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Governor

ANNUAL REPORT

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Department of Community and Economic Development

JEFFREY L. GOCHNOUR ◆◆ DIRECTOR
Division of Business and Economic Development

MICHAEL A. KEENE, Ph. D, MBA ◆◆ DIRECTOR
Centers of Excellence

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Salt Lake City, Utah

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Marshall Wright
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Salt Lake City, Utah

* Division of Business and Economic Development Board Member
**State Science Advisory Council Member
+Guest Reviewer

2002-2003 Centers of Excellence Annual Report

TABLE OF CONTENTS

Executive Summary

Executive Summary

Utah enjoys a rich and diverse legacy of technical innovation, ranging from the invention of television (by Philo Farnsworth, in 1927) to innumerable advances in the fields of computing and medicine during more recent decades. Unfortunately, many of these inventions went on to be commercialized elsewhere, robbing the state of the jobs, revenues and respect that it was rightfully due. The Utah State Legislature established the Centers of Excellence Program (COEP) in 1986 as part of a strategy to improve on that record. They approved the annual allocation of economic development funds, to be awarded to university faculty members on a competitive basis through the COEP, specifically to fund what federal grants from agencies like the National Science Foundation do not support: Highly targeted, market-driven projects that perform the applied research, prototype development and business planning necessary to successfully commercialize promising technical innovations here in Utah.

COEP projects require a 2:1 match with non-state funds, and are subject to an annual competitive renewal for up to five years of support. Over time, an Advisory Council composed of veteran technology executives has been formed to assist in reviewing and choosing the projects to be funded, and a requirement has been added that Centers work with independent, pre-approved Commercialization Consultants to insure that projects remain commercially focused. As a result of this disciplined structure, the Utah Centers of Excellence Program continues to be one of the nations most successful technology commercialization programs as measured by matching dollars, new companies, new products, and state economic impact. During the last year, the program director has been interviewed by representatives of agencies hailing from Rhode Island to Romania.

During the 2002-2003 fiscal year the Centers Program issued $2.162 million in grants to 18 active Centers for use in bringing significant new technologies closer to the marketplace. In the competitive selection process, one center graduated, 15 centers received continued funding and 3 new centers were selected. The Center distribution was as follows: ten at the University of Utah ($1,260,000), three at Utah State University ($332,000), four at Brigham Young University ($500,000), and one at Weber State University ($70,000).

The 18 Centers received matching funds of $6.98 million, resulting in a matching fund ratio of 3.2:1. As of the last audit (2001), those companies directly employed over 1300 persons in the state, at an average wage of $68,000. With some earlier graduates of the program (Myriad Genetics, Inc. and Sonic Innovations, Inc., for example) just beginning to mature as significant, publicly held companies and scores of others developing and growing, it is clear that the entrepreneurial pipeline laid by the COEP will have an ever expanding and progressively more important role to play in Utah's economic future.

2002-2003 Funded Centers

ACOUSTIC COOLING

U N I V E R S I T Y O F U T A H

CENTER

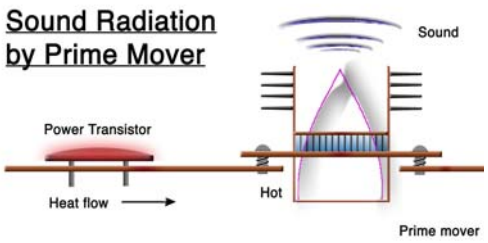
The Center for Acoustic Cooling Technologies has been established for the development of high frequency thermoacoustic engines for cooling applications. The Center is based on two thermoacoustic principles. The first principle is that heat can generate sound, the second is that sound can be used to pump heat. An important application for the above devices is in the heat management of computers, lap-tops, and microcircuits.

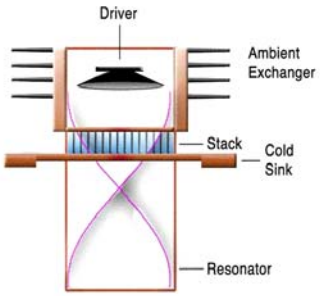
TECHNOLOGY

The Center's technology is based on two effects in thermo acoustics. The first is that heat can be converted into sound energy; and second, that sound can pump heat. Both have been developed into devices with dimensions ranging from 4 cm to 0.8 cm, with the possibility for further miniaturization and microcircuit integration.

ACCOMPLISHMENTS

The Center for Acoustic Cooling is structured on fundamental developments of miniature thermo-acoustic devices supported by the Office of Naval Research, the interfacing of devices to microcircuits and computers as supported by DARPA (HERETIC Program), and industrial collaboration with a local company, for the development and commercialization of Center technologies. Prototype devices have been constructed and successfully demonstrated by an independent company.

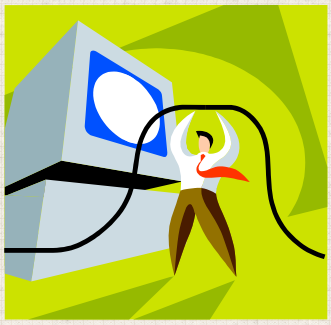




THINK TANK

What if there was...

A miniature cooling device that replaces fans in airplane cockpit displays and personal computers using sound as the main energy source and measuring from 4 cm to less than 1 cm?



Orest G. Symko
University of Utah
115 S 1400 E #201
SLC, Utah 84112
801-581-6132
orest@physics.utah.edu

Advanced Joining of Materials

BRIGHAM YOUNG UNIVERSITY

CENTER

The Center for Advanced Joining of Materials **(CAJM**) is developing enhancements and new technologies based on friction stir welding (FSW). FSW is a relatively new, innovative joining technology that is revolutionizing the way in which aluminum and copper materials are being joined. The objectives are to develop enhancements to this existing technology that will broaden the use of this process in new materials and applications, and to transfer these technologies to local, national and international companies.

TECHNOLOGY

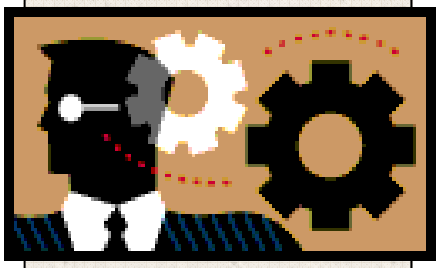
The Center is currently focused on the development and marketing of three technological aspects of FSW: 1) tooling that will last longer, offer the ability to join a wider range of advanced materials, and enable better control of the resulting quality of the weld and its properties; 2) new control systems and hardware for large scale, three-dimensional FSW capabilities; and 3) new methods and novel tooling for joining polymeric materials.

ACCOMPLISHMENTS

All of the fourth year milestones have been met. During its tenure as a Center of Excellence, FSW has submitted five provisional patents, two of which were submitted in year four. Of these, BYU has finalized and issued an exclusive license for the patent on super abrasive tools to a local Utah company. Co-development and marketing of these tools are continuing. BYU is presently seeking a partner for co-development on the FSW of polymeric materials. The center is currently pursuing another licensee and co-development partner. The Center continues development on the Versatile FSW Apparatus.

THINK TANK

What if there was...



A new method for welding metals and plastics that does not melt the material, does not add new material, and forms a joint that is base metal strong and virtually undetectable from the surrounding material?

Tracy Nelson, Ph. D.
BYU—Eng & Tech
435 CTB
Provo, Utah
801-378-6233
tracy_nelson@byu.edu

Advanced Structural Materials

BRIGHAM YOUNG UNIVERSITY

IsoTruss STRUCTURES, INC.

CENTER

The objective of the Center for Advanced Structural Composites is to commercialize the IsoTruss technology. The IsoTruss enables the creation of super lightweight grid structures with the potential for revolutionizing industries as diverse as civil infrastructure (e.g., communication and construction), aerospace, automotive, marine and sporting structures and virtually any application area requiring high strength, high stiffness, light weight and superb corrosion resistance.

