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Success in Science,
Success in Collaboration

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Success in Science, Success in Collaboration

Better flow cytometry through novel focusing technology

THE SCIENCE

Problem

Cell biologists have been interested in improving the sensitivity, throughput and accuracy of flow cytometry-based assays for basic cell biology research and drug discovery.

Solution

Acoustic focusing uses ultrasonic radiation pressure (>2 MHz) to transport particles into the center of the sample stream. This results in a narrow core stream and uniform laser illumination, regardless of the sample input rate.

Advantages

- ✓ Able to achieve sample-throughput rates up to 10 times faster than traditional cytometers.
- ✓ Can acquire sufficient events even from very dilute samples
- ✓ Accommodates no-wash, no-lyse protocols, allowing the collection of data on samples that have been subjected to minimal handling.

Bottom Line

Using acoustic-assisted hydrodynamic focusing, ThermoFisher has deployed the Invitrogen™ Attune™ flow cytometer. This device is able to deliver a narrow core sample stream and highly uniform laser illumination for accurate cell analysis regardless of sample flow rate.

The Invitrogen™ Attune™ NxT Acoustic Focusing Cytometer

THE COLLABORATION

Developing the Technology

Flow cytometry dates back to a cell sorter built by Mack Fulwyler at Los Alamos in 1965. Several additional contributions to the technology have been made at the National Flow Cytometry Resource of Los Alamos National Laboratory. In the early 2000s Los Alamos contribution to the technology was the use of acoustic waves to precisely control the movement of cells in a sample, vastly improving the sensitivity, throughput and accuracy of flow cytometry-based assays.

In order to achieve commercial deployment, in 2006 former Los Alamos researchers founded Acoustic Cytometry Systems (ACS) and exclusively licensed the technology. The ACS team secured seed funding and extended the technology to a commercial prototype stage. Subsequently, in 2008, ACS was acquired by Life Technologies, a leader in the biotechnology industry.

Initial Success

In December 2009, ThermoFisher Scientific (then Invitrogen), announced the release of the Attune® Acoustic Focusing Cytometer. This acoustic flow cytometer featured a reduced footprint, reduced consumables and an affordable price to make the instrument available to researchers and laboratories worldwide.

Continued Success

ThermoFisher Scientific has developed and deployed the next generation of the Attune® Acoustic Focusing Cytometer. The Invitrogen™ Attune™ NxT Acoustic Focusing Cytometer is a benchtop analyzer that uses acoustic focusing, a revolutionary technology that aligns cells prior to interrogation with a laser for multicolor flow cytometry analyses. This allows for significantly greater collection rates and the improved ability to detect rare events without excess sample manipulation.

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Take Off®: Helping the Agriculture Industry Improve the Viability of Sustainable, Large-Production Crops

THE SCIENCE

Problem

Worldwide, farmers are searching for ways to improve the overall health and performance of their crops.

Solution

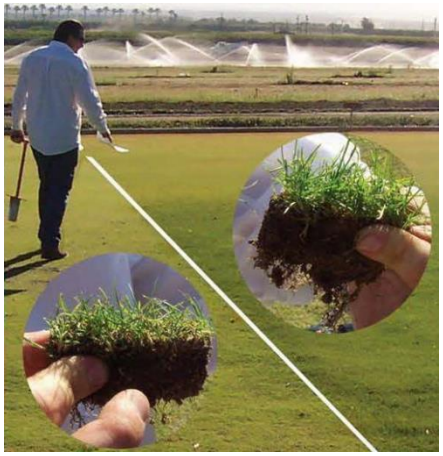
A seed treatment known as Take Off®, increases a plant's efficiency in using nitrogen and other important nutrients. Take Off allows more applied nitrogen to be taken up by the crop, which leaves less in the soil at risk being lost to the environment.

Advantages

- ✓ Reduces nitrogen loss to ground water and atmosphere
- ✓ Increases nitrogen use in plants (plant's use of applied nitrogen is only approximately 50%, according to the United States Department of Agriculture)
- ✓ Increases returns to farmers
- ✓ Creates healthier fresh produce as a result of reduced nitrogen content

Bottom Line

Research has demonstrated that crops treated with Take Off grow in greater abundance—thus enhancing crop yields, and that such use also improves the efficiency of fertilizer use.



