With Contract Numbers **State of Utah**

# Division of Business & Economic Development

## Centers of Excellence
## Funded FY 93-94

92-93

| | | | Award |
|---|---|---|---|
| **I.** | **Established Centers** | | |
| 88-1430 | | Center for Aerospace Technology (WSU) | $ 50,000 |
| → 90-3498 | | Center for Advanced Composites (BYU) | 150,000 * |
| 92-0845 | ✓ | Center for Cancer Genetic Epidemiology (U/U) | 75,000 |
| 91-2396 | | Center for Dairy Foods Technology (USU) | 187,775 |
| → 92-1147 | | Center for 3-D Computer Graphics (Dixie) | 50,000 * |
| 92-0768 | | Center for Value Added Seed Technology (USU) | 70,000 |
| 91-2621 | ✓ | Center for Inverse Prob.Tomography (U/U) | 100,000 |
| 91-1772 | ✓ | Center for Software Science (U/U) | 129,185 |
| 91-0551 | | Center for Chemical Technology (WSU) | 110,000 |
| 92-0769 | | Center for Meat Processing (USU) | 100,000 |
| 93-1135 | | Ctr for Genetic Improvement inLivestock (USU) | 99,000 |
| 92-2181 | ✓ | Center for Computer Graphics & Scientific Visualization (U/U) | 100,000 |
| → 93-1540 | | Center for Controlled Energy Solid Interactions (BYU) | 25,000 * |
| 92-0832 | | Center for Solid Waste Recycling (USU) | 17,000 |
| | | Supercomputer! | 190,000 |
| **II.** | **New Centers:** | | |
| 94-1480 | | Center for Archaeologic & Paleontologic Imaging & Modeling-Don Burge (CEU) | 165,000 |
| 94-1049 | ✓ | Center for Environmental Technology-Peter Gerity (U/U) | 120,000 |
| 94-1046 | | Center for Developmental and Molecular Biology - Kenneth White (USU) | 103,400 |
| 94-1477 | | Center for Multimedia Ed & Technology | 225,000 |
| | | UVSC Gregory H. Jackson $125,000 | |
| | ✓ | U/U Magdy F. Iskander 100,000 | |
| 94-1047 | | Center for Self-Organizing Intelligent Systems-Bob Gunderson (USU) | 100,000 |
| **III.** | **Distinguished Centers:** | | |
| → 93-1133 | | ACERC (BYU) | 100,000 |
| 93-1072 | ✓ | Center for Controlled Chemical Delivery (U/U) | 85,000 |
| 93-1071 — 94-1481 | ✓ | Center for Engineering Design (High Performance Mfg Ctr U/U) Steve Jacobsen ✓ | 135,517 |
| 94-1121 | ✓ | Center for Biopolymers at Interfaces (Special Project)Jim Herron (U/U) | 120,000 |
| 94-1123 | | Ctr\Design of Molecular Function (Biocatalysis) Special Project **Env Tech** (USU) Ron Sims | 100,000 |
| 93-1073 | | Center for Design of Molecular Function (Biocatalysis-Linda Powers)(USU) | ~~50,000~~ 66,000 |
| **IV.** | **Planning Grants:** | | |
| 92-2953 | ~~94-1049~~ | Environmental Technology (U/U) (exp. 1-31-93) | 10,000 |
| | 94-1030 | Emerging Information Systems U\U | 20,000 |
| 94-0735 | | Magnetism in Information Tech (CMIT) Wilford Hansen USU | 5,000 |
| **V.** | **Center Status (unfunded):** | | |
| | | Center for Venture Technology (U/U) | 0 |
| | | Total | ~~$2,601,877~~ |

Terminated
- 92-1255 - ACERC - BYU
- 93-1214 - Supercrit Fluids - BYU
- 93-2095 - New Prod Dev. (Plan grant) - BYU
- 92-2354 - Silicon Dev. - BYU

STATE OF UTAH

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Governor

JOSEPH A. JENKINS
Executive Director
Department of
Community and
Economic
Development

RICHARD J. MAYFIELD
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Division of Business
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# CENTERS·OF EXCELLENCE

# Report to the Utah State Legislature

1 November 1993

**UT[illegible] CENTERS OF EXCELLENCE PROGRAM**
**Advisory Council**

**Brent Anderson,** Partner
Preferred Payment Systems
Salt Lake City, Utah

**Larry H. Brim, Ph.D.,** Director of Research/Development
Hyclone Laboratories
Logan, Utah

**Ben V. Cox, Ph.D.,** Director of Advanced Technology
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**Gary L. Crocker,** President
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**Ping Fong, Jr.**
Private Consultant
Salt Lake City, Utah

**Jerrold L. Foote,** Vice President, Research
Merit Medical Systems, Inc.
Salt Lake City, Utah

**Robert Grow,** President
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Orem, Utah

**Thomas A. Henrie, Ph.D.,**Consultant
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Orem, Utah

**E. Cordell Lundahl,** President/CEO
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**Oren B. Phillips,** Vice President, Business Development
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**Gerald W. Sharp, Ph.D.**
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**James Lee Sorenson,** President
Deseret Research, UBTL, DataChem (CEO)
Salt Lake City, Utah

**Rex S. Spendlove, Ph.D.,** President
Hyclone Laboratories
Logan, Utah

# Utah Centers of Excellence Program
## Report to the Legislature
## 1993

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**Centers of Excellence:**

Center for Aerospace Science Technology
Center for Advanced Composites
Center for Advanced Combustion Engineering
Center for Design of Molecular Function
Center for Biopolymers at Interfaces
Center for Cancer Genetic Epidemiology
Center for Controlled Chemical Delivery
Center for Development and Molecular Biology
Center for Chemical Technology
Center for Engineering Design
Center for Archaeology & Paleontology
Center for Computer Graphics & Visualization
Center for 3D Computer Graphics
Center for Inverse Problems & Tomography
Center for Software Science
Center for Self-Organizing Intelligent Systems
Center for Multimedia Education @U/U
Center for Multimedia Education @UVSC
Center for Meat Processing Technology
Center for Dairy Foods Technology
Center for Value Added Seed Technology
Center for Environmental Technology
Center for Solid Waste Recycling

# Summary Information

# Utah Centers of Excellence Program
## 1993 Highlights

Major Economic Contributions

- 92 high-tech companies and 1,018 industry jobs have been created since program inception in 1986.
- The average salary per industry job created is $35,892.
- 240 additional Utah companies have received considerable assistance improving their products or processes.
- 107 licenses have been signed with Utah industry.
- 277 graduate students are involved in center activities.
- 15 new high tech businesses (47 jobs) have been created from center technology in 1993.
- Assisted in the creation of WestCAMP, the Western Coalition for Advanced Materials and Processes.

Major Technological Results

- Center for Value Added Seed Technology (USU) - Researchers have just identified a process to alter grain producing plants (monocots).
- Center for Genetic Improvement of Livestock (USU) - The genetic market associated with heavy muscling and reduced fat in sheep has been identified and a flock carrying the gene has been formed at USU.
- Center for Supercritical Fluid (BYU) - Developed an Ultra-Sensitive Gas Impurity Detector that received recognition as one of the country's top 100 R&D projects.
- IBC Advanced Technologies Inc., a spin-off from the Center for Chemical Separations (BYU) - Received a $2 million grant from the Advanced Technology Program for work to develop novel systems for anion separations.
- Center for Cancer Epidemiology (U/U) - Spin off company raised over $10 million in venture capital to commercialize center technology.

Impact on Higher Education

- The state's investment in the Centers of Excellence Program (COEP) has leveraged over $235 million in private and federal funds.
- COEP funds help retain 992 skilled researchers and faculty.
- 62 patents have been issued and an additional 102 are currently pending.
- COEP funds have been leveraged to acquire equipment worth $66.8 million.

New Companies Created During 1993

**Center for Cancer Genetics:**
Myriad Genetics (12 employees)

**Center for Advanced Composites:**
Beckwith Technology Group (3 employees)
Blue Cow, Inc. (3 employees)
ClayTech (1 employee)
Controlled Composite Technology (2 employees)
Curecrete (2 employees)
DAH, Inc. (1 employee)
DMS (2 employees)
DPE (5 employees)
Red Hawk, Inc. (3 employees)

**Center for Advanced Combustion Engineering Research:**
GMH Engineering (3 employees)

**Center for Engineering Design:**
MicroJet, Inc. (1 employee)

**Center for Solid Waste Recycling:**
Recycling Technologies Corporation (2 employees)

**Center for Dairy Foods Technology:**
Dairy Research Consulting of Utah (1 employee)

**Center for Meat Processing:**
Canyon Rayas (6 employees)

# Statistical Summary
# Utah Centers of Excellence Program
## Graduated/Discontinued Centers
## 1993

| Center of Excellence | Cumulative State Investment | 1993 Cash Matching Funds | Cumulative Private Match | Cumulative Federal Match | Center Jobs | Average Salary | Industry Jobs | Average Salary | Spin-Off Companies | Companies Assisted | Patents Issued | License Agreements |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chemical Separations | $797,436 | n/a | $637,085 | $1,041,275 | 16 | $7,831 | 25 | $25,800 | 1 | 9 | 9 | 1 |
| Materials | $999,780 | n/a | $1,504,198 | $12,032,787 | 9 | $45,444 | 45 | $63,222 | 0 | 9 | 1 | 0 |
| Supercomputer | $925,000 | n/a | $13,000,000 | $8,600,000 | 17 | $34,882 | n/a | n/a | 0 | 9 | 0 | 1 |
| URI | $740,000 | n/a | $0 | $5,743,980 | 87 | $27,244 | n/a | n/a | 0 | 0 | 0 | 0 |
| VLSI Design | $225,153 | n/a | $319,000 | $500,000 | 18 | $31,277 | 5 | $27,659 | 1 | 4 | 0 | 1 |
| Base Tech Education | $112,000 | n/a | $0 | $546,415 | 8 | n/a | 5 | n/a | 2 | n/a | n/a | n/a |
| CAD/CAM | $423,123 | n/a | $3,905,917 | $4,000,000 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| CINR | $100,000 | n/a | $0 | $658,707 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| CIM/CAM | $222,119 | n/a | $345,555 | $525,595 | n/a | n/a | 38 | n/a | 7 | n/a | n/a | n/a |
| Computer Based Ed. | $510,000 | n/a | $0 | $676,997 | 8 | $15,340 | 21 | $20,426 | 1 | 1 | 0 | 0 |
| Comms. Research | $215,120 | n/a | $571,105 | $1,556,371 | 13 | n/a | 7 | n/a | 0 | 1 | 4 | 1 |
| Handicapped Ed. | $436,325 | n/a | $0 | $6,003,254 | 52 | $26,333 | 28 | $35,333 | 1 | 4 | 0 | 2 |
| Laser Institute | $676,000 | n/a | $0 | $7,302,000 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Pyrometallurgical | $100,640 | n/a | $276,790 | $10,000 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Qual. & Integrity Des. | $260,000 | n/a | $486,000 | $61,650 | 16 | $14,250 | 8 | $10,750 | 2 | 2 | 0 | 2 |
| Sensor Technology | $85,000 | n/a | $170,567 | $0 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Signal Processing | $776,334 | n/a | $0 | $3,507,434 | 14 | n/a | 41 | n/a | 3 | 4 | 1 | 7 |
| Coal | $655,000 | n/a | $51,865 | $2,661,472 | 10 | $16,000 | 16 | n/a | 2 | 3 | 9 | 4 |
| Total: | $8,259,030 | n/a | $21,268,082 | $55,427,937 | 268 | $25,496 | 239 | $38,883 | 20 | 46 | 24 | 19 |
| 1986-1993 Totals: | $19,729,481 | $27,644,297 | $58,690,441 | $178,475,298 | 992 | $30,446 | 1,018 | $35,892 | 92 | 240 | 62 | 107 |