TECHNOLOGY

The core technology consists of an ultra-lightweight composite structural shape known as the IsoTruss. The IsoTruss is a novel, patented, three-dimensional structural form that takes advantage of the highly directional properties of high strength composites to produce an extremely efficient and lightweight structure. The IsoTruss incorporates stable geometric configurations with helical members that spiral in opposing directions around a central cavity, coupled with longitudinal members that pass through the intersections.

ACCOMPLISHMENTS

In 2003, this Center was the recipient of the Stoel Rives Utah Innovation Award in the Mechanical Devices and Advance Materials Category. Several license agreements were negotiated with BYU for the IsoTruss technology, and a new Utah firm, known as IsoTruss Structures Inc. has licensed the rights for domestic commercial applications.

THINK TANK

What if there was...

A power line transmission tower that can withstand extreme wind conditions, support tremendously heavy loads, remain corrosion free, be unaffected by temperature extremes, and weighs significantly less than conventional steel towers?

Center for Advanced CASC Structural Composites

David W. Jensen
BYU
368 Clyde Building
Box 24066
Provo, Utah 84602
801-378-2094
david@byu.edu

Agricultural Byproducts

UTAH STATE UNIVERSITY

CENTER

The Center for Profitable Uses of Agricultural Byproducts was established to strengthen the economy of Utah, particularly the rural economy, by working closely with farmers, ranchers and other agricultural related businesses to transfer technologies utilizing agricultural production and processing byproducts. Byproducts of no or little value are transformed into energy and other salable items using technology developed at the center.

TECHNOLOGY

The technology developed at Utah State University for the profitable use of food production and processing byproducts is manifested in two major areas: 1) anaerobic systems that can produce energy (biogas) and soil amendment from manure and food processing waste, and 2) components of a high rate aerobic bioreactor (drum composter based) system that make the process more cost effective, and the products produced by the process more valuable.

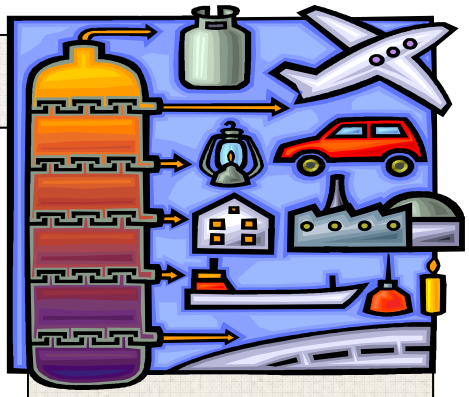
ACCOMPLISHMENTS

A fully operational system has been built at the Caine Dairy at Utah State University and is open for visits to see the system functioning, creating a showcase of this technology. Biogas can be seen burning at this site to produce hot water. A new, larger system is now online at the Ballard pig farm in Benson, UT. This new system is designed to produce enough electricity for 80 homes by utilizing waster from about 650 animals. The permits were obtained from Cache county and the system was installed by early spring 2003. A microturbine generates electricity, a "zone" heating system directs 30 gallons per minute water heated to about 185 degrees from the turbine to heat manure coming into the digester and heat the building.

A contract was negotiated with Pacificorp to accept electricity generated by the this system. It is the first contract of this kind with Pacificorp. Pacificorp pays for the electricity produced at the farm.

The IBR technology is very unique and easy to manage, with a high treatment rate and reliability. The Caine dairy has been operational for over two years without plugging.

Agricultural Byproducts



Placement and painting of tanks for the IBR system at Ballard farm

Benson, Utah

THINK TANK

What if there was...

A technology utilizing agricultural byproducts of little or no value and transforming them into electricity???

Conly Hansen
Utah State University
4105 University Blvd.
Logan, UT 84322
435-797-2188
chansen@cc.usu.edu

BIOMEDICAL OPTICS

U N I V E R S I T Y O F U T A H

CENTER

The goal of the Center for Biomedical Optics is to commercialize optical technologies for diagnostic, therapeutic and disease risk assessment in medicine. Recent advances in novel light sources, laser materials and laser spectroscopy make these optical techniques highly attractive for novel, non-invasive assessment as well as therapeutic treatment of disease.

TECHNOLOGY

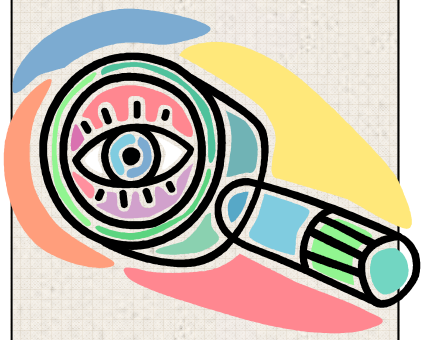
The Center's technologies include Resonant Raman Scattering detection of carotenoid antioxidants in human tissue and a novel light source for biomedical spectroscopy.

ACCOMPLISHMENTS

Nutriscan, Inc. was formed during the second year of COEP and in September of 2002, Raman detection technology was licensed to Cardoderm, Inc. In this funding cycle, a contract was obtained with Yale University from NIH to develop Raman technology for use in cancer epidemiology and also achieved Raman imaging of living human tissue and continued integrating novel, fiber-based light sources into instrumentation prototypes.

THINK TANK

What if there was...



A non-invasive optical laser technique that can detect and treat cancerous cells in the skin or mucosal tissue??

Werner Gellerman
University of Utah
115 S 1400 E #201
SLC, UT 84112
801-581-5222
werner@
mail.physics.utah.edu

BIOREMEDIATION

WEBER STATE UNIVERSITY

CENTER

The Center for Bioremediation develops, refines, and implements innovative biotechnologies for the removal of heavy metal and other inorganic contaminants. The Center's technology focus is biological selenium removal. Additional technologies include technologies for arsenic removal and cyanide degradation with a current emphasis on enzymatic cyanide degradation.

TECHNOLOGY

The Center's field-proven biotechnologies include Selenium reduction, Arsenic Reduction and Cyanide Biooxidation Technology. Selenium Reduction technology is capable of economically removing this contaminant from wastewaters to below detection levels. The Center's selenium technology is based on a novel implementation path requiring a front-end analysis, specially adapted naturally occurring microorganisms, and patented and proprietary process configurations. This path provides unique bioremediation technologies that are more economical, faster, and more durable than other bioremediation technologies. The Arsenic Reduction Technology is based on selected and specially adapted naturally occurring microorganisms, and patented and proprietary process configurations. The Cyanide Biooxidation technology is based on selected and specially adapted naturally occurring microorganisms and patented and proprietary process configurations and developing enzymatic technology

ACCOMPLISHMENTS

The Center's technology has been demonstrated to be approximately 1/10 the cost of EPA's past BDAT and removes selenium to lower levels. Applied Biosciences is a successful spin out company.

THINK TANK

What if there was...

A faster and more economical way to remove heavy metals, such as arsenic or cyanide, from wastewaters to a point below detection, with naturally occurring microorganisms?

Jack Adams
Weber State University
2515 University Cir.
Ogden, UT 84408
801-626-6058
djadams@weber.edu

COMPLIANT MECHANISMS

BRIGHAM YOUNG UNIVERSITY

CENTER

The objective of Compliant Mechanisms is to accelerate and streamline the development and commercialization process of compliant mechanisms, so that they may be quickly licensed to existing or new companies. The use of innovative and patented compliant mechanisms will give existing companies a clear competitive advantage, and will provide a unique and valuable product for new companies. The potential market applications and opportunities are immense.

ACCOMPLISHMENTS

Some examples of compliant mechanisms that have been designed and tested are: fishing reel, bicycle freewheel, derailleur and brakes, pull start for small gasoline engines, centrifugal clutches, string trimmer, small garden tiller clutch , go-cart clutch, continuously variable transmissions (CVT), general purpose belt drive CVT , second generation bicycle CVT prototype , bistable mechanisms, compliant parallel motion mechanisms, constant-force mechanisms, electrical contacts for PDA docking stations, fully compliant bistable micro mechanism, thermal actuators, linear motion micro-bistable mechanism and two position latching mechanism.

