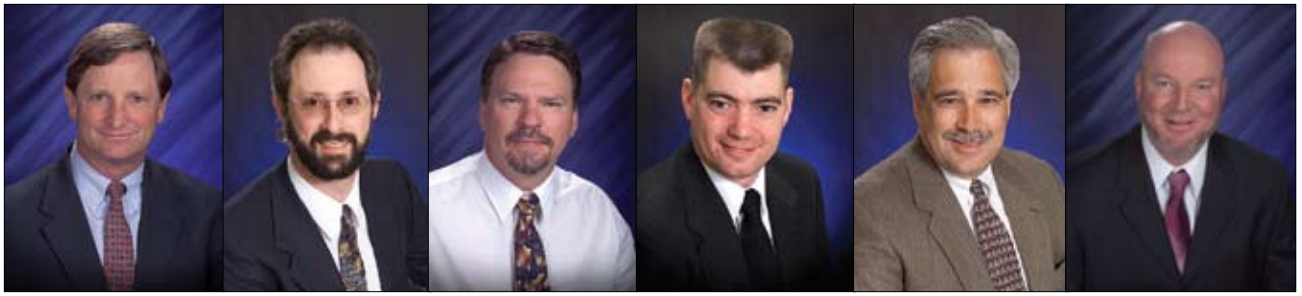
Oak Ridge National Laboratory (ORNL) patented the technology in 2003 and licensed it in 2005 to Sunlight Direct, LLC, in Oak Ridge, Tennessee. A commercial product became available in 2005. Demonstration units were to be deployed at sites across the United States during 2006.

Sunlight Direct is a local startup company spun out from ORNL. The principal scientist, Dr. Duncan Earl, was granted part-time entrepreneurial leave status by UT-Battelle, the management and operating contractor for ORNL under contract to the Department of Energy (DOE), and accomplishing the entire transaction required significant coordination with, and cooperation from, DOE with respect to management and approval of processes relating to potential conflicts of interest.

From left, front:Wes Wysor, Jeff Muhs, Randall Lind, Art Clemons, Dr. Duncan Earl, Christina Ward, John Jordan. From left, back: John Morris, Curt Maxey, Melissa Lapsa, Dave Beshears. Not pictured: Larry Dickens

Contact
Melissa Voss Lapsa
865-576-8620
lapsamv@ornl.gov

Grid Friendly™ Appliance Controller for Grid Frequency Monitoring and Stabilization



Carl Imhoff, David Chassin, Donald Hammerstrom, Jeffrey Dagle, Robert Silva, Robert Pratt

The term "grid" refers to the North American power highways, which move and channel electricity via power lines and substations. If the grid suffers an imbalance and becomes unstable, it could lead to a blackout—similar to the summer 2003 East Coast power outage. PNNL researchers have developed an innovative technology, the Grid Friendly™ Appliance Controller (GFA), which senses grid conditions by monitoring the frequency of the system and provides an automatic response in times of disruption by reducing the demand with no apparent disruption visible to the consumer's everyday life.

This simple computer chip can be installed in household appliances, such as washers, dryers, refrigerators, air conditioners, water heaters, etc., and can turn them off for a short period of time—just a few seconds up to a few minutes—to allow the grid to stabilize. The GFA can be programmed to react autonomously within a fraction of a second when a disturbance is detected, whereas power plants take several minutes to come up to speed and provide the appropriate response. The GFA technology can even be programmed to delay the restart of appliances instead of allowing all of them to come on at once following a power disruption, easing the transition back into full demand on the grid.

The GFA was developed and tested at PNNL, and has been transferred into the homes of several hundred consumers in the Northwest as part of a demonstration project that is demonstrating the device's applicability to grid stabilization and assessing the resulting consumer response.

The capability of the technology to monitor the frequency of the power grid system and respond automatically will result in the grid's increased stability and reliability, making it less costly to operate and ultimately leading to lower costs for consumers. Using the GFA to control demand instead of supply to stabilize the grid also results in fewer power outages, as well as allowing power plants to operate more efficiently and cost-effectively by reducing the need for backup generators to remain constantly on standby.