# Utah Centers of Excellence Program
## Spin-Off Companies (1/94)
### Total: 92 Companies

(continued)

| Currently Funded Center | Spin-Off Companies (Employees) |
|---|---|
| Space Engineering (USU)<br>Dir. Frank Redd 750-2905 | Space Dyn Lab (250)<br>ICOMP (1)<br>Globesat Holding Company (8)<br>Medcom, Inc. (1)<br>CXT, Inc. (3)<br>Interactive Resources (2) |
| Supercritical Fluid (BYU)<br>Dir. Milton Lee 378-2135 | Lee Scientific (12)<br>Sensar Corporation (11) |
| Tomography (U/U)<br>Dir. Steven Johnson 581-7399 | Monolithic Technologies (4)<br>TechniScan, Inc. (8) |
| VLSI Design (U/U)<br>Dir. Kent Smith 581-8653 | Bonneville Microelectronics (5) |
| X-Ray Imaging (BYU)<br>Dir. Larry Knight 378-2186 | MOXTEK (36) |
| 3-D Software (Dixie)<br>Dir. Eric Pedersen 673-4811 | Illustrative Impressions (1) |

## Spin-off Companies from Graduated or Discontinued Centers

| Center | Spin-Off Companies (Employees) |
|---|---|
| Base Technical Education (U/U)<br>Dir. Carol Weller 581-3189 | Assessment Co. (3)<br>Software Co. (2) |
| Chemical Separations (BYU)<br>Dir. Reid Izatt 378-2315 | IBC Advanced Technologies (24) |
| Coal Research (U/U)<br>Dir. Larry Anderson 581-7187 | FemtoScan Corp (4)<br>International Resin Resources (2) |
| Computer Based Education (BYU)<br>Dir. Jerry Larson 378-2349 | CALI, Inc. (21) |
| Computer Integrated Manufacturing (BYU)<br>Dir. Dell Allen 378-3895 | Edge Foundation (15)<br>Edge Inc. (6)<br>Ozone Saver Ind (5)<br>CAM Software (8)<br>CIM Training Ctr. (1)<br>Smartware (1)<br>Utah Pods Mfg Coop(2) |
| Information Technology (USU)<br>Dir. Allen Hofmeister 750-3718 | Effective Inst Tech(5) |
| Quality & Integrity Design (U/U)<br>Dir. David Hoeppner 581-3851 | Tech Mgt. Assoc (4)<br>FASIDE Intnl Inc. (1) |
| Signal Processing (BYU)<br>Dir. Richard Christiansen 378-6587 | ASTECH, Inc. (34)<br>Deseret Dig Sys(6)<br>Vector Technologies (1) |

Note: These companies have been reported by Center Directors as having spun out of their centers. The Office of Technology Development is aware of the viability of many of these companies and their relationship to the centers. If a center has been discontinued, the viability of the company reported is uncertain.

"All the News That's Fit to Print"

# The New York Times

VOL.CXLII.... No. 49,161 Copyright © 1992 The New York Times WEDNESDAY, NOVEMBER 25, 1992

## Searching for New Jobs, Many States Steal Them

By JOEL BRINKLEY
Special to The New York Times

SALT LAKE CITY — In state capitals across the nation, just as in Washington, government leaders are casting about for approaches, new and old, to reinvigorate their economies. And the key to that, where ever it is tried, is creating jobs.

For decades, most states have taken the easy, politically expedient approach. They have offered lucrative tax incentives, a proven technique that lures businesses away from neighboring states, enabling politicians to put hundreds or thousands of their constituents to work before the next elections.

Among the states relying on this approach even today are Arkansas, the home state of President-elect Bill Clinton, and Kentucky, which has perhaps the most generous such program.

But here in Utah, as in a handful of other states, officials are trying new methods. Utah is looking to its own people for creative ideas that can be turned into marketable inventions. When one emerges, the state helps to turn it into a business venture, creating home-grown enterprises that sell new high-tech products.

### To Meet Competition

Economic development experts say that if the nation is to remain competitive internationally, Washington cannot rely only on large-scale Federal public works projects and tax incentives to create jobs. They say the Government should also encourage the creation of innovative businesses, as Utah does. Even though most of these start quite small, such new companies, with patented, cutting-edge products, hold the greatest potential to keep the nation competitive.

One such enterprise may have been born at a meeting of scientists, engineers, venture capitalists and marketing specialists who had been brought together here this month by Utah economic development officials.

Dr. Paul Savello, a professor at Utah State University, told the group that in five years, "there will be no more whole milk for sale in grocery stores."

He explained: "People are concerned about the fat, and in 15 or 20 years people are going to want to move away from 2 percent milk, too. But the problem is, they just don't like the taste and the appearance of skim milk. It's watery."

"It looks blue," an investor, Lee Smith, interjected with a dismissive laugh.

"Well," Dr. Savello went on, "we have firmly developed a way to make skim milk indistinguishable from 2 percent milk in blind taste tests. We don't add anything; it's still regular skim milk. All we're doing is manipulating the protein structure."

That caught everyone's attention, and the investors immediately peppered Dr. Savello with questions about marketing, distribution, costs. He didn't have many

Continued on Page A9, Column 1

### Finding What Works

*Second article of a series:*

State Job Programs

Continued From Page A1

answers. "I'm just a scientist," he said, almost as an apology. But he did say, "the cost of the process is probably under one-tenth of a penny per gallon."

With that, a businessman, Jim Dreyfous exclaimed, "This could be the Nutrasweet of milk!" And within a week Dr. Savello had heard from several eager suitors, venture capitalists and others eager to join forces with him — start a company, build the equipment, hire employees and begin licensing the technology to local dairies nationwide.

"We're really excited about this," Rick Sherle, an Utah entrepreneur who was at the breakfast guest, said later. "We're putting together a business plan."

Down the street, at Utah's economic development department a few days later, Michael Alder, head of the state's job creation office, was smiling. He is the one who organized the breakfast. And now, Mr. Alder said, "it looks like the skim milk is taking off."

Mr. Alder's office had helped finance Dr. Savello's research; over the last two years the state had given him almost $200,000. Dr. Savello and Dr. Ault are just two of several dozen scientists and engineers at Utah's universities who have been given $16.5 million for research in the last six years, grants that have been matched 10 to 1 by the Federal Government, foundations and private companies.

The state money is awarded with the clear instruction that it must be used to produce cutting-edge commercial products. Economic development experts say this program is among the nation's most innovative projects for creating jobs. About two-dozen other states offer aid to inventors in universities, said Walter Plosila, an economic development official in Maryland who was hired to evaluate Utah's program last year. "But very few of them are oriented to moving the inventions into industry," he said.

Now with Dr. Savello's work, once again Utah appeared ready to create jobs in an innovative field, jobs that might never have been created without the state government's help.

**A Success**

## Utah Seeks Out Cutting Edge

In northeast Salt Lake City, right beside the university campus, the entrance sign to a modern industrial park reads: "University of Utah Research Park: Technology, Creating Industry, Creating Jobs."

Inside are rows of squat, red-brick industrial buildings housing more than 50 start-up concerns, all of them born of research in the university's labs, many of them financed in part with money from Mr. Alder's program.

Not many universities encourage their professors to start businesses; in fact the whole idea seems contrary to the philosophy of academia. But "this institution has a view that we are an important part of the regional and local economy, and one thing we can do for the state is commercialize our research," said Richard Koehn, the University of Utah's Vice President for Research.

That's not just an altruistic view; by a variety of arrangements the university shares in the profits from commercial ventures born in the school's labs. "Last year we took in $1.3 million," Dr. Koehn said.

And it is also true that his university is known for unorthodox experiments. It was here in 1989 that two researchers announced that they had achieved cold nuclear fusion, a claim that was later largely discredited. And it was here, seven years earlier, that Dr. William DeVries implanted the first permanent artificial heart in a patient, Barney Clark. He died three months later.

On a trial production line in one of the industrial-park buildings, a wide strip of special, pourous plastic material rolls past, and steel nozzles just above spit small globs of clear gel at designated intervals, 70 of them a minute. A few inches farther along, another layer of plastic is laid on top, a punching device cuts the sheets into individual two-inch squares. And then these little patches of medication are dumped into a basket ready for packaging — the first products in a new market with an estimated potential value of $1 billion.

The squares are transdermal patches of testosterone, the male sex hormone. They are like the nicotine patches many people use to help them quit smoking, though far more sophisticated. Pasted most anywhere on the body of a patient suffering from malfunctioning gonads, they dispense testosterone through the skin to replace the testosterone the body should be producing on its own, under a new, patented process unknown before it was pioneered in a University of Utah laboratory.

Creation of the process was financed in part by more than $1 million from the state, Dr. Sung Wan Kim, one of the inventors, said. With encouragement from both the university and Mr. Alder's office, he founded a company, Theratec Inc., which produces the patches and several other novel drug delivery technologies.

Theratec made a public offering of its shares early this year, and the over-the-counter stock has grown to be a darling of some financial analysts. "The unappreciated gem of the drug delivery area," an analysis by Vector Securities said early this year. Last month, Kidder, Peabody & Company said "the uniqueness and proven benefits of these products gives us confidence in the company's profitability."

Now Theratec employs 80 people in a field that did not exist just a few years ago. And the company is almost certain to grow after it gains Food and Drug Administration approval for its initial products. Already, the average salary of Theratec's employees exceeds $40,000 a year. But like most speculative new companies, Theratec's early days were not easy.

"It would have been tough getting going without that money from the state," says Dinesh C. Patel, the company's president. "The state stepped in where most new companies fail."

Dr. Kim said, "Because of the state funding, we were able to initiate many new areas of research," adding that the Clinton Administration should look to Utah for ideas.

"The new Government in Washington has to stimulate small technologies like ours," he said.

Stephen C. Jacobsen has a similar view. He is a professor of engineering at the same university, and with help from the state, among others, he created a successful robotics company now employing 120 people. He put it this way: "People like us create the headwaters of innovation that can enable this country to stay ahead of Japan. But in the beginning, it's a minefield, and that's where the state helps."

If the Federal Government "doesn't do something to help entrepreneurs, something like the state does here, then we'll be in trouble."

# Centers of Excellence

# Center for Aerospace Technology

## Mission

The Center for Aerospace Technology is a Department within the College of Applied Science and Technology (CAST). Its mission is to obtain and manage projects to enhance the practical education of the students. The major emphasis of CAST's projects is the development and operation of small, low Earth orbiting satellites.