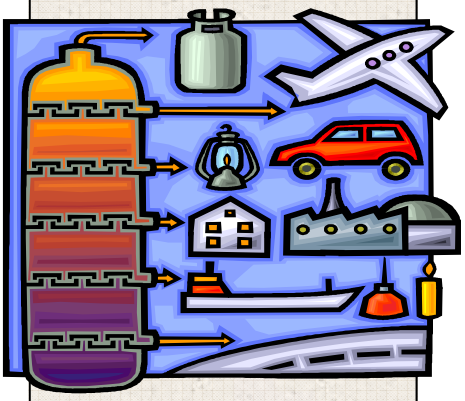
TECHNOLOGY

The Center possesses methods for the design of compliant mechanisms that have reduced part count reduced cost and increased precision compared to conventional mechanisms. A number of specific classes of mechanisms have been investigated and developed for commercialization.

THINK TANK

What if there was...

A method for redesigning any complex machine part to significantly reduce the number of parts, simplify the manufacturing process, reduce costs and end up with a more reliable and wear-resistant device?



Spencer Magleby
BYU
435 CTB
Provo, UT 84602
801-378-3151
magleby@byu.edu

Computational Design and Testing

U N I V E R S I T Y O F U T A H

CENTER

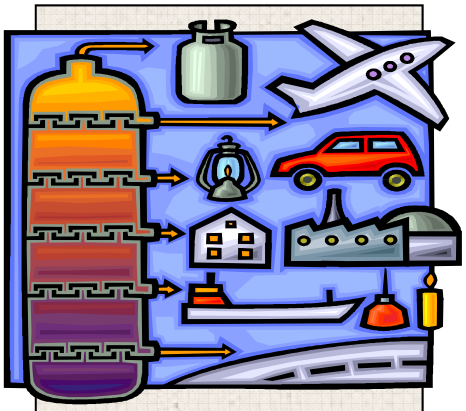
The objective of this Center is to develop computational technologies for industrial design and testing of novel materials and device elements, with a special focus on nanostructured materials and devices.

TECHNOLOGY

The center's technology is based upon several different ideas. First is computational algorithms for first-principles materials design and testing, computational engine I: materials designer and computation engine II: device simulator. Web based user interface for on-line computational applications. Licensed designs of novel nanostructued materials and device elements.

ACCOMPLISHMENTS

This is the first year of funding for this center. In the first year several goals were accomplished. A design for a carbon nanotube electromechanical pressure sensor, developed a prototype of web-interface for on-line computations and developed the first version of Mades, a computational engine.



THINK TANK

What if there was...

A way to model semiconductors and other materials by computer, to evaluate their properties before incurring the expense of prototyping?

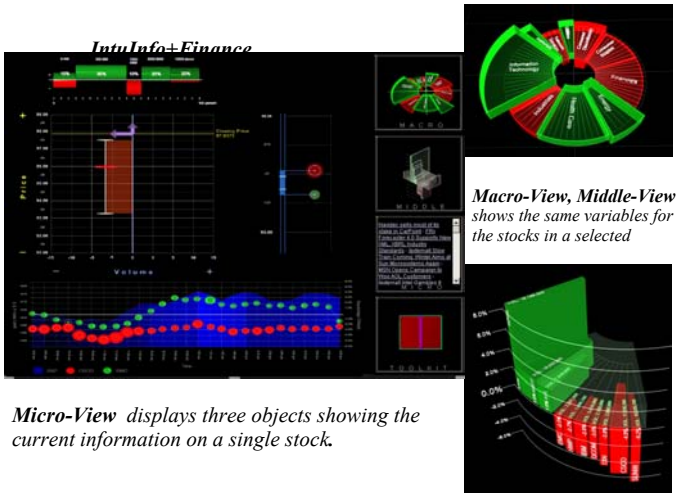
Feng Liu
University of Utah
122 S Central Campus Dr., #4
SLC, UT 84112
801-587-7719
fliu@eng.utah.edu

Representation of Multi-Dimensional Information (CROMDI)

U N I V E R S I T Y O F U T A H

CENTER

The Center for the Representation of Multi-Dimensional Information (CROMDI) was established in 2000 to commercialize a new audio-visualization technology (IntuInfo) that facilitates the rapid and accurate analysis of large quantities of quickly changing data. CROMDI is an interdisciplinary team dedicated to the innovative representation of information, comprised of experts of Architecture, Computer Science, Anesthesia, BioEngineering, Finance, Mathematics, Psychology, Communication and Music. These diverse experts participate with their own unique perspectives and provide solutions to complex information design needs through a unique methodology and iterative process that has been refined over the years.



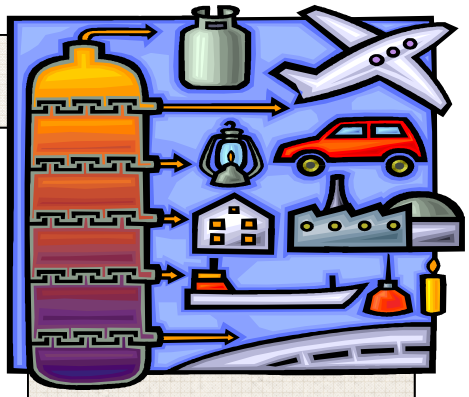
Micro-View *displays three objects showing the current information on a single stock.*

Macro-View, Middle-View *shows the same variables for the stocks in a selected*

TECHNOLOGY

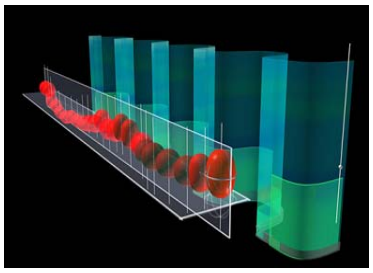
IntuInfo embodies the ancient proverb that "a picture is worth ten thousand words." By visually displaying multiple variables using various objects and colors, a wide range of information is clearly presented. The association between the graphical objects and the data is designed to facilitate rapid understanding of large quantities of data. The state of the art in many fields is to represent information with tables of numbers, waveforms, pie charts, diagrams, icons, matrices. IntuInfo enables recognition of events that is significantly faster, more accurate, less mentally demanding and with less training than is possible using existing technologies. This patent pending technology has been applied in medicine, finance, defense, and entertainment, and may also be successfully utilized in other applications where decision making depends on monitoring or analyzing large quantities of information (process control, vehicle operation and traffic control, corporate management, quality assurance, network monitoring).

CROMDI



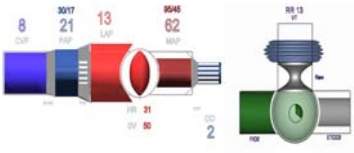
ACCOMPLISHMENTS

In the second year of funding CROMDI licensed the "cardiovascular display" to GE Medical Systems. Since then, CROMDI received a NASA STTR phase II grant in the amount of $250,000, awarded for "Graphic Displays to Support Treatment of Medical Emergencies." CROMDI received a DARPA seed grant to research preliminary audio-visualization concepts to convey to commanders the status of network resources under cyber-attack. Also, to support scheduling problems applying to both resource management and intelligence (detecting patterns of hackers, terrorists, etc.), a new audio-visual concept provisional patent has been filed, a prototype has been developed and contact with several partners has been made to utilize this technology. Several patents were filed in the Medical field ranging from drug display to pulmonary graphic metaphors.