Taking Off. *The photo above shows field testing Take Off. The sample on the left did not use the product while the sample on the right did have Take Off applied.*

THE COLLABORATION

Developing the Technology

Discovered by scientists at Los Alamos National Laboratory and developed by Verdesian Life Sciences, Take Off® is a technology that increases a plant's nitrogen efficiency. In addition, the technology enhances the absorption of other nutrients, such as potassium, and improves the efficiency of fertilizer use. Take Off, which features a proprietary mixture of amino and organic acids, can be used in seeds, fertilizer, pesticides, and irrigation to improve crop growth and enhance yields.

Initial Success

Take Off's development is a classic example of a small business successfully commercializing a technology developed at a national laboratory. This small company secured investment, was acquired, and is now the largest independent nutrition company in the United States. Technology transfer mechanisms include a Cooperative Research and Development Agreement and licensing.

The technology was first commercialized in Europe for use on wheat in 2006. The commercial launch in the US took place in 2007, for use on both wheat and vegetables.

Continued Success

Today—after several major acquisitions—Verdesian Life Sciences stands as one of the largest independent and nutritionally focused companies in North America. Take Off represents a compelling and game-changing technology in agriculture.

The company has worked with Los Alamos to develop two other technologies that complemented the core Take Off technology.

The first of these new technologies is a chemical compound known as ketosuccinimate. When combined with Take Off, this compound expands the variety of crops for which the co-formulation is effective. The company expects to scale up production and begin field trails in 2016.

The second technology is a transgenic that could have much the same effect as the agrochemical technology. This technology improves the use of nitrogen, carbon dioxide fixation, and photosynthesis; enables the earlier emergence and the establishment of the plant; increased plant biomass; produces more robust and healthier crops; and increases plant yield.

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VERDESIAN

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The National Institutes of Health's Models of Infectious Disease Agent Study (MIDAS)

THE SCIENCE

Problem

Furthering the ability of public health practitioners and policymakers to effectively manage an epidemic.

Solution

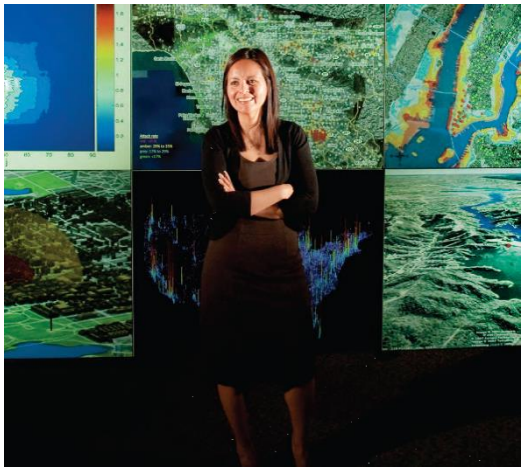
The Mathematical Computational Epidemiology (MCEpi) Team combines mathematical and computational approaches as well as Internet data such as social media to predict people's social behavior, forecast disease dynamics, and quantify uncertainty during an epidemic.

Advantages

- ✓ Real-time forecasts that can inform mitigations
- ✓ Models that incorporate emergent behavior
- ✓ Open source and open data approaches

Bottom Line

Based on the results of the model, public health practitioners and government agencies can better manage resources and change their communication strategies and policy decisions.



Until we understand and incorporate these complex social dynamics in our models, we won't be able to accurately predict the spread of epidemics." - Sara Del Valle, Energy & Infrastructure Analysis

THE COLLABORATION

Developing the Technology

The MCEpi team is part of the Models of Infectious Disease Agent Study (MIDAS), a collaboration of research and informatics groups that focuses on developing computational models for public health. These models often capture the interactions between infectious agents and their hosts, disease spread, prediction systems and response strategies. The tools and methods developed by the modelers can be useful to a variety of stakeholders who want to better understand emerging infectious diseases.

Through Internet data streams, scientists have been able to quantify the degree to which some people started wearing surgical masks and the resulting impact on disease spread. If there's a new pandemic, scientists can start tracking what people are tweeting and use this information to make better predictions of how likely they are to change their behavior, such as getting vaccinated, washing their hands, or wearing a mask. In addition, they are estimating the geographic and demographic contact patterns for the U.S. in order to develop social contact networks and predict the spread of behaviors. Most recently, they have been forecasting the spread of influenza within the United States using clinical surveillance and Internet data.