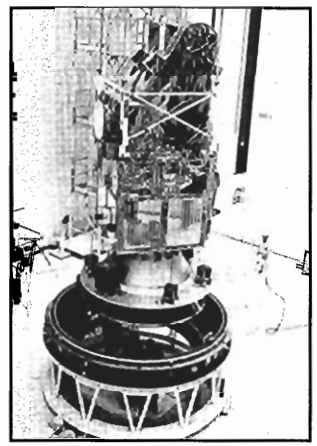
## The Center

The initial work on aerospace projects at Weber State University started in 1982 with the development of a small satellite to be used to demonstrate a method to evaluate the beams on the Federal Aviation Agency secondary radar systems. This satellite called NUSAT 1 (Northern Utah Satellite), a joint project with Utah State University, was the forerunner in a new type of specialized small, simple, and low cost satellite. The educational and technological innovations associated with NUSAT 1 were so successful, the Center for Aerospace Technology was created to direct future satellite work.

*Mounting of microsatellites as secondary payload for the Ariane 4 rocket.*

There are three active projects being managed by CAST:

- WeberSAT is a joint project with AMSAT-NA, a scientific, non-profit organization of amateur radio operators that have been active in building small satellites for a number of years. This satellite, one of four small 27 pound satellites equipped with five radio receivers, two transmitters, a color video camera, and other scientific experiments was launched in 1990 on a French Ariane rocket. Currently, this sun synchronous, polar orbiting satellite is successfully performing worldwide educational experimentation.



*Ariane 4 primary and secondary payloads.*

- JAWSAT or Joint Air Force Academy Weber State Satellite, is a 200 pound, three axis stabilized satellite with a propulsion motor. This satellite will be launched as a secondary payload on an Air Force launch vehicle in 1995. Building a three axis stabilized satellite with the capability to make orbit changes with a small electric pulsed plasma motor is a new step in technology for CAST. The primary payload on this satellite will be an improved camera earth imaging system, a camera used as a star mapper for altitude determination.
- Phase 3D is a new AMSAT international project to build a thousand pound communication satellite to be launched on the next generation of the French Ariane rocket in 1997. CAST has the major role of building the space frame for this satellite. Weber State University, under the direction of CAST, is the only undergraduate university in the world working on this international project.

## Center Highlights

- The development and operation of NUSAT 1, the only undergraduate university built satellite launched from NASA space orbiter.
- The successful launch of WeberSAT in January of 1990, a 27 pound internationally known educational satellite that is a student programmable laboratory in space.
- Through the CAST satellite research, two companies were formed to pursue commercial and military applications of this new technology. A number of commercial contracts have been developed.

For more information, please contact:

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# Center for Advanced Composites Manufacturing and Engineering

## Mission

The three fold mission of the Center for Advanced Composites Manufacturing and Engineering is to, first, provide extension services designed to assist Utah companies in areas such as development of product prototypes, testing of new product innovations, and improving manufacturing methods for existing products; second, provide industrial education and training to meet Utah's expanding industrial needs; third, develop innovative technologies resulting in new companies, patents, licenses and other economic benefits for the state of Utah.

## The Center

The Center for Advanced Composites Manufacturing and Engineering (ACME) has been able to assist in creating $37.2 million in actual business through extension services and other center related activities. These activities have also provided 437 new jobs in spin–off companies launched with support from ACME. The Center has extensive test analysis and manufacturing equipment to assist companies with composite, plastics, and other advanced materials manufacturing. Companies are invited to request assistance from the Center.

EXTENSION SERVICES

The ACME Center has developed a unique support service for Utah's manufacturing and engineering industries. 102 companies have been assisted through extension services since its creation, 38 companies this year. 32 new companies have been launched using technology that was developed outside the center, but where the implementation of that technology critically depended on the Center's support. To further assist these companies, testing and processing equipment has been increased to over $1.2 million in value. This will provide valuable testing capabilities that are not readily available to most companies within the state.

INDUSTRIAL EDUCATION AND TRAINING

at the ACME Center has experienced widespread acceptance. Training programs have been provided to specific companies. ACME personnel have taken the lead in coordinating industrial conferences, 5 of which they co–sponsored. The Center has also assisted other state colleges and universities in their educational efforts in advanced materials manufacturing.

TECHNOLOGY DEVELOPMENT

Five patent applications have been derived from center–developed technology, 3 of which have been granted. Other accomplishments include: 1 licensed software product, 3 joint proposals with other universities, 3 published technical books, and 44 scientific presentations at industrial conferences.

## Center Highlights

- *The Center is currently establishing an advanced materials and processes association with participants throughout the West,* which will strengthen industry within the State and give Utah business greater access to technology, facilities, equipment, expertise, financing, suppliers, and customers inside and outside the State.
- Composite manufacturing design capabilities include: Pultrusion, filament winding, RTM, high temperature autoclave, injection molding, extrusion, rotomolding, blowmolding, and vacuum molding.
- Various testing methods available include: Stress/strain, SEM, FTIR, x–ray, weatherometer, and dynamic impact testing. In addition, the center has developed unique vibration damping, cure sensing, plasma treatment and rapid prototyping.
- Products are emerging in areas such as aerospace, recreation, medical devices, transportation and sports.

For more information, please contact:

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Provo, Utah 84602
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# National Center for Advanced Combustion Engineering Research

## Mission

To substantially improve the current combustion technologies needed to maximize the conversion of fuel values from low-cost, low-quality fuels in environmentally acceptable ways.

## The Center

Burning low-cost domestic fuels, such as coal, shale-oil, and heavy petroleum liquids, increases pollution and complicates the task of reducing acid rain, smog, particulates, and carbon dioxide emissions. Current combustion technologies need substantial improvement to maximize the extraction of fuel values from these low-cost domestic fuels.

*Advanced fuel mixture.*

To address these problems, engineers and scientists from Brigham Young University and the University of Utah have joined with industry and state and federal governments to create the Advanced Combustion Engineering Research Center (ACERC) under the direction of Professor L. Douglas Smoot, BYU. Research is done principally at Brigham Young University and the University of Utah. Investigators from the University of North Dakota and the University of Kentucky also participate in the research activities.

ACERC OBJECTIVES ARE TO:

- Expand fundamental knowledge of combustion in order to improve related technology and practice.
- Educate students at all levels about ways to increase the all around efficiency of combustion, particularly in chambers fired by readily available, low–cost fuels.
- Transfer developed combustion technology to industry in order to help solve crucial combustion problems in the design and analysis of advanced combustion systems.

INDUSTRIAL COLLABORATION/ TECHNOLOGY TRANSFER

Students and faculty from various disciplines work closely with over 30 industrial, state, and federal organizations on an array of diverse research projects that have substantial practical applications in industry. Qualified ACERC professionals play key roles in software management, technology transfer, and industrial relations, and the creation of comprehensive computerized models for controlling combustion.

## Center Research

- Understand mechanisms of fossil–fuel combustion and pollutant and soot formation.
- Understand the relationship between fuel properties and conversion.
- Develop robust, reliable computer models to control and record the performance of particular combustion chambers.
- Apply non–intrusive diagnostics for complex combustion systems.

ACERC RESEARCH PROJECTS ARE FOCUSED IN SIX AREAS:

- Fuel structure and reaction mechanisms.
- Pollutant formation/control and waste incineration.
- Fuel minerals, fouling, and slagging.
- Turbulent reacting fluid mechanisms and heat transfer.
- Comprehensive combustion model development.
- Model evaluation data and process strategies.

Each of the six research thrust areas has an active working group of ACERC researchers and national and international authorities, primarily from industry, who help identify research needs. At any one time, more than 150 ACERC participants (including faculty, professionals, and students) conduct about 35 coordinated research projects.

For more information please contact:

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# National Center for Design of Molecular Function

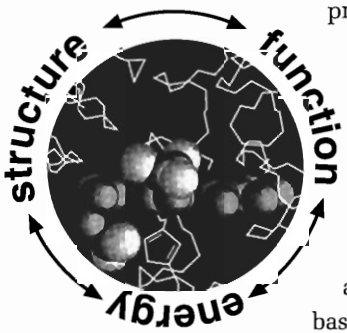
## Mission

To act as a focal point for new ideas and collaborations by the establishment of the underlying basis of design of molecular function and to provide this molecular design information and the related specialized tools for utilization by Utah's scientific and engineering community.

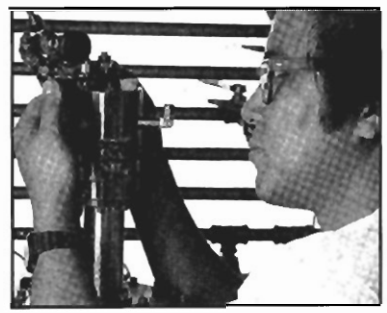
## The Center

The National Center for the Design of Molecular Function (NCDMF), a joint research effort between three State of Utah Centers of Excellence, is a newly created National Institute of Health- Biotechnology Research Resource at Utah State University.

The establishment of the underlying basis for the design of molecular functions is a necessary prerequisite to ultimately tailor molecular structure. The potential to do so offers great utility in nearly every aspect of science and technology. The basis of design capability lies in the intimate and intricate relationship between structure, function, and energy. Investigation of this relationship requires simultaneous real-time time-resolved spectroscopic instrumentation together with data analysis, interpretation, and visualization.




In accordance to the National Center's goal to provide molecular design information and specialized tools, the center is developing the following time-resolved spectroscopic technologies having nanosecond time resolutions: optical absorption, fluorescence, and resonance Raman. In addition, new spectroscopies such as dual wavelength, pulsed laser photothermal spectroscopy, and photothermal imaging spectroscopy are being developed. These spectroscopies can be employed in combination simultaneously or individually.



*Instrument fabrication.*

Other technologies such as rapid flow, regenerative flow, and freeze-quench techniques are available to biochemically poise the sample. Data are collected and analyzed on line, and in real-time, using specially designed parallel processing systems. A Sun 4/690 computer system with high resolution graphic terminals, an Ardent vectorized parallel processing system with 3D molecular graphics, molecular dynamic software and a multi-node parallel processing supercomputer are also a part of the Center's facilities. Overall, this national resource offers capabilities that exist nowhere else in the world.

## Center Technology

The NCDMF has currently developed the following technologies which are particularly applicable to biomedical/diagnostic and environmental monitoring:

- Trans-Acq fast data collection and analysis system collects data from multiple detectors and analyzes it in real time. Based on low-cost parallel processing hardware, this system is capable of data collection and processing at a rate of 120 MHz per channel. Data before or after digital filtering and analysis can be displayed by interactive graphics.
- Two-color and imaging photothermal spectroscopies are capable of optical absorption measurements in highly scattered media with differential sensitivities of 1 part in 106. Images of the absorber can be produced with a resolution of 500 nanometers.
- Flow apparatuses poised biochemical reaction so that the mechanisms of fast reactions can be determined. Several apparatuses have been developed for use in optical and magnetic spectroscopes which use only microliter samples and have time resolutions as low as 100 microseconds.

For more information, please contact:

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# Center for Biopolymers at Interfaces

## Mission

To perform basic research on the interactions between solid surfaces and biological macromolecules in solution, and to apply the findings to the design of new materials, including: biocompatible polymers, diagnostic devices, surfactants, and highly selective biopolymer separations products.

*Measurement of surface fluorescence are useful for the development of diagnostic products.*

## The Center

The Center for Biopolymers at Interfaces (CBI) began its formal operation in 1986, joining together University of Utah faculty members with a common interest in surface characterization, interaction of proteins and nucleic acids with artificial surfaces, and the ultimate use of such surfaces as biomaterials and biosensors. The Center thus became a natural extension of the Artificial Organ tradition at the University. In 1991, CBI was given Distinguished Center of Excellence status by Utah Governor Bangerter. The Center is supported in a major part by corporate membership dues. More than 30 national and international corporations have held CBI membership over the years.