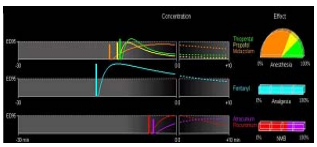


IntuInfo+Anesthesia

Traditional Anesthesia Display



Cardiovascular and Pulmonary

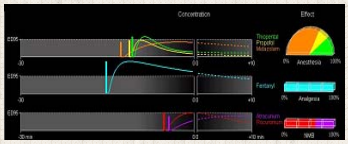


Drug Display

THINK TANK

What if there was...

A more efficient way to evaluate mass amounts of information more clearly and accurately???



Stefano Foresti
University of Utah
155 S 1452 E, #405
SLC, UT 84112
801-581-3176
stefano@chpc.utah.edu

Direct Machine and Control

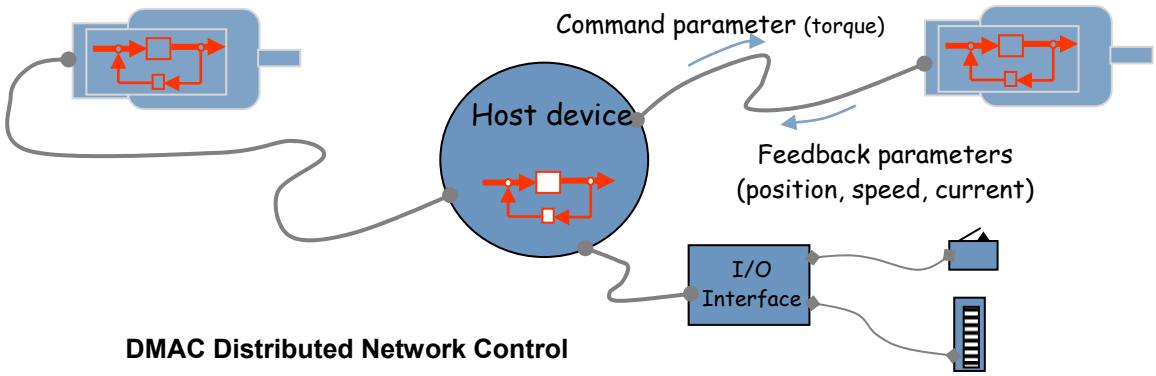
BRIGHAM YOUNG UNIVERSITY

CENTER

The center is developing a software-based digital control architecture configured on a host computing device to control, in real-time, a distributed high speed network of motors, sensors and other I/O devices. The primary control loops are closed over the high speed network. Only the torque/current loops are closed at the motor using digital power electronics. Although the primary focus is software development, some supporting hardware has been developed and/or configured to support the control network, including dual CPU control processors, machine tool enabled Coordinate Measurement wireless hardware, and Ethernet enabled sensor boards and motor control boards. The advantage of this new distributed approach to control is reduced control hardware, control of distributed rather than collected devices, reduced control costs, and greater control flexibility through modern control methods that cannot be enabled under the restrictions of modern controllers. DMAC is currently working on other technologies in relation to the DMAC technology.

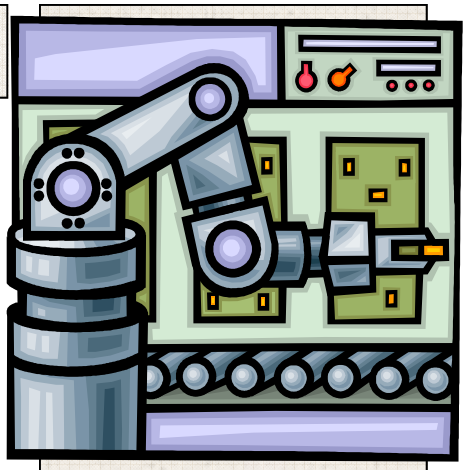
TECHNOLOGY

The DMAC technology is based on the development of an open architecture controller and supporting control algorithms for general control of advanced mechanisms such as 5-axis machine tools. This controller uses a dual CPU PC/controller so that the CAD/CAM application can run under Windows, while the real-time control software can run under a second CPU. The motors and machine Input/Output (I/O) are commanded over a high speed network such as fiber optic and IEEE 1394 (firewire). The control software consists of object oriented libraries that integrate motion planning, trajectory generation, servo-control, communication, and user interfaces. In addition, new control methods are being developed such as curvature matched machining (CM2), and higher dimensional methods of representing and passing geometric tool path data between the CAD/CAM application and the DMAC controller. The center has also been used to investigate and evaluate current process planning applications for industry.



DMAC Distributed Network Control

DMAC



ACCOMPLISHMENTS

In the first year of funding DMAC has accomplished several milestones which includes the following: the DMAC motion control library near commercial grade; new NURBS look-ahead algorithms for motion planning; control across both fiber optic and IEEE 1394 networks; DMAC control retrofit of the GM donated 5-axis Taurus mill underway; the Proof-of-concept for direct process planning in Alias/Waveform geometric modeling application and work performed for General Motors; Proof-of-concept for using N-dimensional NURBS to pass advanced tool paths to the DMAC controller. Continued support of Direct Controls, Inc. in commercialization of DMAC controller. Developed API control interface library jointly with Wilcox for direct control of CMM process by PC-DMIS application which is now in testing phase; developed VMAC control architecture for variable frequency control of different devices; developed new VMAC I/O and control board hardware that uses 802.3 communication standards, modified for real-time control using a *speak when only spoken to* protocol; developed new user XML user interface methods for control of the distributed VMAC devices. We have used grant money from Ford to compare/evaluate 5-axis tool path planning among the more popular commercial CAM application software packages. Grants have been obtained from Wilcox of wireless CMM hardware and PC-DMIS software and installed on Sugino 3-axis mill. Communications have been established between application and hardware.

THINK TANK

What if there was...

A way to control, in real-time, a high speed network of motors sensors and other devised with a software-based digital control computing device???

Ed Red
BYU
435 R CTB
Provo, UT 84602
801-422-5539
ered@et.byu.edu

Electronic Medical Education

U N I V E R S I T Y O F U T A H

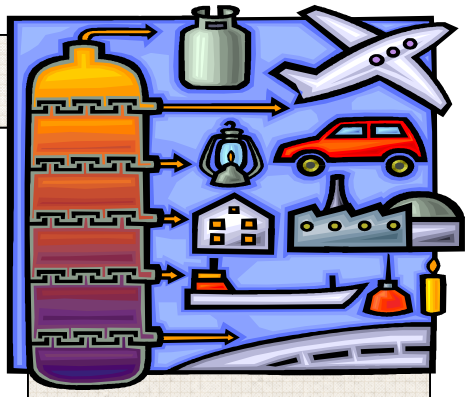
CENTER

The Center for Electronic Medical Education (CEME) is located at the University of Utah Health Sciences (UofU). The focus of this Center is to develop component software technology for use by physicians and scientists in image intensive fields, specifically targeted at visual annotation and knowledge representation. Initially, the software consisted of author tools for medical case creation and information management of image intensive data for publishing web-based clinical reference material. In 2001 Amirsys Inc., a commercial spin-off, licensed the medical case creation and annotation tools for medical case creation. In fiscal year 2002, the original technology development was extended into decision support and evidenced-based medicine solutions, biomedical imaging and bioinformatics. CEME established itself as a multidimensional technology hub by extending technology development into three additional markets. Those markets are: 1) telemedicine and remote consultation, 2) electronic medical records (EMR) specifically collection of expert knowledge and annotation of visual data as part of the clinical workflow and 3) biomedical/ biotechnology imaging informatics annotation and knowledge representation.

TECHNOLOGY

CEME technology provides clinicians and basic scientists with knowledge representation tools built on the need to visually annotate (identify and label) images and add expert clinical knowledge (e.g., diagnosis, pathology report, or clinical note) to image data in the healthcare enterprise. The technology enables consultation and sharing of results at each stage of the clinical management of a patient, research or clinical study, and provides a mechanism to track multiple images and textual results. CEME technology can be integrated into existing imaging systems as a layer that facilitates communication or exist as a standalone application in a research or healthcare enterprise. CEME technology was developed in response to the critical need to capture the growing and evolving base of imaging results and expert knowledge, such that downstream experts can utilize the expert knowledge base. The goal is to improve the process of delivering healthcare and scientific discoveries by developing technology for the purposes of consistent, context-appropriate communication and collaboration, standardization and interoperability of clinical tools and interactive presentation of data.

