

NFS Award Number 0216131

Title: Acquisition of Equipment for the Purdue Envision Center for Data Perceptualization
Final Report

Envision Center Highlights

- Over 12 different summer camps with students touring, some working on visualization projects
- The center staff have developed and taught 2 graduate level courses, 12 short courses, and a variety of training courses for students, faculty, and staff
- Continued expansion of the International Visualization Consortium with over 125 members from around the world and expanding – offers a portal for visualization delivery of education materials, and collaborations <http://www.ivisc.org/>
- Currently working on over 31 projects from 11 different schools and departments
- Working with Purdue Regional campus to expand projects and include faculty from those schools
- During first semester, center provided support for 19 students – senior project -- plus a variety of graduate student projects
- Creation and expansion of the Envision Discoverers – an undergraduate project and learning environment designed to expand the understanding of the Centers technology
- 6 Industrial Research Projects
- Center had over 1100 scheduled events, classes and project based events during this time
- Over 2100 staff, students, and guests attended sessions in the center
- 2 International Staff and student groups
- Created, developed and hosted a multi-site dance and art presentation over the Access Grid

The funds provided by this grant, along with the cost share provided by the University are having the desired impact within the research community. Development opportunities and projects from all schools within the University and the private sector are continuing at a rapid pace. It will continue to take time to fully measure the impact that the Center is having on the discovery process. Through the efforts of the PI's and the Envision Staff the process will continue to expand and the Center will become the hub for perceptualization efforts across Purdue.



Envision Center for Data Perceptualization Purdue University

The mission of the Envision Center for Data Perceptualization is to serve, support, and collaborate with faculty, students, and industry to be a leader in scientific visualization and human computer interaction through learning, discovery, and engagement.

Final Report

September 7, 2005

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Introduction

The Envision Center for Data Perceptualization is proud to offer this summary of activities for 2002-2005. The Centers mission statement provides the base for our activities.

Envision Center Mission Statement

The mission of Envision Center for Data Perceptualization is to serve, support, and collaborate with faculty, students, and industry to be a leader in scientific visualization, and human computer interaction, through learning, discovery, and engagement.

A few of the very distinct features regarding the origin, development and visions for the center:

- The Envision Center is administered and supported under the Office of the Vice President for Information Technology.
- Faculty driven initiative with initial funding from a \$900,000 NSF-MRI grant, Chris Hoffmann from Computer Science was the PI.
- Purdue University has dedicated capital funding, facilities and ongoing full operation funding.
- IBM and Intel donated hardware for the facility and a teaching lab in CS.

Report Components

This report has been broken into various components – allowing us to summarize our focus activities for the past year.

Staffing – growth and changes to expand capabilities

Learning – the teaching, training and learning

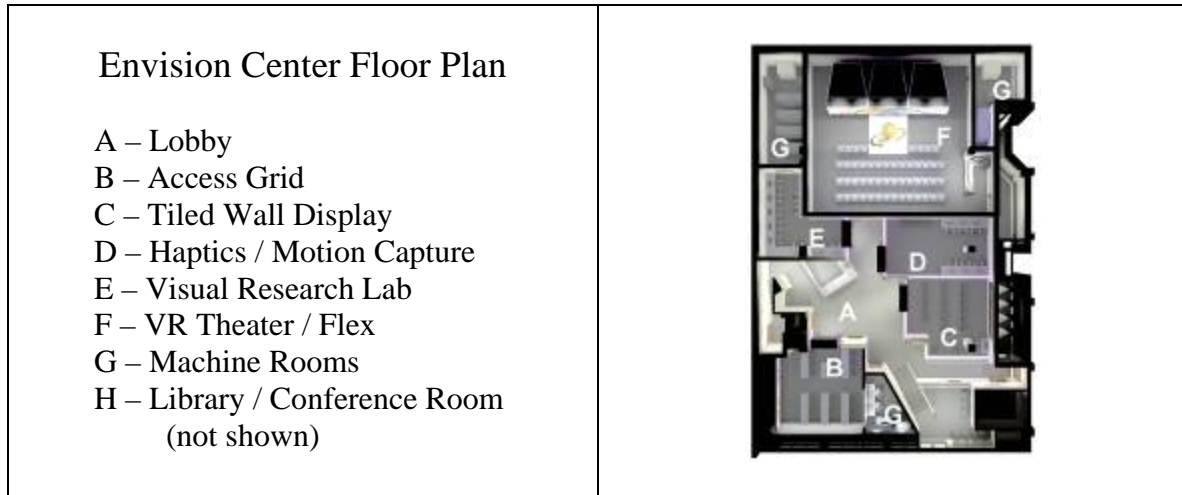
Discovery – both hardware and software as the teams continued to evaluate product selections