TECHNOLOGY TRANSFER:

Center research has resulted in about 40 patent disclosures to the University Technology Transfer Office. Of these, 12 have led to patents that have been issued or are currently pending. Two spin-off companies have been created based on center technology. Publications of Center sponsored work are currently numbering in excess of 150 documents. In addition, CBI's academic accomplishments include 16 doctorates and ten masters degrees.

## Center Services

The Center maintains several state-of-the-art analytical laboratories, or facilities, that provide services to faculty and industrial members, as well as to external customers. The capabilities of these facilities include:

- Surface characterization by means of ESCA as well as static and dynamic contact angle; surface and bulk fluorescence spectroscopy and surface IR spectroscopy for the study of protein absorption and the resulting confirmational changes; and STM and AFM capabilities for the analysis of surface modification and biomolecular adhesion.
- Surface modification by means of plasma treatment; covalent attachment of proteins to surfaces, e.g. for immunosensing or diagnostic applications; and polymer coating of surfaces to enhance biocompatibility.
- Identification and quantification of protein deposits on synthetic materials via 1-D and 2-D electrophoresis, amino acid analysis, ELISA, and isotope labeling.
- Determination of colloidal sizes, size distribution and surface charge, emulsion characterization as to size, size distribution, stability, and composition.
- Protein stability evaluation by calorimetry and drop volume measurements.
- Protein and polymer visualization by molecular graphics and simulation of molecular dynamics.
- In vivo, ex vivo, and in vitro evaluations of biocompatibility.

For more information, please contact:
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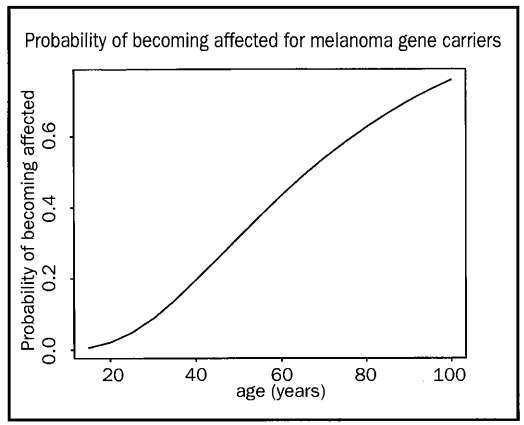
# Center for Cancer Genetic Epidemiology

## Mission

To research the genetic basis of common cancers in the United States, specifically, breast cancer, colon cancer, prostate cancer, and melanoma. In recent years, genetic analysis of cancer has become an increasingly critical national research focus. More and more evidence indicates that most, if not all, of the common forms of cancer frequently occur in genetically predisposed individuals.

## The Center

The Center for Cancer Genetic Epidemiology is focusing its attention on breast, colon, and prostate cancers, and melanoma because of their strong hereditary basis and widespread occurrence. The study of a hereditary basis or predisposition for contracting cancer is becoming increasingly important. Such predisposing genes often take the form of defective tumor suppressor genes, which suggests that discovery of these genes may have a wide impact on cancer therapeutics. If a gene which predisposes an individual to cancer is present, the onset of that cancer may be triggered by an environmental injury to the gene. *If the predisposing gene responsible for the high incidence of the common cancers were isolated, DNA diagnostics could be employed to identify those at risk and enable them to avoid genetic damage and detect tumors at a treatable stage.*




Dr. Skolnick, the director of the Center for Cancer Genetic Epidemiology, pioneered the study of genetic based diseases by utilizing Utah's unique genealogical data base. This study of multi-generational extended families over the past 19 years has identified genetic cancer clusters in large Utah genealogies. Dr. Skolnick was one of four scientists who conceived of using DNA sequence variations as genetic markers, a conceptual breakthrough that underpins the Human Genome Project. Dr. Skolnick's group has used this genealogical data base and gene mapping technology to link genetic markers to various diseases. These studies have led to the search for an inherited breast cancer precursor. *The research group at the Center for Cancer Genetic Epidemiology is recognized as a leader in the race for cancer gene discovery, and has contributed greatly to the University of Utah's reputation as one of the leading human genetic research centers in the world.*

## Center Projects

The Center is moving rapidly toward commercialization. It has developed an important relationship with Myriad Genetics, Inc. to commercialize the Center's technology. Currently there are two research projects involving licenses to Myriad Genetics, Inc. The first is for the isolation of a breast cancer susceptibility gene, called BRCA1. The second project is focused on mapping and isolating predisposing genes for colon cancer, prostate cancer, unmapped breast cancer, and melanoma. This collaboration is based on the Center's expertise in genetic epidemiology of cancer and gene mapping and on Myriad Genetic, Inc.'s rapidly developing expertise in gene isolation and the development and delivery of diagnostic services.

For more information, please contact:

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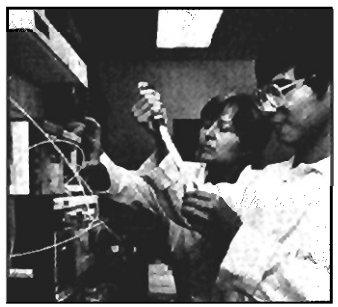
# Center for Controlled Chemical Delivery

## Mission

The Center for Controlled Chemical Delivery is devoted to active research in chemical delivery systems.

## The Center

The Center for Controlled Chemical Delivery (CCCD) was established at the University of Utah in 1986, consisting of faculty from the Department of Pharmaceutics and Pharmaceutical Science. As an extension of these departments, the CCCD maintains a strong graduate training program and has attained a leading position in worldwide pharmaceutical, polymer, and biomedical research. Ongoing research projects at CCCD include:



*CCCD Laboratories.*

POLYMERIC MATERIALS

A central theme of the research being pursued within CCCD is the development and application of new and useful polymeric materials. Biodegradable polymers are coupled with drugs through enzymatically and hydrolytically labile bonds and fabricated for long term delivery as implantable devices. The chemical composition of the polymer backbone is designed to degrade into common body metabolics after all the drug have been released. Antihyperintensive drugs for the development of a long term delivery system and bioadhesive polymers used to increase the residency time of oral protein-polymeric carrier delivery systems are also being explored at the Center. Additionally, novel hydrogels, such as temperature, pH, electrical, and ultraviolet radiation, are being synthesized and characterized. These new and exciting hydrogels are currently being evaluated for oral drug delivery and as implantable systems.

NONTHROMBOGENIC SURFACES

The design of nonthrombogenic surfaces entails the modification of new and existing blood-contacting polymers used for small diameter vascular grafts, left ventricular assist devices, artificial hearts, vascular stents, and implantable sensor systems. Blood compatible surfaces are archived by grafting hydrophilic groups and the coupling of antithrombotic drugs directly onto the polymer surface. These modified surfaces demonstrated suppression of clot formation and extended the usefulness of blood contacting devices.

SELF-REGULATED INSULIN DELIVERY SYSTEMS

This insulin delivery device demonstrates a unique concept in controlled drug delivery technology. Insulin is chemically modified through the attachment of saccharide groups. These saccharides provide a binding site for the glycosylated insulin (G-Ins) with a lectin (Concanavalin A-Con A). The self-regulating aspect of this device centers around the fact that blood glucose will also bind to the saccharide binding site on Con-A. This device, a polymer membrane pouch filled with G-Ins bound to Con-A, will react to glucose molecules by releasing G-Ins. As the blood glucose concentration increases, more G-Ins are released; minimal G-Ins releases occur at low glucose levels.

TARGETABLE DRUG DELIVERY is being developed for anticancer therapy. An anticancer drug and a specific targetable antibody are chemically coupled to a polymer backbone. The targeting antibody allows the system to be aimed directly at a cancer cell. Once inside the cell, the drug is cleaved from the polymer by lysosomal enzymes to destroy the cell. The mechanism of action of the targetable polymeric drug is being studied at both a cellular and sub cellular level.

*New Biomedical Polymers Research Facility, University of Utah Health Sciences Center, due for completion in 1994.*

ORAL DELIVERY

The oral delivery of peptide drugs is hampered by rapid degradation in the acidic environment of the stomach and by specific enzymes in the small intestines. The large molecular weight and surface charge of peptides also limits their internal absorption. The use of low molecular weight stabilizing compounds and carrier polymers may increase the stability and absorption of peptides. Peptide drugs, especially insulin, could then be taken orally, much to the benefit of the patient. In addition, CCCD is investigating colonic delivery of peptides.

For more information, please contact:

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(801) 581-6801

# Center for Development and Molecular Biology

## Mission

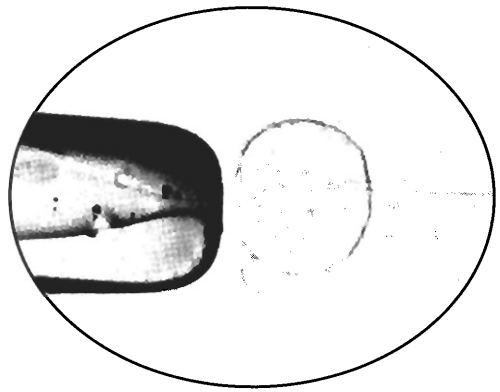
To facilitate product development, supplement near-term research, stimulate additional patent development, and increase the commercialization process of current near-term products in biotechnology, agriculture, and human medicine.

## The Center

Utah State University (USU) in cooperation with Hyclone Laboratories, Inc., has established, through the Utah Centers of Excellence program, the Center for Development and Molecular Biology (CDMB): Mammalian Tissue Culture, Immuno-modulation and Lytic Peptide Research. CDMB research will have a direct impact on important areas within biotechnology. The focus of this research team is in the following areas:

PRIMARY CELL CULTURE MEDIUM DEVELOPMENT

*Researchers at Hyclone Laboratories, Inc. working in conjunction with scientists at USU have developed a lymphocyte culture fluid that out-performs all other culture media in the culture of lymphocytes and embryos.* It is anticipated that this research will result in development of additional medium formulations for cells which are currently difficult to culture. Marketable products in this area include a tumor infiltrating lymphocyte medium and cells transected with the Lytic peptide gene for



*DNA injection into pro-nuclear stage embryo to produce transgenetic animals.*

treatment of several types of tumors in vitro embryos and embryonic stern cells.

LYTIC PEPTIDE EXPRESSION AND EXPRESSION VECTOR DESIGN

Researchers at USU have evaluated, developed, synthesized, and characterized several synthetic chemotherapeutic peptides referred to as Lytic peptides. These peptides have shown to be effective against a number of disease states that are currently very difficult or impossible to treat with conventional therapy. CDMB research focuses on the enhanced disease resistance of animals, plants, and fish by the transfer and expression of Lytic peptide genes. In addition, immuno-modulation of lymphocytes by Lytic peptide gene therapy for treatment of certain tumors has become a research focus of the Center. Recently, a patent application through the USU Office of Technology Transfer has been filed for the transfer and expression of Lytic peptides in transgenitic animals and mammalian cells to confer disease resistance.