Electronic Medical Education



ACCOMPLISHMENTS

As part of our objectives, CEME has adopted an intellectual property strategy of maximizing commercial potential by decomposing CEME technologies into as many individually licensable pieces as possible. This strategy recognizes that software applications developed for medical publishing contain intellectual property threads that can be pulled out into individual invention disclosures and woven into new combinations to meet market needs. The additional markets lead to new commercial entities that push the technology into new markets.

The accomplishments include—A commercial spin-off, AMIRSYS, Inc., that produces electronic reference material. A right to use license with AMIRSYS, Inc. for U of U image content. Established the CEME as a multidimensional technology hub that addresses the needs of image integration in the electronic medical record and field of biomedical imaging informatics. Strategic positioning of CEME technology with key industry participants that has resulted in a Memorandum of Understanding and Teaming Agreement to get CEME technology into Battlefield Telemedicine. Patent on the core technology. CEME technology generated multiple invention disclosures as part of a multidisciplinary collaboration and technology development effort. A new commercial spin-off company, Resilient Imaging, that is a services-based company for integration of annotation and knowledge representation technology. Two SBIR grants have been submitted to the NIH National Institute for Biomedical Imaging and Bioengineering and the NIH National Cancer Institute for further development of CEME technology. Resilient Imaging is in the process of negotiating a non-exclusive license for the CEME technology and patent with the Technology Transfer Office at the University of Utah.

THINK TANK

What if there was...

A way to share visually annotated images with other healthcare professionals throughout the healthcare system???

Patricia Goede
University of Utah
729 Arapeen Drive
Salt Lake City, UT 84108
801-581-4624
pgoede@hsc.utah.edu

High-Speed Information Processing

UTAH STATE UNIVERSITY

CENTER

The purpose of this center (CHIP) is to design, prototype, and commercialize fast algorithm technologies for specific families of high-speed integrated circuit (IC) chips. When implemented in IC chips, fast algorithms such as these add great value to chip designers, chip manufacturers, and original equipment manufacturers (OEM) because their products are cheaper, faster, smaller, and less power hungry than those with standard algorithms that use multipliers and large amounts of memory. The use of our technologies offers additional benefits through faster design cycles, compact imple-

TECHNOLOGY

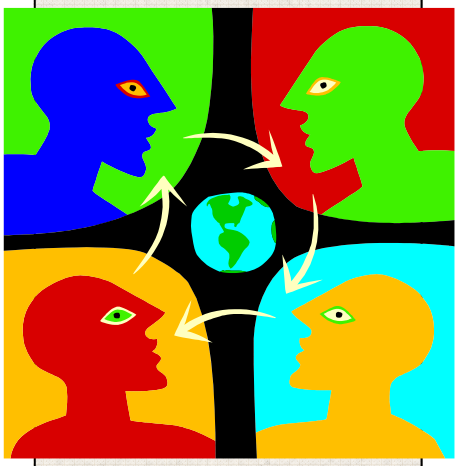
The center holds rights to several technologies such as: multiplier-free digital filters: design methodology and architecture; multiplier-free algorithms for hyperspectral image restoration and compression.; full-duplex echo canceller: algorithm and architecture; feedback cancellation algorithms for hearing aids.; Fast Integer Fourier Transform (FIFT).

ACCOMPLISHMENTS

This is the first year of funding for this Center. During this year multiplier-free algorithms for hyperspectral image restoration and compression was completed, a patent filed on full-duplex echo canceller and a patent filed on multiplier-free digital filter design. In CHIP, we have developed a full-duplex echo canceller using advanced signal processing. The new echo canceller enables natural, face-to-face like conversations with speaker phones and never cuts off or enters half-duplex mode. We have implemented the new echo canceller on a digital signal processing (DSP) chip that could be put into speaker phones for the home or office.

THINK TANK

What if there was...



A way to have face-to-face like conversations with a speaker phone without those annoying echos and cut offs???

Tamal Bose
Utah State University
Electrical & Computer Engineering
4120 Old Main Hill
Logan, UT 84322
435-797-7227
tamal.bose@ece.usu.edu

RAPID MICROBE DETECTION

UTAH STATE UNIVERSITY

CENTER

The focus of this center is the development of technologies that lead to the real time detection of pathogenic micro-organisms. This involves the development of novel pathogen capture molecules, platform development, prototype development, and commercialization. Industries where this technology is useful include pharmaceuticals, biomedicine, biotechnology, veterinary, production agriculture, food processing, public health, defense, and water and sewage treatment.

TECHNOLOGY

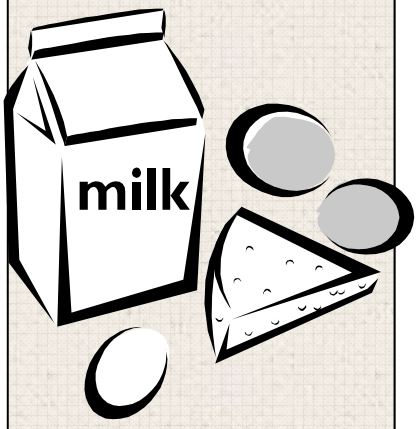
The primary focus of the Center is bacterial detection, but other targets are also investigated. To date, four technologies have been developed: ImmunoFlow, ImmunoDNA, GlycoBind, and TissueTag. Each technology has a unique use and application, but is not limited to a single type of use. For example, ImmunoFlow has many fields of use ranging from water to air, and has the potential to detect many types of bacteria. Initial prototypes are available for Bacillus globgii spores, Lactobacillus, Salmonella and E. coli O157 cells. Each type of assay has a maximum detection time of 30 minutes with a sensitivity of about 1000 cells. A unique feature of each technology is that it is volume independent; both large (tens of liters) and small (1 to 100 milliliters) samples are commonly used. Each technology is at a different stage of development, with ImmunoFlow being the most developed.

ACCOMPLISHMENTS

The Center has licensed the ImmunoFlow technology to Stellar Technologies. Demonstration of a prototype to several large food companies began in 2002.

THINK TANK

What if there was...



Being able to detect less than 10 cells of a harmful pathogen, such as salmonella or E. coli, in a quart of milk, within 30 minutes?

Bart Weimer
Marie Walsh
Utah State University
NFS, UMC 8700
Logan, UT 84322
435-797-3356
milkbugs@cc.usu.edu
mkwalsh@cc.usu.edu

Nuclear, Medical and Environmental Technologies (CNMET)

U N I V E R S I T Y O F U T A H

CENTER

The commercial strategy of the **Center for Nuclear, Medical, and Environmental Technology (CNMET)** is to acquire selected spun-off facilities and consolidate existing niche markets into a single, well-managed and licensed entity that can provide a convenient source for a full range of nuclear services. Large companies are currently downsizing, outsourcing, and eliminating risky and costly nuclear research and development (R&D) capabilities, and are teaming with universities with established nuclear engineering programs and research facilities to perform key services. An additional market trend is for companies to off-load ownership and operation of their nuclear testing, diagnostic, and irradiation facilities, and to contract with new owners for specific access and services. Others are simply decommissioning their nuclear facilities without replacement. The result is a decrease in availability of licensed facilities. That, in combination with an increasing demand for services from the private sector, provides the basis for a solid commercial opportunity. E-Cubed and Nuclear Labyrinth will assume commercial production to reduce costs, implement uninterrupted production cycles, and achieve economies of scale. Appropriate R&D functions then will be merged and contracted to universities with nuclear facilities, such as the University of Utah's TRIGA reactor, to promote innovation, train co-operatively, and supply a steady stream of knowledgeable and seasoned potential employees to the workforce.