Contact
Robert Pratt
509-375-3648
robert.pratt@pnl.gov

The Morning Report: Advanced Proactive Safety and System Monitoring

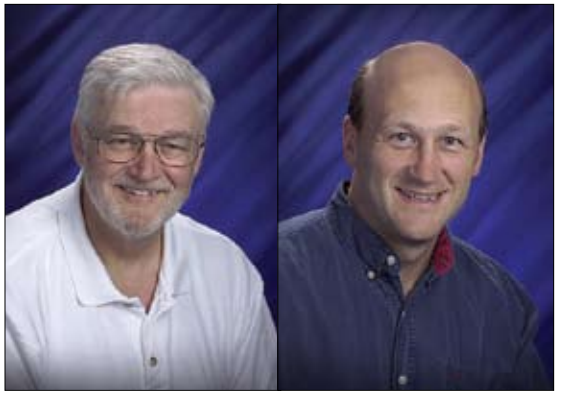
Department of Energy
Pacific Northwest National Laboratory

An R&D 100 Award–winning technology, The Morning Report is a data-intensive airline safety and information tool that gives aviation personnel more insight than ever before into overall flight patterns and subtle flight characteristics. Commercial airlines, along with the federal government, the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA), are focused on more proactive aviation safety efforts.

The Morning Report provides a new ability to gain insight into potentially unsafe flight practices and conditions. Using sophisticated multivariate statistical algorithms, the system analyzes gigabytes of data from thousands of airline flights overnight, generating an intuitively structured report every morning. The powerful algorithms that are the backbone of the analyses are combined with user-intuitive software to enable users to drill down, and understand, the details underlying any portion of any flight.

The transfer of The Morning Report technology culminated 10 years of research and development to create the automated capability to analyze huge amounts of data recorded during aircraft flights to improve the safety of flight operations. Tracking flight data is a voluntary effort for airlines and has, in the past, been prohibitively labor- and time-intensive. The Morning Report helped lower these hurdles for airlines to successfully track and make meaningful sense of flight data. This highly sophisticated computerized statistical analysis technology, coupled with user-friendly front-end software, can be readily used by aviation personnel without a high degree of statistics knowledge.

PNNL scientists were recruited by NASA because of their technical expertise in data mining and informatics. They developed the mathematical and statistical methodologies and algorithms to ingest data from a variety of flights of varying durations; to construct mathematical vectors that captured the essence and nuance of each flight in a manner that enabled efficient and automated analysis; to identify typical patterns and atypical events; and to present the results to users of The Morning Report, including nontechnical explanations of the major sources of the error. PNNL provided demonstrations of the power of The Morning Report and explanations of the scientific principles on which it is based to NASA, airline safety officers, and the FAA.



Dr. Thomas Ferryman and Brett Amidan
Not pictured: Dr. Tom Chidester, Capt. Robert Lawrence, Capt. Robert Lynch, Gary Prothero, Loren Rosenthal, Dr. Irving Statler

Contact
Dr. Thomas Ferryman
509-375-3888
tom.ferryman@pnl.gov

Advent Solar's Breakthrough Back-contact Photovoltaic Cell Design and Fabrication Process

From left: David L. King, Paul M. Smith, James Gee, and Mark S. Allen
Not pictured: Jeffrey Nelson

Rising energy costs and instability in regions producing most of the world's fossil fuels have refocused attention on the need for alternative renewable energy sources.

While the cost of solar cells has dropped over the past several decades, the technology is still not cost-effective for on-grid applications (i.e., homes, businesses). The solar industry needs further process improvements so that photovoltaic cells are more efficient and less expensive to manufacture.

Researchers at Sandia National Laboratories (SNL) have developed a breakthrough photovoltaic cell design and fabrication process that eliminates current-collection grids from the front surface of the cell. The new process uses a laser to drill holes through the silicon substrate and form conductive channels from the front to the rear surface. This advance allows the electric power to flow to the back surface, where the backside wiring carries the current away. Unlike conventional cells with wiring on the front that blocks sunlight, these laser-drilled holes make the cells more efficient by exposing more of the top surface of the solar cells to sunlight. These back-contact cells also reduce assembly cost by eliminating the front-to-back connection step, and they offer a more aesthetically pleasing product for the consumer. Recognizing this need in the market, Russell Schmit—former president of Photowatt International, a photovoltaic manufacturer based in France—approached SNL to start a new company that would manufacture SNL's novel back-contact solar cell design. The startup, Advent Solar, is located in Albuquerque, New Mexico, and has licensed SNL's back-contact photovoltaic cell technology. The new solar cell design offers a more efficient and less expensive option than other cells currently available in the marketplace.