Initial Success

In 2011, The National Institutes of Health awarded a five-year MIDAS) grant to the MCEpi team consisting of researchers from Los Alamos National Laboratory and Tulane University. This team, led by principal investigator Sara Del Valle, connects social media and epidemiological research in an attempt to predict people's social behavior and quantify uncertainty during an epidemic. If successful, the study could lead to improvements in the computer models used to simulate disease outbreaks, thus saving lives as well as millions of dollars in epidemic response planning.

Continued Success

Studies such as this one can help improve all existing epidemiological models, furthering the ability of public health practitioners and policymakers to effectively manage a burgeoning epidemic. Their goal is to develop a global disease forecasting system.

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Success in Science, Success in Collaboration

Expanding the capabilities of SOLVE/RESOLVE through the PHENIX Consortium

THE SCIENCE

Problem

Need for three-dimensional (3-D) pictures of proteins to provide important information about the way in which proteins operate for applications in biotechnology and health care industries.

Solution

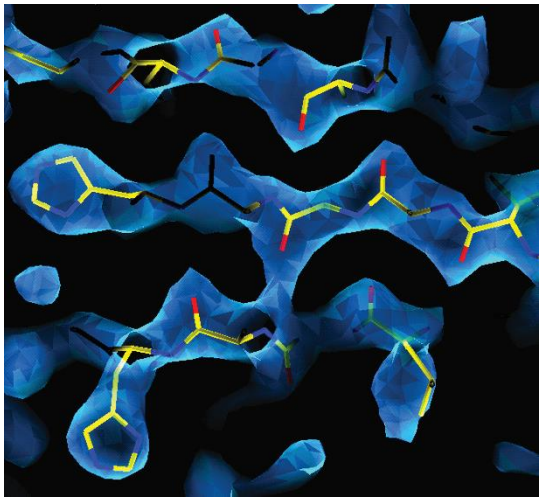
The PHENIX software suite is a highly automated system for macromolecular structure determination that can rapidly arrive at an initial partial model of a structure without significant human intervention, given moderate resolution and good quality data.

Advantages

- ✓ The algorithms are tightly linked and made easily accessible to users
- ✓ There are also a number of tools in PHENIX for handling ligands
- ✓ These algorithms are based on a highly integrated and comprehensive set of crystallographic libraries that have been built and made available to the community.

Bottom Line

PHENIX software suite is continuously being developed for research that depends on knowledge of protein structure.



Rendition of SOLVE imaging of protein structures

THE COLLABORATION

Developing the Technology

Because 3D images can provide important information about the structure and function of proteins, they have indispensable applications in biotechnology and health care. Realizing this importance, Tom Terwilliger and his team developed a unique computer software application for this purpose. Known as SOLVE, this software was the first expert system that produces 3D images of protein structures by automatically solving for the missing information in macromolecular x-ray crystallography. SOLVE's speed—faster than any other available method at the time—and ease of operation enabled the rapid analysis needed to determine the shapes of protein molecules.

PHENIX, is a software suite that expanded the capabilities of SOLVE/RESOLVE and can be licensed through the PHENIX Consortium at Lawrence Berkeley National Laboratory.

Initial Success

The principal applications of the product include rational drug discovery, which is used in designing new, improved drugs; the engineering of enzymes with new catalytic properties useful in the rapid breakdown of toxic waste and in rapid chemical synthesis; and the engineering of robust, heat-tolerant enzymes useful in chemical manufacture.

Before combining efforts with the PHENIX Industrial Consortium, SOLVE was being used at over 60 government and academic laboratories worldwide. Users include DuPont, Harvard, Yale, MIT, and Stanford. The system was also installed at Brookhaven National Laboratory, Stanford Synchrotron Radiation Laboratory, and the Advanced Photon Source at Argonne National Laboratory—all of which have special facilities for producing high-intensity x-rays.

Continued Success

PHENIX continues to be developed under a grant funded by the National Institutes of Health (General Medicine) and the PHENIX Industrial Consortium. The PHENIX development team consists of members from Lawrence Berkeley Laboratory, Los Alamos National Laboratory, Cambridge University and Duke University.

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Phenix