## Center Accomplishments:

- The development of lymphocyte culture fluid (LCF) and Embryo culture fluid (ECF) that out perform all other culture media. Commercialization of these products will be through Hyclone Laboratories, Inc..
- Results of the subsequent efforts in culture media development will serve to provide additional products.
- Results of work on Lytic peptides and expression vector development will lead to the foundation of new companies as well as license agreements with existing companies.

For more information, please contact:

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Logan, Utah 84322-4500
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# Center for Chemical Technology

## Mission

The Center for Chemical Technology utilizes a variety of advanced technologies to study natural resources and assist Utah businesses in developing new products. Employing a multidisciplinary approach, the Center assembles teams of faculty, students, and corporate partners to identify and develop these new products.

## The Center

The Center for Chemical Technology at Weber State University, under the direction of Dr. Edward B. Walker, was organized in 1990. The Center's research fosters the development and commercialization of Utah's natural resources, generates technological advances in medicine, and provides technical assistance to Utah's manufacturing business and inventors. To date, the Center has established partnerships with 44 Utah businesses and 3 firms from outside the State.

NATURAL RESOURCES

Significant research in the development of natural resources from plants is currently being performed at the Center for Chemical Technology. For example, certain naturally occurring bacterial anti-adherence factors from plants may offer a new class of infection preventing drugs. *New enzymes from coffee and soybeans offer the potential to convert various blood types into universal donor, O-type blood.* Also, new technologies under development at the center will allow harvesting of b-carotene, an important nutritional supplement, from algae found in the Great Salt Lake.

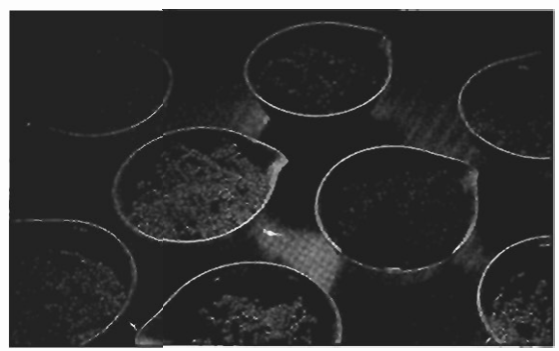
HEAVY-OIL

The processes for extracting heavy-oils (bitumen) found in tar sands has the potential to become a profitable industry. In the past, the extraction of bitumen from these tar sands for the production of asphalt has been difficult due to the high cost and inefficiency of the extraction processes. *The Center for Chemical Technology has developed an innovative and profitable method for extracting bitumen from tar sands.* Efforts in bitumen extraction have also lead to new applications in reclaiming soils contaminated by oil or fuel spills. The Center's partnership with BVRC and Crown Energy has resulted in the construction of a demonstration plant in Asphalt Ridge, Utah. The design of a larger, $12 million, 3,000-barrel-per-day facility is in progress.

## Center Highlights

- Attracted Eastman Chemical's interest in building a $34 million facility on the Great Salt Lake as a result of the Center's b-carotene research.
- Established a cooperative research association with Agridyne Technologies of Salt Lake City.
- Developed patented methods for extraction of heavy-oils from tar sands.
- Established partnerships with 44 Utah business and 3 out-of-state firms.

*Oil sample.*



*Tar sand samples.*

For more information, please contact:

Edward B. Walker
Weber State University
Center for Chemical Technology
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(801) 626-7444

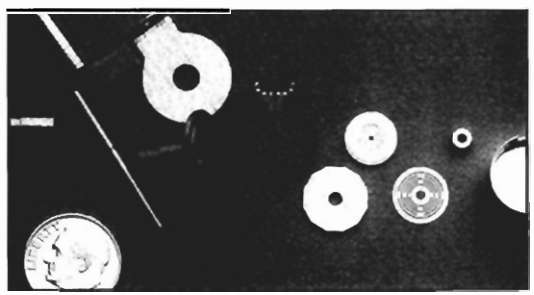
# Center for Engineering Design

## Mission

The Center for Engineering Design (CED) exists to develop original solutions for technological challenges. By utilizing state-of-the-art equipment and research facilities, the CED can and will continue to bring innovative ideas in the form of superior products to the marketplace.

## The Center

Founded in 1973, the Center for Engineering Design (formerly the Center for Biomedical Design) under the direction of Dr. Stephen C. Jacobsen, has become an internationally renowned research and development facility. The CED began primarily as a bioengineering facility specializing in medically-related technologies. Today, the CED has expanded its areas of expertise to include robotics, micro-electro mechanical systems, teleoperation systems, human emulation, virtual world interfaces, novel drug delivery systems and sophisticated manufacturing and fabrication technologies. Working with companies as diverse as Walt Disney Imagineering, Merck Sharp and Dohme, and Hydro Quebec, as well as a host of government agencies and universities, the CED has developed both functional prototypes and products for the entertainment, research and development, heavy industry, and medical fields. Drawing upon the rich human resource base at the University of Utah, the CED's unparalleled staff have propelled it to the forefront of engineering research.



*RDT – an integrated chip-based rotary position encoder.*

## Highlights and Specialties

Two of the many innovations pioneered by the CED's researchers are the RDT (rotary displacement transducer) and the Dextrous Teleoperation System, a high dexterity, general purpose, anthropomorphic robotic master/slave arm.

- The RDT is an integrated chip-based rotary position encoder. The RDT is unique, as compared with other sensors, because of its digital multiplexed output, "dime" size, high resolution, and a price tag that is cheaper than existing products that possess only a fraction of the RDT's features. The RDT enables robots to be made smaller, lighter weight, possess greater reliability, and be more cost competitive, thereby, increasing their range of applicability and their market size.
- The Dextrous Teleoperation System surpasses the severely limited, traditional robotic manipulators with their restricted ranges of motion, limited functionality, and difficulty in carrying out dextrous tasks. Because the Dextrous Teleoperation System can duplicate the motions of a human arm and allow the operator to feel the forces being felt by the slave arm, it is capable of deftly manipulating even the most fragile objects and effectively acquiring and using a wide variety of standard tools. The system has been configured to successfully carry out complex tasks in unstructured environments, especially those that were originally configured to be worked in by people, but are now considered hazardous or unpleasant. The Dextrous Arm is currently in use in leading world research laboratories as well as in teleoperation applications such as the maintenance and repair of high tension, high voltage power lines.

*Dextrous Arm developed at CED.*

The system can be used in three basic modes: 1) as a master/slave teleoperation system, 2) as a slave that is controlled autonomously by a computer, or 3) as a virtual world interface able to transmit high fidelity force and position information directly to the person from the virtual world.

For more information, please contact:

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# Center for Advanced Archaeologic and Paleontologic Imaging and Modeling

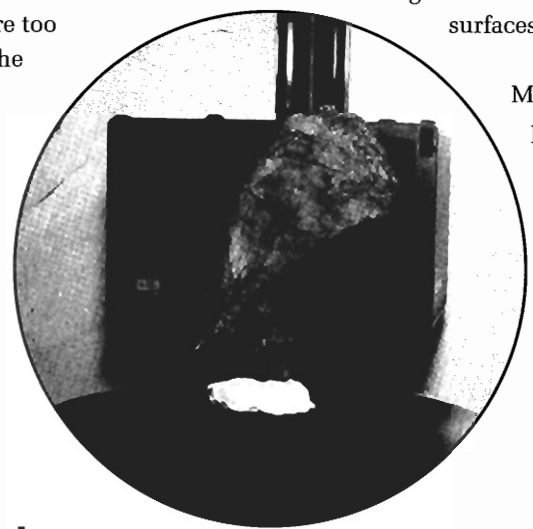
## Mission

The establishment of the Center for Advanced Archaeologic and Paleontologic Imaging and Modeling (CAAPIM) provides an opportunity to utilize leading edge technology to implement a revolutionary approach to the creation of museum reproductions, models and miniatures. The overall objective is to integrate CAD-CAM technologies in the areas of archaeology and paleontology. This will result in enormous reduction of reproduction time and costs as well as greatly reduce the possibility of damage to extremely valuable and rare original specimens.

## The Center

The College of Eastern Utah Prehistoric Museum has been involved in molding and casting dinosaur bones for thirty years. Recently the Museum was given casting responsibilities for the Huntington Canyon Mammoth and has furnished casts of the mammoth to museums across the United States and some foreign countries. There is a great demand for exhibit reproductions, but often the original specimens are too fragile to withstand the traditional molding process. Stereolithography, a process used to produce models or miniaturizations and supply missing elements, will allow the museum to preserve the specimen's scientific integrity.

*Don Burge, Director of College of Eastern Utah Prehistoric Museum holding the Nodosaurus scapula. The monitor screen has the same bone shown. The next step is to make the bone using the SLA.*



*Nodosaurus dinosaur scapula. This is part of the College of Eastern Utah's Prehistoric Museum "bone" collection from the Gaston Quarry north of Moab.*

## Center Projects

- Remolding of the Huntington Canyon Mammoth. As the original molds wear out, this non-intrusive technology will make the mammoth specimen available to more museums.
- Two new, recently discovered dinosaur species, one of which was made famous by the movie Jurassic Park, will be molded by the CAAPIM.
- Through the application of CAAPIM technology, archaeologic specimens such as the rare and fragile one thousand year old unbaked clay Fremont figurines will finally be available to other museums as exhibit and study specimens and to private citizens as art. The CAAPIM will be able to produce molds of the figurines without touching the fragile surfaces.
- The College of Eastern Utah Museum has actively provided programs to public school students both as a part of the state core curriculum and as supplementary programs.

For more information, please contact:

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Center for Advanced Archaeologic and Paleontologic Imaging and Modeling
College of Eastern Utah Prehistoric Museum
451 East 400 North
Price, Utah 84501
(801) 637-5060
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# National Center for Computer Graphics and Scientific Visualization

## Mission

The center for Computer Graphics and Scientific Visualization exists to develop integrated computer aided solutions to problems in computer graphics, scientific visualization, computer aided geometric design, and computer aided manufacturing, and bring them to bear in the industrial arena.

## The Center

Founded in 1991, the Center for Computer Graphics and Scientific Visualization under the direction of Drs. Richard Riesenfeld and Elaine Cohen is also the Utah site of the National Science Foundation/ARPA Science and Technology Center for Computer Graphics and Scientific Visualization, Since 1980 the Alpha 1 project, headed by Drs. Riesenfeld and Cohen, has attacked problems in visualization, graphics, modeling, design and manufacturing with a holistic integrated approach. This approach is characterized by both theoretical soundness and experimental validity in addressing real world, large scale, engineering problems. Working with a variety of industrial sponsors has insured that our technical solutions solve problems relevant to people in the field.

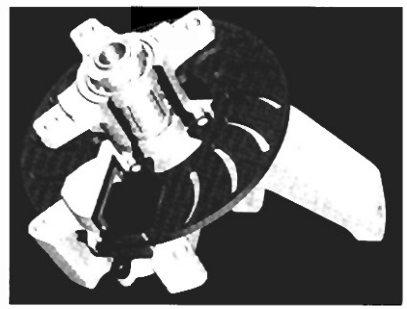
## Highlights and Specialties

- The Utah Raster Toolkit, a computer imaging tool, was developed and is maintained and distributed to over 600 sites and has become a standard for representation and manipulation of digital images.
- The Center continues research and development on integrated computer aided design, visualization, and manufacturing to decrease the time and improve quality of product design and manufacture.
- An innovative low cost technique for synthesizing high definition television signals (HDTV) from current NTSC signals has been developed. It can serve as a temporary, low cost transition technology for television stations moving to full HDTV production, and as a feasible permanent format for small, lower budget television stations.
- Software products based on Center technology have been licensed to leading hardware and software vendors to improve accuracy and efficiency of computer graphics rendering.