TECHNOLOGY

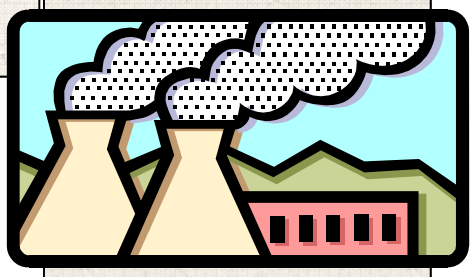
The operating entity for the University's research reactor and is primarily used for teaching, research, and limited fee-based irradiation services for external clients. Teaching and research activities include radiation chemistry and bioassays. Commercial services include ultra-sensitive fission track analysis (FTA), ultra-sensitive neutron induced autoradiography (NIA), advanced Pu diagnostics, high specific activity short-lived radioisotopes (for example, F-18), irradiation of unique medical "seeds" for cancer treatment, and performance testing of military electronic components and integrated systems upon exposure to neutrons. All intellectual property (IP) that results from CENTER activities is the property of the University and is licensed through the Technology Transfer Office (TTO).

E-Cubed: An independent entity that facilitates and integrates University reactor services with other intercollegiate and international reactors under research/grant programs administered by the DOE, NRC, and other related governmental agencies.

Nuclear Labyrinth: A newly formed company under CNMET that will engage in commercial nuclear production services beginning in January 2004. Nuclear Labyrinth will exclusively contract out all its research and development functions to the CENTER and license back applicable IP through the University's TTO. Together with the CENTER, Nuclear Labyrinth will provide valuable hands-on training functions for E-Cubed and its partners.
Nuclear Labyrinth's marketing mission is to provide improved and expanded
nuclear services to existing and underserved clients in the Western U.S. with nuclear production and testing needs.

1) **Little Mountain, Utah.** Boeing is currently in the process of closing its radiation facilities in California, and is a prime candidate to initially bring in

CNMET (cont.)



commercial work displaced by the closing. Thus, a unique opportunity exists for Nuclear Labyrinth to contract with Little Mountain for increased civilian work. An initial estimate of at least $1 million/year is estimated for non-defense work.

2) **Aerotest, Oakland, California.** Aerotest Corporation operates an explosives and jet engine neutron radiography business. During an earlier divestiture, the Autoliv-ASP company (originally based in Ogden, Utah) retained Aerotest (along with its nuclear reactor) as a stipulation to the spin-off transaction. AutoLiv now has indicated that it would like to divest itself of the reactor in part due to perceived operational risks and burdensome regulations required to conduct an operation that is outside of their core business. Nuclear Labyrinth is currently in negotiation to acquire the Oakland facility. If sale terms are reached and concluded, then Nuclear Labyrinth will assume full operational responsibility of the current reactor. Nuclear Labyrinth plans to convert the reactor's technology to all-digital format to significantly increase marketability of its commercial services.

ACCOMPLISHMENTS

Nuclear Labyrinth plans to contract with the CENTER on various research and development (R&D) projects, such as the digitization of Aerotest existing imaging technology and other R&D activities currently being conducted in Oakland. Segregation of R&D activities from scheduled production will dramatically increase capacity and efficiency at the Aerotest facility. Nuclear Labyrinth may contract with the CENTER to develop rapid bioassay techniques. If perfected, this new technology would greatly expand Utah market opportunities with commercial entities such as Envirocare. Nuclear Labyrinth intends to conduct targeted market research to identify and approach other potential underserved clients. Future contracts with the CENTER to develop new technologies shall be licensed back to the University via TTO.

David M. Slaughter
University of Utah
50 S Central Campus Dr.
SLC, UT 84112
801-581-8499
slaughter@
nuclear.utah.edu

PETROLEUM RESEARCH

U N I V E R S I T Y O F U T A H

CENTER

The mission of the Petroleum Research Center (PERC) is to conduct research and development studies leading to practical, cost-effective solutions to liquid hydrocarbon production, handling and transportation. With funding from the U.S. Department of Energy and the petroleum industry, the PERC coordinates basic and applied research in: the physical properties and physical and chemical thermodynamics of naturally occurring hydrocarbons, development of pipeline transportation and flow assurance strategies, and simulation, optimization and control of oil and gas recovery methods.

TECHNOLOGY

PERC works to understand problems related to the production, transportation and processing of waxy and asphaltenic crude oils and the subsequent alleviation of these problems and developing a variety of methods and software tools (models) for the efficient and optimal production of oil and gas from underground reservoirs. Over the last several years, oil companies and federal agencies have funded (and continue to fund) research in PERC, which is an integral part of the Department of Chemical and Fuels Engineering at the University of Utah.

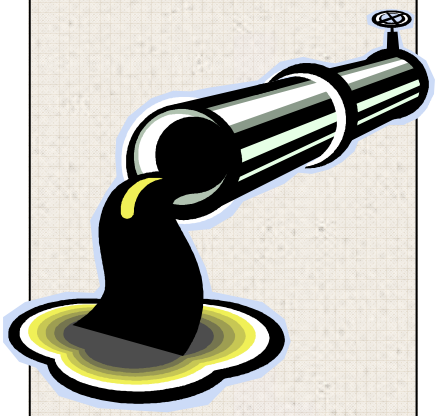
ACCOMPLISHMENTS

A patent on wax temperature measurement and wax amounts determination using spectroscopic methods was filed along with identifying two potential instrument manufacturers willing to produce commercial online units utilizing PERC technology. A property database enhancing online wax technology and Chemometrics model has been partially completed.

THINK TANK

What if there was...

A variety of methods and software tools for the efficient and optimal production of oil and gas from underground reservoirs?



Milind Deo
University of Utah
50 S. Central Campus Dr.
SLC, UT 84112
801-581-7629
mddeo@eng.utah.edu

Rapid Prototyping

UNIVERSITY OF UTAH

CENTER

The Center for Rapid Prototyping is focused in the areas of ultrasonic sensing of injection molding, and physical and virtual geometric modeling for computer aided design.

TECHNOLOGY

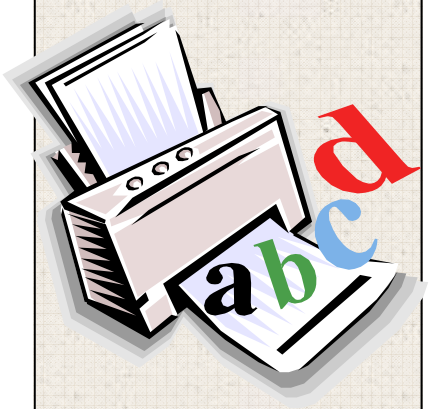
The Center for Rapid Prototyping works on several projects including: machining techniques that allow prototyping of geometric objects of arbitrary complexity on a 3 axis CNC mill with limited tools and little operator skill required; a series of new sensors and control techniques for improved polymer processing; a Personal Prototyping System (PPS) that makes rapid prototyping affordable for small companies and perhaps even the average consumer; low cost 3D scanning technologies that make acquisition of 3D geometric data practical and affordable for reverse engineering, medical imaging/reconstruction, etc.; a device that is capable of producing very large prototypes (Shapemaker); a photopolymer based technique to create prototypes in a single step (Inverse Tomographic Construction). New micro and nano-scale polymer manufacturing techniques have been developed to include a micro forging technique and a nano scale injection molding machine.

ACCOMPLISHMENTS

In the second year of funding, several milestones were met including the production of the first micro-scale injection molded part, the first successful machine scan of the human face and completed a production-type prototype of high temperature ultrasound transducer and control system. The Center for Rapid Prototyping also conducted a market survey for the 3D Scan Machine franchise concept.

THINK TANK

What if there was...



A personal prototyping system that develops and creates prototypes at a very low cost on your own inkjet or laser jet printer???