Contact
Dr. Paul Smith
505-845-8007
smithpm@sandia.gov

Jess® - the Rule Engine for the Java™ Platform

Department of Energy
Sandia National Laboratories

Jess®, the Rule Engine for the Java™ Platform, is a tool for building a type of intelligent software called an Expert System. An Expert System is a set of rules that can be repeatedly applied to a collection of facts about the world. In traditional computer programming, the programmer tells the computer precisely what to do, one step at a time; the computer then solves the problem that is implicit in this description. Many problems are naturally algorithmic, meaning that a well-defined series of steps leads to a solution. Most computer applications fall into this category. However, some problems—such as "Is our network under attack?", "Is this document fraudulent?", and "How should we schedule resources?"—resist being reduced to rote computation. That's where Jess® comes in.

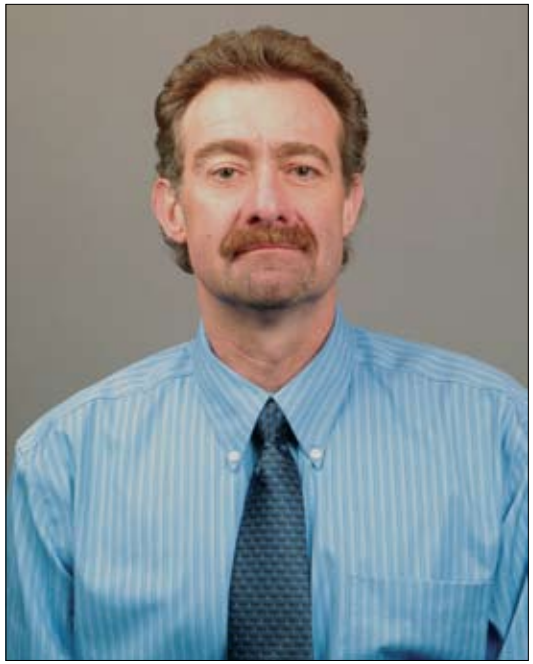
Jess® is a declarative programming environment that lets the programmer describe the problem explicitly; Jess® then decides what steps to follow to reach a solution. This makes Jess® an excellent tool for solving difficult or ill-defined problems. Jess® is portable to a wide range of computer systems. Users of Jess® can build Java™ software that has the capacity to "reason," using knowledge the user supplies in the form of declarative rules. Jess® is small, light, and one of the fastest rule engines available.

The first rule engine for the Java platform, Jess® now is the most mature and among the most advanced. Its problem-solving abilities have been applied to an extremely varied range of problems in the technology, insurance, and financial services industries and in academic artificial intelligence research. Logistics, planning, order processing, data mining, and optimization are just some of the areas in which Jess® has been used. Jess® has also been licensed to hundreds of academic institutions for use in artificial intelligence research laboratories and classrooms.

Craig Smith and Dr. Ernest Friedman-Hill

Contact
Craig Smith
925-294-3358
casmith@sandia.gov

Novint's 3-D Haptic Technology Software Adds Interactive Touch to Computing



Nathan Golden
Not pictuerd: Tom Anderson, Dr. William Camp, Dr. Arthur Hale, Dr. Mark Allen

Contact
Nathan Golden
505-845-9737
nlgolde@sandia.gov

Typical human-computer interaction situations, such as in video games, lack realistic virtual touch capabilities. Novint Technologies, Inc., has changed that with its new technology that allows users to experience the interaction physically and emotionally. Novint has taken the three-dimensional (3-D) touch (haptic) software it licensed from Sandia National Laboratories (SNL) and paired it with the Novint Falcon 3-D touch controller to make interactive, 3-D touch possible and practical for consumer applications for the first time. With these products, users feel realistic weight, shape, texture, dimension, dynamics, and force effects. This revolutionary technology will be introduced in the global video game market in 2007.

Haptic technology is one of the few technologies we will see in our lifetime that will fundamentally change computing, on par with the mouse, keyboard, monitor, and Internet. The technology is applicable to many different fields, such as video games, operating systems, the Internet, military applications, medical training and visualization, CAD/CAM, remote vehicle or telerobotic control, computer modeling and animation, scientific visualization, toys, design and layout, artistry, and uses for visually challenged users.