## Center Research Topics

- Developing new mathematical forms for representing complex objects bounded by sculptured surfaces.
- Improving process planning and integrating geometric modeling and manufacturing to reduce time from design to manufacture for the mechanical designer. Create more effective and automated interfaces to manufacturing processes.
- Finding new methods for visualization, animation, simulation, and the interaction of complex models.

*Both the picture on the screen and the metal chess pieces were generated from the same Alpha 1 computer designs.*



*The complete front spindle assembly was parametrically designed, visualized and manufactured in Alpha 1.*


For more information, please contact:

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# Center of Excellence for 3D Computer Graphics

## Mission

To provide an innovative learning and product development facility where art, business, and technology can be creatively combined. Dixie College recognizes the impact of new computer visualization and information technologies in the marketplace and is committed to maintaining state-of-the-art equipment and facilities.

## The Center

...DIGITAL TECHNOLOGY, WHICH TRANSLATES IMAGES, GRAPHICS, TEXT, VIDEO, AND SOUND TO A COMMON LANGUAGE, REVOLUTIONIZES INFORMATION INDUSTRIES FROM PHOTOGRAPHY TO PUBLISHING, FROM EDUCATION TO ENTERTAINMENT...

Over half of American workers today are involved in some form of information management. As a result, Dixie College founded the Center of Excellence for 3D Computer Graphics with a central focus of supporting the technology needs of our community. *Many of the industry's best and brightest artists have come to the center to test-drive the latest computer visualization technologies.* Among these artists are: Harry Marks, who has worked for both ABC and CBS as V.P. and creative director for on-air advertising; Joe Summerhays, Freelance Illustrator; Frank Barriuso of Macro Media Technologies, Inc.; and James Quirk of North Michigan University's School of Art & Design.

New technologies have empowered creativity and extended imagination, opening the way from idea to expression, from vision to art. The Center is searching for innovative thinkers from all areas of industry and is accepting proposals for special projects from individuals or businesses in need of equipment, facilities, and/or technical assistance. Currently, the Center for 3D Computer Graphics is working on product development projects with six Utah companies. These projects are the driving force for the activities at the Center.

The role of computers in education is another fundamental concern. The Center now offers many intensive, hands-on courses, technical demonstrations, and weekend programs spanning the full range of art, business and computer technology. The curriculum is comprised of courses which, using the latest technologies and techniques, help to enrich creative vision and the ability to communicate. The classes are small with an average participant to staff ratio of 15 to 1 and focus on a wide variety of software including:

WordPerfect
Microsoft
Excell
Windows
DOS
Autodesk AutoCAD
Peachtree
Lotus
Instant Replay
Macintosh OS
Aldus PageMaker
QuarkXPress
Adobe Photoshop
Illustrator
HyperSPACE
StrataVision 3-D
StudioPro Professional

This instruction is provided at any desired degree of supervision. The time spent at the center will cultivate technical proficiency and, most importantly, enhance computer confidence and embolden creative ability.

## Center Highlights

- Established project partnerships with six Utah companies: Strata Inc., Mira Imaging, IBM, Whitestone Software, St. George Magazine, and Instant Replay.
- Arron Gifford, a student at Dixie College, developed a software code that imports Abode Illustrator's™ files into Strata Vision™.
- The Center is made up of a number of different facilities and maintains the best and latest hardware and software for the Macintosh as well as IBM compatible platforms.
- Showcases UNIX workstations (RS 6000, DEC) as software development and scientific visualization tools.

For more information, please contact:

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# Center for Inverse Problems, Imaging and Tomography

## Mission

To provide a bridge for the transfer of fundamental science and technological developments into profitable commercial and industrial applications. More specifically, to develop new technologies, assist in demonstrating commercial feasibility of these new technologies, and to enhance Utah's competitiveness in technology industries by creating jobs, forming alliances, licensing technology, and creating new companies.

## The Center

The Center for Inverse Problem, Imaging and Tomography (CIPIT) is the result of research efforts conducted at the University of Utah's Advanced Imaging Methods Laboratory (AIM lab). The AIM lab was developed to study medical ultrasound imaging. Further research was then introduced in advanced sonar and geographical/environmental imaging methods based on common mathematics. In 1990, the AIM lab submitted a proposal for independent support as the CIPIT and initial funding was received in February of 1991. Some of CIPIT's technical accomplishments are in the areas of:

MEDICAL ULTRASOUND

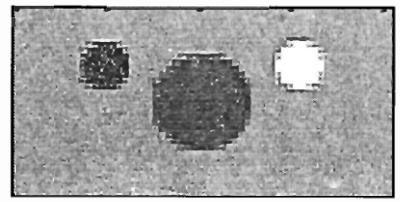
*An advanced pre-clinical medical ultrasound scanner has been designed and is being constructed to detect cancer in tissue samples.* Improvements have been made in the speed of basic inverse scattering algorithms. These algorithms have been ported and operated on a parallel computer which will allow commercial medical scanners to use imaging software with low cost parallel processors.

HAZARDOUS SITE IMAGING

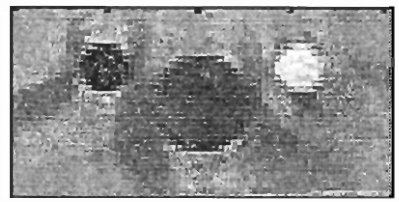
In connection with the Navy, work has been done scanning images buried in sand. This will allow Navy submarines to image objects buried in the ocean and to use acoustics for hazardous site imaging.

3-D MICROSCOPE

A 3-D, inverse scattering optical microscope was designed and the prototype has been completed. This microscope will demonstrate the first high resolution, quantitative 3-D images of microscopic test objects. Further tests will involve the use of nono-structures and human cells and chromosomes to demonstrate the commercial and medical advantages.



*a. Shows the test object consisting of three rods or cylinders at left, middle and right.*



*b. Shows the inverse scattering of the test object that was reconstructed from synthetic scattering data generated by scattering from the test object in panel (a).*

*c. Shows an image made from the identical synthetic scattering used to make the image in panel (b).*

For more information, please contact:

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The Center for Inverse Problems, Imaging and Tomography
University of Utah
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Salt Lake City, UT 84112

# Center for Software Science

## Mission

The Center for Software Science was established to create and operate an environment for the research and development of next generation system software.

## The Center

The Center for Software Science, under the direction of Robert Kessler at the University of Utah, performs research and development in a broad range of software systems and tools. Research includes: programming language design and implementation, targeting portable lisp, C and C++ compliers as well as object-oriented programming systems and persistence; operating systems, particularly distributed memory machines, BSD Unix™ systems, virtual memory design, and Mach microkernel systems; parallelism, with regard to resource allocation, parallel lisp and parallel C++; and finally, system software for the integration of PCs and Unix systems.

Recently completed Center work has been done on the joint development with Hewlett-Packard research labs of the Mayfly, a distributed memory parallel processor and the programming languages (Concurrent Scheme and DC++) and operating systems supporting that machine. Ongoing work continues in the areas of operating systems (Mach and BSD), networking, distributed system management and file systems, optimizing compliers, debuggers, networked window systems, and software engineering. Also, Center personnel have made significant progress on an ARPA sponsored project that is attempting to utilize shared libraries in support of an object-management layer upon Mach.

The Center is known for its ability to perform research and development of systems and then produce software that is used by colleagues around the world. Successes include over 1000 copies of the Lisp system, hundreds of copies of BSD Unix™ for Hewlett-Packard workstations, and around 100 copies of MacDump, a utility for backing up Macintosh computers over the network. Recently, the Center has been distributing copies of the Mach operating system for HP workstations.

Successful technology transfer has occurred with the Center's spin-off company Hippo Software. Hippo Software, Inc. was founded in 1991 with technology developed by the research team at the Center for Software Science. Hippo Software is committed to providing the complete integration solution between UNIX and the new generation of powerful PCs. Hippo Software is currently distributing the HIPPIX software, a product designed to allow compatibility between PCs and Unix workstations, throughout the country. HIPPIX is actually two products. The first is command utilities, which consists of over 100 separate programs which give the customer the same operating commands and utilities that are present in the Unix system. The second product adds a library containing approximately 150 programming functions that permits someone to take Unix compatible software programs and run them on a PC. HIPPIX was released for IBM's OS/2 2.0 in March, 1993 and released for Windows NT in August, 1993.

## Center Research

- Research and Development of object support in modern operating systems.
- Research in parallel programming languages and their software support (program development, visualization, and debugging).
- Development of a single address space and distributed operating system.
- Research into allowing local workstations to transparently participate as compute nodes in a large multicomputer.
- Research into tight integration of PCs and Unix systems, for example through enhanced ease of communication between PCs and Unix systems.

For more information, please contact:

Robert R. Kessler, PhD
Center for Software Science
University of Utah
Department of Computer Science
Salt Lake City, UT 84112
(801)581-4653

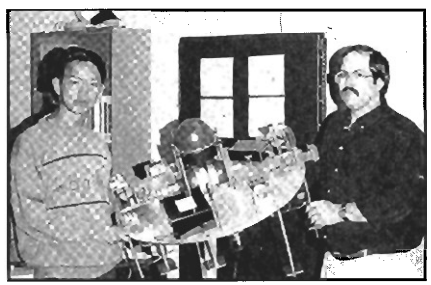
# Center for Self-Organizing Intelligent Systems

## Mission

To develop a world leadership position in neural networks and fuzzy inference machines (fuzzy logic) while helping Utah companies develop marketable products in these new intelligent systems technologies.

INTELLIGENT SYSTEMS TECHNOLOGY:

"Intelligent Systems" is a new term used to describe the result of combining two similar but distinct technologies of neural networks and fuzzy logic. Neural networks consist of massive parallel interconnections of simple computing elements, called artificial "neurons," which mimic the ability of the brain and its central nervous system to learn and to generalize from past experience. Fuzzy inference machines are similar to neural networks but they attempt to emulate the reasoning process fundamental to human intelligence. The approach taken by the Center for Self–Organizing Intelligent Systems (CSIS) is to combine fuzzy logic with neural networks, achieving an intelligent system which retains the distinct advantages of the two individual technologies, while eliminating their shortcomings.



*Dr. R. Fullmar and graduate student S. Kuntanapreedor with the Center's 3-axis small satellite simulator, used for intelligent control system design projects.*

## The Center

According to the Market Intelligence Research Co. (MIRC), the worldwide market potential for embedded intelligent control systems alone is projected at a figure close to $7 billion by 1995. Although basically a U.S. invention, successful Japanese products ranging from VCR controllers to washing machines provide convincing justification for the accuracy of the MIRC projection. The basic CSIS objective is to assist Utah industry in entering this market by identifying and developing marketable products based on intelligent systems technology, as well as developing applications to enhance the competitiveness of the manufacturing process itself. The Center includes faculty and talented graduate engineering students from Utah State and Brigham Young Universities. This combination provides a broad spectrum of engineering talent and specialties, ranging from control systems to irrigation engineering, which enables CSIS to achieve its goals.