Charles Thomas
University of Utah
50 S Central Campus Dr.
RM 2202
SLC, UT 84112
801-585-6939
cthomas@eng.utah.edu

SMART SENSORS

U N I V E R S I T Y O F U T A H

CENTER

Smart Sensors probe the environment and modify their function in order to improve their data gathering capability. A smart sensor adapts to its environment, and sends improved data to the main processing computer. A smart sensor melds sensor, signal processing, and computer technologies. Applications span medicine, precision agriculture, electronics manufacturing, wireless communication, transportation and radar.

TECHNOLOGY

The Center for Smart Sensors focuses on two core technologies that have the greatest commercial potential, and five support technologies that are key aspects of the Center and enable the development and implementation of products utilizing the core technologies. This year new methods have been added and are available for the core technologies, license agreements are near in each of the core technology areas. Additional patents and invention disclosures have been filed in both core areas this year. Both families of technologies are based on simple ideas and simple circuits that result in two critical advantages **-- Small and Cheap**. This makes them applicable to a wide array of applications.

ACCOMPLISHMENTS

This year the Center for Smart Sensors moved to the University of Utah from Utah State University. After this move, a number of critical partnerships were established and a spin out company was created to act as a development intermediary. The center funding has been a critical part in developing prototypes that are of interest to potential licensees.

THINK TANK

What if there was...

An early warning system for computer disk drive failure, a pre-flight test system for aging aircraft wiring, and a system to protect military personnel from being overrun by tanks?

Cynthia Furse
University of Utah
MEB 3102
SLC, UT 84112
801-585-7234
furse@ece.utah.edu

VASCULAR BIOTHERAPEUTICS

U N I V E R S I T Y O F U T A H

CENTER

The Center for Vascular Biotherapeutics is focused on commercializing medical strategies and devices that target blood vessel formation for the treatment of cancer and obstructive vascular diseases such as atherosclerosis. This Center capitalizes on a robust scientific program aimed at deciphering the molecular blueprint for vessel regeneration using human genetics and transgenic mice technologies; these technologies were pioneered at the University of Utah. The "Functional Vascular Genetics" program established at the University of Utah is identifying genes that are essential for vascular development.

TECHNOLOGY

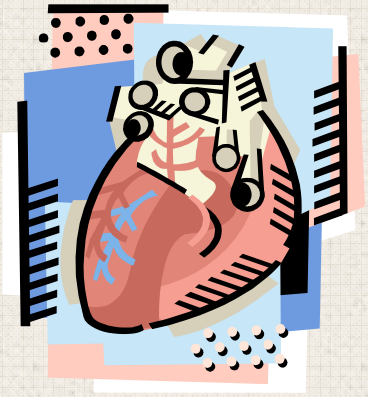
The Center for Vascular Biotherapeutics offers three fundamental and complementary technology benefits. First, using a functional human genetics approach, we have identified genes that are required for vascular development. Knowing which genes are essential for blood vessel formation and understanding their mechanism of action are required for developing strategies to modulate vessel growth in the treatment of cancer and vascular diseases. This center has also generated assays that rely on genetically manipulated cell lines that are proprietary and enable us to discover new signaling pathways and the Center focuses on developing real products.

ACCOMPLISHMENTS

New IP has been filed and discussions with companies on developing targets are being initiated. Negotiations for a licensee are in progress and we have designed and tested a first generation elastin sheath-stent and showed it to be effective in preventing restenosis in a porcine model. This success has directly led to the development of a second-generation elastin peptide stent.

THINK TANK

What if there was a way to...



Decipher the molecular blueprint for vessel regeneration, in order to treat cancer and other vascular diseases such as atherosclerosis?

Dean Y. Li
University of Utah
15 N 2030 E Room 4110B
Salt Lake City, UT 84112
801-585-5505
dean.li@hmbg.utah.edu

Program Description

PROGRAM DESCRIPTION

BACKGROUND

The Utah State Legislature created the Centers of Excellence Program (COEP) in 1986. The Legislature recommended the allocation of economic development funds annually to the COEP, to be awarded to college and university faculty on a competitive basis. Recognizing that both the growth of new industry and the expansion of existing industry, in the next century would require a strong technology base, a steady supply of new ideas, concepts, innovations, and prototypes. The objectives of the COEP are to enhance and expand the applied technical research activities at institutions of higher education in Utah, to develop technologies that are considered to have potential for economic development in the state, and to assist in the actual commercialization of those technologies. This research and technology commercialization process ultimately results in the creation of new companies, the enhancement of business opportunities for existing companies that license COEP technologies, and in the growth of Utah's job opportunities. In addition, the proprietary value of technologies created is reflected in the number of patents issued and the associated royalty-bearing licenses that are signed.

These measurement parameters (jobs created, companies assisted and/or created, inventions disclosed or patents issued, and license agreements signed) are summarized in this report as indicators of the value of the COEP to state economic development.

Ongoing funding of the program has been based upon the real and potential economic impact that the Centers of Excellence Program has had upon the State of Utah during the years since its creation. This Annual Report summarizes the significant accomplishments of the program during the recently completed fiscal year.

OPERATIONS AND OBJECTIVES

The operating methods of the Centers Program have evolved over the years since its inception, with a continuing goal of achieving the maximum economic benefit from the individual Centers that have been created. Upon selection on a competitive basis, new Centers are funded with a minimum requirement of a 2:1 matching fund ratio from the private and federal sectors. Matching funds are reported and audited on a regular basis. Centers are also audited regularly for the achievement of technical and commercial milestones. Center directors are required to submit annual reports to the COEP director. The Centers of Excellence Program Annual Report, attached here , is based on submitted reports and upon information gathered from site visits, audits and other data sources. In addition, each funded Center is assisted by one or more designated commercialization consultants, who assist Center directors in defining commercialization strategies, performing market and competitive analysis, and locating potential investors or licensees.

Centers are normally funded for a maximum of five years, and are then expected to be self-sustaining through license contract royalties and new research grants. Centers with especially noteworthy histories and ongoing technological impact are designated as Distinguished Centers, and thereafter may be funded on a project-by-project basis as requests are approved.

CENTER SELECTION PROCESS

Proposals from researchers for new Centers of Excellence or for renewal of existing Centers of Excellence are submitted to the COEP office in response to a Request for Proposal which is normally published in late December. The incoming proposals are critically reviewed by the Centers of Excellence Advisory Council. Centers are selected for funding based on a ranking established in extended review sessions with the Centers Advisory Council.

The State Advisory Council for Science and Technology (SAC) has advisory responsibility for the Centers of Excellence Program by statute. SAC members participate on the Centers Advisory Council, reviewing proposals and conducting site visits. This provides Science Council members with in-depth knowledge of the program, Center specific information and a strong technical and industrial perspective for making funding decisions. The State Science Advisor reviews the Annual Report and presents it to the Science Council for acceptance.

COMMERCIALIZATION PROCESS

Over the past seven years, the Centers of Excellence Program has funded a consulting program to assist Center directors in preparing and implementing commercialization strategies. Each Center is unique in terms of which strategy is optimal - there is no single solution, and each requires customized approaches.

Early market surveys and competitive analyses are conducted to discover which market segments are most promising, and which product features will be of interest to potential customers and licensees. Consultants assist in targeting potential licensees for the technology and in positioning products for anticipated markets.

These early strategic discussions often reveal product variations that can be introduced to the marketplace earlier than previously planned. Such early commercialization has several benefits: (i) getting products to consumers for preliminary market validation and directional planning; (ii) early cash flow strengthens continuing research at the Center and hastens financial independence, and (iii) the future value of technology licenses is enhanced.

The Centers of Excellence Office works closely with the Technology Transfer Offices at the universities in an effort to extract maximum value from the licenses that are signed for Centers technologies. Through the commercialization consulting program, assistance is given in defining market opportunities, identifying potential target licensees, providing key information for license valuations, and consulting assistance to those companies considering license opportunities.