Collaborations / Engagement – building the relationships which will allow for future growth

The discovery component has been expanded over the year to almost 50 different projects that are either in process or completed. The learning component has been addressed via short courses, undergrad and graduate level courses and Access Grid events promoting the various technologies applications. Our engagement focus will center on in reach and out reach activities, promoting the center, our technology applications and the various levels of collaborations that are achievable.

The Facility

The formal opening for the Center was on April 12, 2004. Below is a brief overview of the growth and changes in each of the areas in the Center:



Virtual Theatre

A virtual theatre features four 10' x 8' panels for rear projection of large-scale, 3D images. The base system has been expanded to use both the SGI Onxy 4 and a Windows/ Linux based cluster. This allows for better rendering and real time relationships for the users.

Tiled display wall

The tiled display wall is a large high-resolution display made up of a grid of smaller projection displays controlled by many computers working together. Over the last year, we have modified the system to operate in Windows and Linux.

Access Grid

The Access Grid network links Purdue with more than 400 high-speed multimedia research and academic facilities on five continents. Equipped with a full wall screen, the Access Grid room in the center offers the ideal components for multi-site conferencing and collaboration.

Haptics

Haptics is an area of research which seeks to enhance human-computer interfacing (HCI) by adding the extra dimension of touch.

Motion Capture

In cooperation with the Department of Visual and Performing Arts, the Envision Center houses a STT Motion Captor optical motion capture system. The system has been improved by adding 3 new computers and redesigning the rack configuration to better allow for movement across campus.

Motion capture is often used for entertainment graphics for film and games as well as ergonomic studies and motion analysis for sports and medical applications.

Machine Rooms

The computing power to drive the display systems in Envision is housed in two machine rooms.

The west machine room contains image generators, including a 32 processor SGI Onyx 2 (taken out of service July 2005) and an 8 processor SGI Onyx 4, rack space for a planned graphics cluster computer and the video and audio switching and control systems.

The east machine room houses servers, including two quad processor Intel Itanium 2 systems and a multiple Terabyte disk array accessible by all the systems in the facility.

Staffing

As the center becomes more widely used and matures, the staff, by virtue of this unique experience, will have the opportunity to move on to more challenging roles. Even though we have just completed our first year, we have experienced some of this change. Dwight McKay, Envision Technical Architect has assumed a similar role within Discovery Resources (allowing him to continue to play a reduced role within the center), Seungmoon Choi has moved to the Pohang University of Science and Engineering, Scott Meador moved to the University of Arkansas, while Ben Mora has relocated back to France. While we will miss these very talented individuals, we have been able to strengthen the team with other necessary skills that will allow us to continue to excel. New to the group are: Carlos Morales, Craig Miller, and Ekhtuvshin Drjgotov.

We continue to expand the talent pool by providing grad students the opportunity to learn and work in the center. We currently have 3 grad students directly funded and 4 funded through current projects.

University Steering Committee

The Envision Center Steering Committee has continued to provide the guidance and high level direction assuring the growth of the Center. This group meets on a routine basis discussing new technology, scientific research in the non-technology areas, and functions as advocates for the Center.