*George Powell, SOIS Center Associate, with the Russian MARS 96 Robotic Rover.*

INDUSTRIAL COLLABORATION:

- Manufacturing industries as diversified as Bourns Inc., Hercules Inc., and Geneva Steel can use our technology to improve product quality, reduce defects, and increase efficiency.
- Utah companies such as Parvus Inc. and Omnidata International can use our technology to develop specific new markets and products.
- CSIS faculty and students are actively working directly with Campbell Scientific's engineering and management personnel in a flagship project to transfer intelligent controller technology over to Campbell in the form of marketable open channel and pressurized flow irrigation control system products.
- Projects involving voice input data acquisition systems, autonomous control of micro–robotic vehicles, fault detection, and error diagnostic systems are getting underway.

For more information, please contact:

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# Center for Multimedia Education and Technology (CMET) at University of Utah

## Mission

To stimulate and accelerate the use of computers and software tools in engineering, science and mathematics education and to provide avenues and opportunities for the effective integration of multimedia lessons in teaching.

## The Center

In addition to the financial support from the Utah Centers of Excellence Program, the Center for Multimedia Education and Technology (CMET) is funded by the National Science Foundation (NSF). CMET is managed through a Policy Board by the Executive Office of the Institute of Electrical and Electronics Engineers, the largest professional organization in the world. In accomplishing its objectives, CMET is engaged in a number of different projects including:

- Publishing annual books of tested and approved software packages that contain diskettes of selected software and multimedia (interactive video) lessons.
- Training workshops.
- Funding software development projects at universities across the United States and Europe.

14 universities in the United States participated in the development of CMET's first software book which is in the area of electromagnetic education, an abstract and highly mathematical course in electrical engineering. This book contains 15 diskettes and 2 videos. This educational package has been distributed to hundreds of universities in 28 countries. In addition, CMET, in collaboration with John Wiley & Sons, publishes a quarterly archival journal titled, *Computer Applications in Engineering Education.*

*Hands-on multimedia education.*

CMET has recently been appointed manager of the COLOS USA (Conceptual Learning of Science) project funded by Hewlett–Packard, COLOS is based on the realization that nature does not solve mathematical equations and that teaching and learning may be based on intuitive concepts. 10 universities from across the U.S. were selected to participate in COLOS, while the University of Utah has been given the leadership role.

The State of Utah support for CMET is mainly focused on the development of multimedia lessons for precollege physics and calculus education. R&D activities are focused on the use of CD ROM to distribute CMET products to high schools and universities and on investigating the use of the Virtual Reality technology to mimic laboratories.

## Center Products

- Educational software and videos (highly visual, interactive packets containing tutorials and exercises).
- Multimedia (interactive video) lessons on topical subjects in engineering, science, and mathematics.
- Workshops and training institutes.
- Catalogs of available software for science and engineering education.
- Software and multimedia for industrial training.


For more information, please contact:

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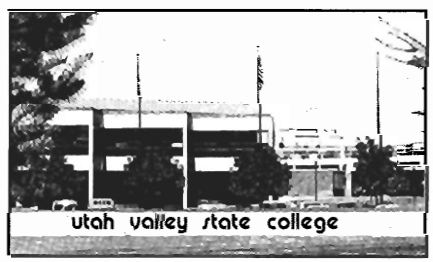
# Center for Multimedia Education and Technology (CMET) at Utah Valley State College

## Mission

To research state-of-the-art, interactive multimedia computer technology to author and produce corporate training and educational applications.

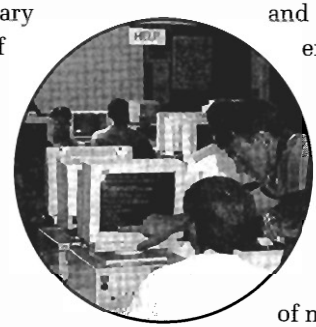
## The Center

Interactive (digital) multimedia computer applications, after two decades of conceptual research and development, have finally come of age. The market for this technology in corporate training alone has grown to $50 billion and is projected to double every two years. *Utah Valley has an estimated $2.2 billion industry consisting of 100-200 companies that could benefit from this multimedia technology boom.* The advent of low cost hardware, simple and flexible authoring and monitoring tools, full-motion video, audio (stereo) input, and compression/decompression technologies are rapidly creating a revolution in education and training delivery systems. To assist the development of educational uses for this new technology, in 1993, Utah Valley State College (UVSC) created the Center Multimedia Education and Technology (CMET) under the direction of Gregory H. Jackson, the Center's Administrative Director and Principal Investigator. The Center is housed under UVSC's School of Continuing Education reporting to Dean Gary S. Wixom. Gary L. Phelps is the Executive Director of Development Programs. CMET's purpose is to combine new multimedia technology in a unique partnership with business and industry. While both multimedia technology and industrial training will continue to grow, these unique partnerships will establish a new mechanism for both elements to grow much faster than either would in isolation. CMET at the UVSC location is working jointly with the University of Utah to synergize development projects wherever possible.



*UVSC campus in Orem, Utah.*

Companies that are using this multimedia approach to education and training have seen great success. CMET is fortunate to have already created opportunities to jointly produce multimedia products with many quality companies. *For example, Motorola, whose Six Sigma Performance has been a model for U.S. business, has attributed its success to a lifelong corporate learning program of which one-third is interactive multimedia.* This industrial involvement and hands-on experience has qualified CMET to produce quality, cost efficient, and effective multimedia applications. One of the prominent reasons why CMET will succeed where others have failed is because the actual technology, hardware, and authoring tools available on a cost effective basis have only recently been truly perfected. Hundreds of companies are now poised to take full advantage of this new and exciting technology.



## Project Highlights

CMET's anticipated production of multimedia applications are in areas where integration can be quickly accomplished through UVSC departments, joint ventures, external partnerships, and the creation of new companies.

Currently planned projects are:

- Aviation — Basic flight training modules for use in first time private pilot license training.
- Environmental Technology — Standardized CD-ROM database and multimedia applications for material data safety sheets. Initial partnerships are already formed with three external partners.
- Fire Science — Production of 6-10 CD-ROM modules for use in the Utah Fire and Rescue Academy at UVSC. These modules will be marketed nationally.


For more information, please contact:

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Tammy J. Rowan
Exec. Asst. Ext. 8783

Gary L. Phelps
Executive Director
Development Programs
(801) 222-8000 Ext. 756

# Center for Meat Processing Technology

## Mission

The mission of the Center for Meat Processing is to develop new added-value meat products that are lower in fat, pathogen free, convenient, and satisfy consumer demands.

## The Center

ULTRA-HIGH TEMPERATURE, LOW-FAT AND VALUE ADDED PROCESSING

The Center for Meat Processing is focusing its research in developing technology to pasteurize the surface of meat and produce low fat meat products.

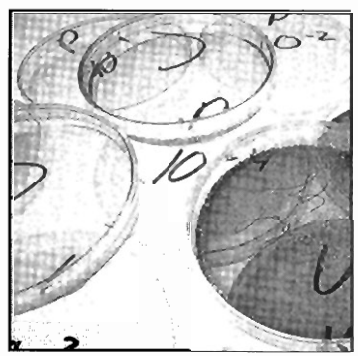
Utah is one of the world's major producers of lamb. However, consumer acceptance of lamb is low, only 0.5 lbs per capita. This lack of acceptance is due to several reasons: 1) retail cuts are too fat –the average cut contains 22% fat, 2) retail cuts are not readily available in supermarkets, and 3) lamb meat has a distinct species flavor that is not always acceptable to the consumer. The Center's approach to increasing the acceptability and quality of lamb involves the separation of fat from lean meat. The lean meat is then fabricated into the desired product and water is added to replace the fat. Also, certain technologies have been identified by the Center that significantly improve lamb flavor.

*The Center is exploring another alternative for reducing fat.*

The Center is exploring another alternative for reducing fat. This method is through the manipulation of genetics traits.

GENETIC IMPROVEMENT OF LIVESTOCK

Genetic Improvement of Livestock was added to the Meat Processing Center in 1991 with the focus of identifying the genetic markers in sheep. Genetic Marker research was designed to develop markers that would saturate the ovine genome and increase the chances of identifying a genetic marker associated with carcass composition in sheep. *Recently, the Center has identified two genetic markers that flank a gene causing heavy muscle in sheep.* In primary investigations, sheep carrying the gene have 8% more muscle, 8% less fat than flock-mates not carrying the gene. A flock of sheep that carry this gene has been developed at Utah State University. The manipulation of these genetic traits could significantly affect retail yield and the percentage of carcass weight found within the high-priced cuts of meat for all species of livestock.

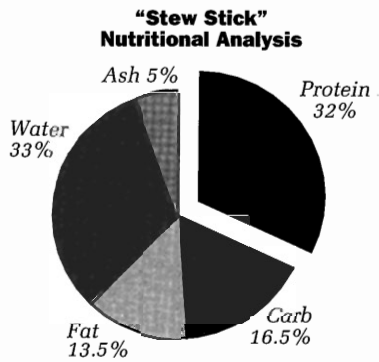


*Petri dishes of cells containing genetic markers associated with carcass composition in sheep.*

## New Product

"STEW STICK"A GREAT-TASTING SNACK THAT YOU CAN FEEL GOOD ABOUT!

Convenience food items generally share one thing in common; they are all bad for you. Now, a new meat and vegetable snack changes all that. The Center's "Stew Stick" combines meat (beef, pork, chicken, turkey, lamb, or fish) with vegetables (potatoes, onions, carrots, tomatoes, etc.) to make a juicy, tasty meat stick. This meat stick is softer and fresher tasting than jerky, and more nutritious. Stew Sticks are high in fiber, vitamin C, vitamin A, and carotene.This all-natural recipe, together with the Stew Stick's low fat content (less than 14%) should appeal to the world's increasingly health conscious market.




The Stew Stick is more than a snack and better for you.

For more information or for samples, please contact:

Von T. Mendenhall
Center for Meat Processing
Utah State University
Logan, Utah 84322-8700
(801) 750-3463

# Center for Dairy Foods Technology

## Mission

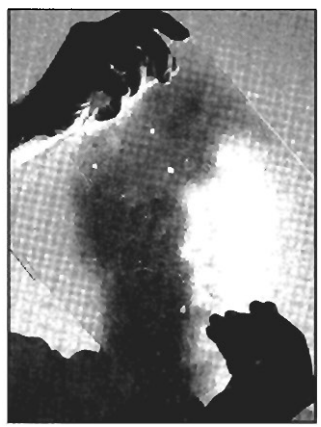
The Center for Dairy Foods Technology investigates the newest technologies in dairy products research. This research focuses on technologies that will produce new and novel dairy products that have advanced and advantageous properties.

## The Center

The Center for Dairy Foods Technology (CDFT), under the direction of Dr. Paul A. Savello, investigates two milk processing technologies: ultra-high temperature (UHT) processing of milk and milk concentrates and concentration and separation of specific milk components by the use of synthetic membranes.