2002-2003 Financial Summary

CENTERS OF EXCELLENCE - 2002-2003 FINANCIAL SUMMARY

CENTERS FUNDED IN FISCAL 2002/2003	State Funding 2001/2002	State Funding 2002/2003	Cumulative State Funding	Fed. Match 2002/2003	Private Match 2002/2003	Total Match 2002/2003
Acoustic Cooling Technology-U/U	$100,000	$99,000	$299,000	$194,158	$34,000	$228,158
Advanced Joining of Materials-BYU	$120,000	$130,000	$490,000	$230,000	$135,000	$365,000
Advanced Structural Composites - BYU	$120,000	$120,000	$570,000			$0
Biomedical Optics - U/U	$130,000	$150,000	$410,000	$175,728	$304,885	$480,613
Bioremediation-WSU	$68,000	$70,000	$188,000	$184,000	$0	$184,000
Compliant Mechanisms -BYU	$120,000	$130,000	$490,000	$219,000	$114,580	$333,580
Electronic Medical Education - U/U	$120,000	$125,000	$485,000	$0	$267,000	$267,000
Rapid Microbe Detection - USU	$120,000	$77,000	$597,000	$124,314	$199,360	$323,674
Multi Dimensional Information-U/U	$130,000	$140,000	$377,000	$693,095	$0	$693,095
Petroleum Research-U/U	$120,000	$111,000	$331,000	$250,000	$144,000	$394,000
Profitable uses of Agricultural by-products-USU	$100,000	$105,000	$305,000	$91,312	$191,431	$282,743
Smart Sensors-U/U	$100,000	$150,000	$350,000	$434,175	$0	$434,175
Vascular Biotherpeutics-U/U	$100,000	$140,000	$240,000	$457,351	$0	$457,351
High Speed Information Processing - USU	$0	$150,000	$115,000	$445,000	$122,200	$567,200
Computational Design and Testing - U/U	$0	$115,000	$115,000	$230,000	$0	$230,000
Direct Machine and Control - BYU	$0	$120,000	$120,000	$0	$967,400	$967,400
Rapid Prototyping and Manufacturing - U/U	$100,000	$130,000	$230,000	$569,024	$0	$569,024
Nuclear Medical and Technologies - U/U	$100,000	$100,000	$200,000	$160,000	$40,000	$200,000
Subtotals:	**$1,648,000**	**$2,162,000**	**$5,912,000**	**$4,457,157**	**$2,519,856**	**$6,977,013**

2002/2003 MATCHING RATIO 3.2 :1

2003-2004 Funded Centers

Utah Centers of Excellence Program

Description of Centers Selected for Funding 2003-2004

Center (University)

Acoustic Cooling Technology (U/U)
Developing novel miniature acoustic cooling devices without moving parts for application in computers and other electronics.

Advanced Imaging LADAR (USU)
Developing an airborne high-resolution, laser-based 3D color imaging platform for both military and civilian use.

Advanced Joining of Materials (BYU)
Developed new friction stir welding tools and materials capable of joining a wide range of metals, now being transferred to industry for aerospace, military and other manufacturing.

Advanced Structural Composites (BYU)
Developing manufacturing technology and commercial products based on the IsoTruss structures formed from lightweight composite materials.

Computational Testing & Design (U/U) - Developing powerful computational packages capable of designing and predicting the electrical, mechanical and structural characteristics of novel materials, especially nanostructured materials and components such as carbon nanotube-based electromechanical devices.

Direct Machining And Control (BYU)
Developing method that allows a manufacturing machine controller to directly interpret CAD/CAM models, resulting in superior resolution for complex shapes.

Electronic Medical Education (U/U)
Authoring tools used to create medical education products, and selling them as a component based medical information management and processing system.

Global Knowledge Management (U/U)
Developing Knowledge Fusion and Dynamic Knowledge Refreshing software to enable next-generation data mining technology.

High-Speed Information Processing (USU)
Designing fast algorithms for Application Specific Integrated Circuits, which have value in most military and compact consumer electronic devices.

Homogeneous DNA Analysis (U/U)
Developing a simple and inexpensive method for genotyping DNA samples from patients or disease organisms right in a doctor's office.

In Situ Ozonator for Remediation (U/U)
Developing new equipment to integrate biological and chemical treatment processes for the detoxification and restoration of waterways contaminated by PCBs and other pollutants.

Petroleum Research (U/U)
Develops cost-effective solutions for liquid hydrocarbon production, handling and transportation. Optimizes petroleum recovery; process control and production automation in oil and gas fields.

Profitable Uses of Agricultural Byproducts (USU)
Develops cost-effective technologies to treat animal wastes, generating "biogas" that can be used to produce energy, and nutrients to be used in soil amendments.

CROMDI (U/U)
Developed new visualization technology that facilitates the rapid and accurate analysis of large quantities of complex and continuously changing data, with applications in medicine, finance…

Smart Sensors (USU)
Engaged in the development and commercialization of sensor-based products, such as an application for the detection of faults in aircraft wiring.

Titanium Boride Surface Hardening (U/U)
Developing harder, longer-lived components and devices for the aerospace, biomedical and industrial markets.

Legislation

Part 6
Centers of Excellence

9-2-601. Purpose.

(1) The Legislature recognizes that the growth of new industry and expansion of existing industry requires a strong technology base, new ideas, concepts, innovations, and prototypes. These generally come from strong research colleges and universities. Technical research in Utah's colleges and universities should be enhanced and expanded, particularly in those areas targeted by the state for economic development. Most states are enhancing their research base by direct funding, usually on a matching basis. The purpose of this part is to catalyze and enhance the growth of these technologies by encouraging interdisciplinary research activities in targeted areas. The Legislature recognizes that one source of funding is in matching state funds with federal funds and industrial support to provide the needed new technologies.

(2) The Legislature recommends that the governor consider the allocation of economic development funds for Centers of Excellence to be matched by industry and federal grants on at least a two-for-one basis.

(3) The Legislature recommends that such funds be allocated on a competitive basis to the various colleges and universities in the state. The funds made available should be used to support interdisciplinary research in specialized Centers of Excellence in technologies that are considered to have potential for economic development in this state.

History: C. 1953, 63-62-1, enacted by L. 1985, ch. 103, § 1; 1986, ch. 109, § 1; renumbered by L. 1992, ch. 241, § 60.

9-2-602. Short title - Definitions.

(1) This part is known as the "Centers of Excellence Act."

(2) As used in this part, "Centers of Excellence" means university-based, industry-supported, cooperative research and development programs.

History: C. 1953, 63-62-2, enacted by L. 1985, ch. 103, § 2; 1986, ch. 109, § 2; renumbered by L. 1992, ch. 241, § 61.

9-2-603. Administration - Grants.

(1) This part shall be administered by the Division of Business and Economic Development.

(2) The department may award grants to the various colleges and universities in the state for the purposes of this part.

(3) Recommendations for funding shall be made by the division with the advice of the State Advisory Council for Science and Technology, with the approval of the board. Each proposal shall receive the best available outside review.

(4) In considering each proposal, the division shall weigh technical merit, the level of matching funds from private and federal sources, and the potential for job creation and economic development. Proposals or consortia that combine and coordinate related research at two or more colleges and universities shall be encouraged.

(5) The State Advisory Council on Science and Technology shall review the activities and progress of individual centers on a regular basis and assist the division in preparing an annual report on the accomplishments and direction of the Centers of Excellence Program.

History: C. 1953, 63-62-3, enacted by L. 1986, ch. 109, § 3; renumbered by L. 1992, ch. 241, § 62.

Repeals and Reenactments. - Laws 1986, ch. 109, § 3 repealed former § 63-62-3, as enacted by L. 1953, ch. 103, § 3, relating to creation of a committee for technology excellence in engineering research, and enacted the above section.