- Jim Bottum, VP ITaP
- Ed Delp, Electrical and Computer Engineering
- David Ebert, Electrical and Computer Engineering
- Ananth Grama, Computer Science
- Christoph Hoffman, Computer Science
- Zygmunt Pizlo, Psychology
- Voicu Popescu, Computer Science
- J. Paul Robinson, Basic Medical Sciences
- Ahmed Sameh, Computer Science
- Glenn Sparks, Dept of Communications
- Hong Tan, Electrical and Computer Engineering
- William Cleveland, Department of Statistics
- Patricia Davies, Mechanical Engineering

Special Interest Group

The center has been instrumental in the creation of a campus wide Special Interest Group in the area of visualization and perceptualization. With over 90 members, from a variety of departments and schools, the diversity of this group offers yet another opportunity to expand the centers research focus and cross discipline collaborations.

***** Discovery *****

External Projects

The goals for the Center's project development efforts are three fold:

- 1.) Relationship building – development of long term relationships which will strengthen and grow over time
- 2.) Technology driven – using new tools and techniques that continue to expand the current knowledge level both within the Center and with our collaborators ;
- 3.) Provide the researcher with new tools that will enhance their research.

The combination and success of meeting these drivers will allow the center to achieve one of our core strategies - Discovery. At present the Center has over 31 active projects and has completed 14 projects since the center startup.

A complete list of projects, project abstract and research area is available for your review at the end of this report.

Internal Projects

To date, the scope of our internal project selection has been driven by the staff's current research interest and the potential for collaboration with other researchers. Below are a few of these projects.

Hardware

- SGI Onyx 4 specifications
- Opteron cluster specifications
- Data and Video Routing for Envision Facility

Software

- Virtual Campus – Purdue University
- Access Grid providing Stereo Capabilities
- Purdue network rendering

Service / Education Based

- Rear projected portable display
- Network-based VR course with other universities
- Development and delivery of technical short courses
-

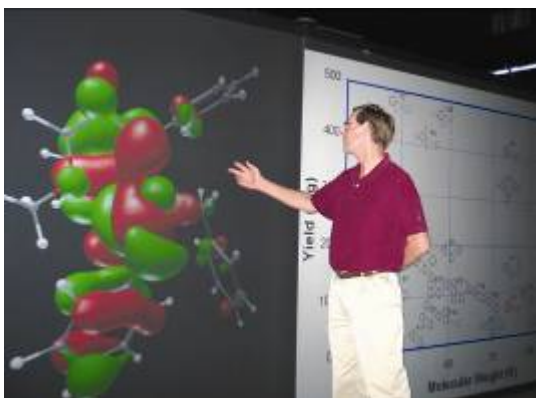


Image courtesy of Dr. James Caruthers

Catalysis Project Quantum Chemistry

Preliminary images of electron density and orbitals. Developing an understanding of orbital relationships and provide the ability to visualize these relationships.

DOE funded project with Dr. James Caruthers from Chemical Engineering

Computational Humanities

This project performance incorporate theater, text, music, performance art, virtual reality, and motion capture which are concurrently captured, mixed, digitized, encoded and streamed onto the network.

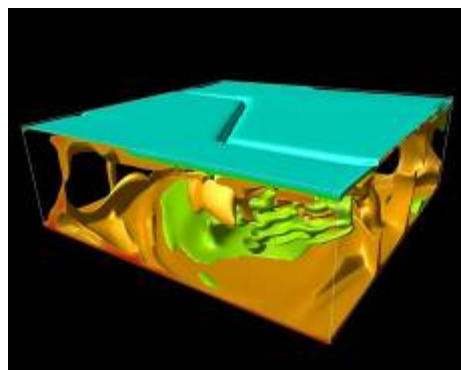


Image courtesy of Dr. Scott King

Plate Motion

Studying the interactions between mantle convection, fluid dynamics, and plate movements.

Dr. Scott King, Dept. of Earth and Atmospheric Sciences

Visualization of cancer cells grown in collagen.

Data obtained using laser scanning confocal microscopy. Dr. Robinson is a leading researcher in the area of the confocal microscopy and the study of cells.