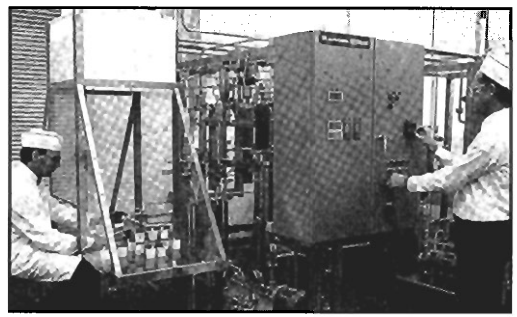
UHT processing of milk concentrates produces a high quality non-refrigerated milk product that promises to reduce the high cost of transportation and cold storage. These shelf stable milk concentrates will provide international markets with a fluid milk product that can be reconstituted by simply adding water. This product can also be used in a concentrated state for yogurt, ice cream, and some types of cheese production.

ULTRAFILTRATION membranes are being investigated to concentrate and fractionate fluid milk. This process is designed to remove water, some lactose, and other minerals from the milk, whereas other processes such as reverse osmosis only remove pure water. Ultrafiltration is performed at low temperatures so the flavor profile of the milk is not affected. Subsequent UHT processing of *this concentrate yields a commercially sterile milk that has up to one year non-refrigerated storage life.*



*Eatable coating/film using whey proteins.*

FRACTIONATION of milk into its individual components is a cutting-edge technology that will add more value to fluid milk. Milk components are being separated and purified using specialized membranes. Some of these components have been identified as having bioactivities that can prove to be important in the pharmaceutical and cosmetic industries. *The Center has already isolated a biomolecule from milk that has shown important bioactivity in cell culture studies.* Further research in this biomolecule's identification and purification will continue with the recently proposed funding from a major pharmaceutical company in the U.S.



*Aseptic filling chamber for ultra-high temperature processing of milk.*

## Center Highlights

- Formally filed for three patents with the U.S. Patent and Trademark office. The CDFT has on file three invention disclosures that are now being reviewed for possible patent application. Research is continuing in one area that should lead to an additional invention disclosure.
- The patent application "Concentrated Sterile Milk" has been pursued by NutriScience, Inc., a Logan, Utah venture group.
- The patent application "Creamier Skim Milk" is being pursued by Utah State University's Research and Technology Park. This innovation prepares and processes skim milk to yield a fluid milk product that has the color and mouthfeel characteristics comparable to 2% milk and still has all the health qualities of skim milk.

For more information, please contact:

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Center for Dairy Foods Technology
College of Agriculture
Utah State University
Logan, UT 84322-8700
(801) 750-3618

# Center for Value Added Seed Technology

## Mission

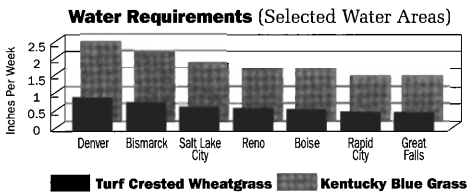
To assist industries through the genetic transfer of carefully chosen and economically important traits to wheat, barley, forage and turf grasses, and by releasing genetically enhanced breeding lines and varieties.

## The Center

The Center for Value Added Seed Technology (CVAST) at Utah State University is developing drought-resistant, low maintenance turf grasses, and hybrid varieties of wheat that could transform wheat production much as corn hybrids did when they were introduced over a half century ago.

TURF CRESTED WHEAT GRASSES

Turf Crested Wheat Grasses are the carefully bred progeny of wheat grasses obtained from the Mideast. Wheat grasses are now widely planted on range lands to provide forage for livestock. However, this new turf grass should be available for commercial uses in a few years. *Lawn varieties of this commercial turf grass grow more slowly and require about half as much water and less mowing than that of conventional lawn grasses.* The development of this grass would capitalize on a growing market estimated at $200 million annually.

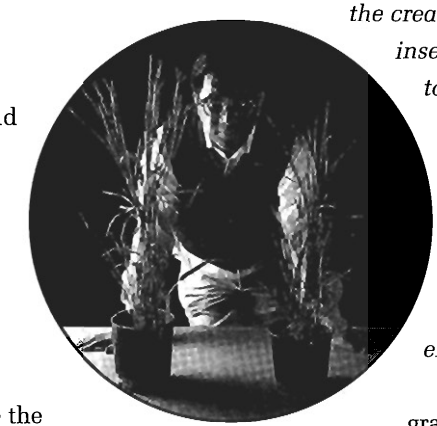



| | Kentucky Bluegrass | Turf Crested Wheatgrass |
|---|---|---|
| Denver | 2.25 | 0.90 |
| Bismarck | 2.00 | 0.80 |
| Salt Lake City | 1.70 | 0.68 |
| Reno | 1.50 | 0.60 |
| Boise | 1.50 | 0.60 |
| Rapid City | 1.25 | 0.50 |
| Great Falls | 1.25 | 0.50 |

Source: Cooperative Extension Service

HYBRID WHEAT

The key to producing hybrid wheat varieties, another focus of CVAST's research, is the transfer of the genes that control apomixis, the ability of some species of plants to clone themselves through their seed. The transfer of desired traits through genes would eliminate the need for labor intensive and expensive hand pollination of wheat that is currently required to produce wheat hybrids. USU researchers have already produced a few wide hybrids with desired traits by hybridization with a species of wheat grass, a distant relative to wheat. *Developing successful hybrids could boost production of wheat by 10% to 15%, an increase worth hundreds of millions of dollars annually.*



*Hybrid wheat varieties.*

## Center Highlights

- Proprietary procedures for efficiently producing genetically engineered wheat were developed and are undergoing final testing by CVAST scientists. *This innovation will facilitate the creation of wheat lines with unique insect, disease, and herbicide tolerances, higher yields, and improved nutritional and bread making qualities and will catapult wheat and probably other world grain crops, for the first time, into the realm of modern genetic engineering.*
- A promising turf-type wheat grass, obtained from Kazakhstan in 1992, will enhance development of a variety of turf grasses with unique applications.

For more information, please contact:

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Utah State University,
Plants, Soils, Biometer
Logan, Utah 84322-4820
(801) 750-2233

# Center for Environmental Technology

## Mission

To strengthen participation in environmentally conscious manufacturing and service markets through university-based research, technology transfer and assessment services, and environmental education programs.

## The Center

Established as a Utah Center of Excellence in 1993, the Center for Environmental Technology (CET) operates through the College of Engineering at the University of Utah. Over 350 companies in Utah are involved in activities which will be significantly impacted by developments in environmental technology. Many of Utah's leading businesses have included integration or acquisition of environmental technologies in their strategic plans. *The rapid conversion of military to civilian technologies at national facilities, and the formation of new technology policy in the U.S. will be heavily influenced by needs in environmental restoration and conservation.* The Center for Environmental Technologies will be developing new ideas in three key technology areas: sensing and monitoring, waste stream reduction, and pollutant destruction & environmental remediation.

SENSING AND MONITORING

Many sensing technologies are under development at CET. Among these, sensing devices based on mass spectrometry have been found to have market-driven applications to environmental monitoring problems. CET will take advantage of its existing expertise in this field to gain a strong foothold in markets related to timely identification of toxins, hazardous waste, and to drug interdiction. These are areas in which there is a need for low cost, accurate and robust field measurement devices for discovery, analysis and delineation of these hazardous chemicals. Development of the theory, and associated software and hardware for these monitoring systems is a key mission of the Center.

WASTE STREAM REDUCTION

As available landfill space becomes more restricted, and as clean air and water become scarce commodities, it is increasingly important to develop technologies which will reduce all kinds of waste streams. CET, in conjunction with industrial and academic researchers, is developing methods for cleanup of soils and process streams contaminated with industrial explosive and radioactive waste. Each of these technologies reflects CET's commitment to pollution prevention.

POLLUTION DESTRUCTION AND ENVIRONMENTAL REMEDATION

CET is also working with industry to identify safer and more effective methods for destruction of pollutants and for environmental restoration. Beginning with environmental restoration opportunities, CET will be developing technologies which will cover a range of needs, from autonomous and teleoperated sensor-laden robotics to provision of higher efficiencies in conventional remediation equipment.

## Center Accomplishments

- Introduction of a Utah company to U.S. Customs Agency officials in Washington to demonstrate its newest developments in remote sensing technology. Development of this new time-of-flight mass spectrometry system may also be instrumental in making airports safer by detecting explosives and will help stop the flow of hazardous materials and drugs across the borders.
- Development of Air-sparged Hydrocyclone (ASH) flotation, a separation process common in the minerals extraction industry, which uses hundreds of times less water than conventional flotation methods and is being applied effectively in solving many environmental problems.
- In conjunction with an international company based in Salt Lake City, CET is developing a knowledge-based expert system which will define parameters and automatically control the operation of cement kilns. This will ensure that important operating variables such as temperature and fuel feed rates are integrated so that the kilns will operate efficiently, completely destroying pollutants and leaving plant emissions clean.

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# Center for Solid Waste Recycling

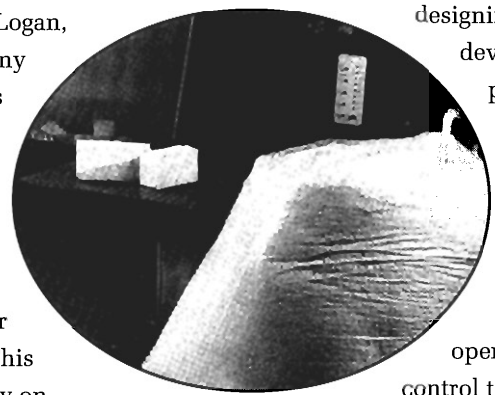
## Mission

To pursue realistic and comprehensive solutions designed to overcome the social and economic problems our environment faces in the elimination of solid waste

## The Center

Utah State University, in cooperation with Huntsman Chemical Corporation have placed themselves in the forefront of the plastics industry in dealing with the challenge of plastic waste. This challenge is both a fact of life and a social issue that must be addressed.

On May 23, 1989, Jon M. Huntsman, Chairman of Huntsman Chemical Corporation, announced the creation and funding of the Huntsman Environmental Research Center/Center for Solid Waste Recycling at Utah State University in Logan, Utah. This is one of the many state research centers that is partially funded by the Utah Centers of Excellence Program. The center is designed to pursue realistic and comprehensive solutions for environmental problems. This research will focus primarily on four areas: recycling, improving air quality, degradability, and conservation of trees.



*Densified foam.*

One of the projects that is funded by the State Centers of Excellence is the Polymax 5000 Polystyrene Foam Densifier. It was designed to develop a means of densifying polystyrene so that it will become economical for users and suppliers to ship polystyrene to facilities where it can be recycled. This process increases the use of recycled polystyrene in various products and prevents it from being sent to landfills in an undensified form or disposed of in other environmentally hazardous methods.

## Polymax 5000

POLYSTYRENE FOAM DENSIFIER

The Polymax 5000 is a low density polystyrene foam densifier, designed by the Huntsman Environmental Research Center at Utah State University. The purpose for designing the Polymax 5000 was to develop a process of densifying polystyrene to densities that will permit polystyrene to be more economically recycled.

The Polymax 5000 offers the following benefits:

- Automatic or manual operation and automatic load control to provide low cost operation.
- High output capacity, up to 300 lbs. per hour.
- Automatic output density control.

*Polymax 5000 – polystyrene foam densifier.*

- No heat is required in the process which eliminates polymer degradation.
- Polystyrene is densified to 30 lbs. per cubic foot in 4 1/2 by 4 1/2 inch blocks which allows for easy handling.

For more information, please contact:

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