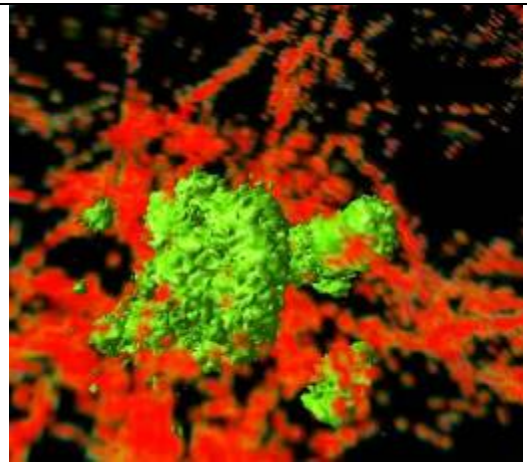


Image courtesy of Dr. Paul Robinson



Synthetic Environments for Analysis and Simulation

Dr. Alok Chaturvedi and Shailendra Mehta

Virtual reality model developed for a Homeland Security presentation and Regional Simulation. Model used to analyze the pathway for emergency personnel movement.

Virtual Campus Project

The goal of this project is to create a virtual model of the Purdue campus. Users can perform a walkthrough of the virtual campus, and the model is also being used as a test bed for other research projects.



*** Learning ***



International Visualization Consortiums

The following is a brief overview, the vision, and the highlights of last year's activities for the Consortium. Highlights include national meeting, discussions of current and new technology and the refocusing of the group to better define potential collaboration in grants, research and education.

Vision

The International Visualization Consortium will explore emerging computer graphics, auditory, and haptic technologies that combine advanced computation, networking, storage, and high-end immersive visualization environments to assist researchers and industry in their quest for new knowledge and products.

- Our aim is to enable the development and practical application of virtual reality through collaboration and a focused research agenda.
- Our focus is on the development, integration, and evaluation of consumer and high-end technologies and systems that extend and complement commercially available perceptual tools.
- Our motivation is the belief that tele-immersion provides the ideal framework for exploring new ideas, discovering new knowledge, and learning in new ways through collaborative VR environments, advanced scientific visualization, interfaces to high-performance computing systems, and related human performance issues.

Steering Committee

Mike Bailey	San Diego Supercomputer Center
Gary Bertoline	Purdue University
Glenn Bresnahan	Boston University
Carolina Cruz-Neira	Iowa State University
Eric Frost	San Diego State University
Kelley Gaither	University of Texas
Jason Leigh	University of Illinois, Chicago
Eric Wernet	Indiana University
John West	Army Engineer Research and Development Center
Nancy Smigiel	Purdue University, Admin Assistant
Steve Dunlop	Purdue University, Managing Director

Training

The Envision Center's staff has developed and delivered a group of short courses as an introduction to the various technologies used in the center. In many cases these courses

are used as a precursor to the traditional college level courses. Courses that have been offered during the prior year:

- Introduction to Virtual Reality
- Introduction to Distributed Rendering
- Introduction to Augmented Reality
- Introduction to the Envision Center
- Introduction to the Access Grid
- Introduction to the Use of the Flex
- Introduction to the Use of the Tiled Wall
- Introduction to the Use of the Motion Capture Software
- Introduction to Programming Virtual Environments
- Introduction to Researchers Use of the Access Grid
- Introduction to the Extended Tera Grid for Visualization

Other Training Opportunities

The Center also offered other training opportunities related to much larger campus events, these include Alumni back to School and Teaching, Learning and Technology conference. Between these two events the center interacted with over 100 individuals.

Higher Education Class Offering

In conjunction with Iowa State University Visualization Laboratory and the Envision Center staff a graduate level course was offered over the Access Grid during the spring semester of 2004. The course "Introduction to Virtual Environments" (519V) will cover basic concepts in virtual reality (VR) and virtual environments (VEs) including display devices, real time graphics, tracking technology, multi-modal interaction, as well as VR task analysis, interface design, development methods and application areas

Other graduate level courses that are currently offered or under development:

- Introduction to Augmented Reality
- Introduction to Virtual Reality
- Design Visualization
- Design of Human Subject Experiment for Immersive Environments
- Advanced Computer Graphics Programming
- Scientific and Information Visualization for Scientist

Master Program

The center's leadership is aggressively working to develop and deliver an integrated graduated level concentration program. The focus of the concentration will cover all phases of visualization and will fully utilize the technology of the center.

Envision Discoverers

The Envision Discoverers is an undergraduate student group formed to expand the understanding of the Center's technology. The process is project based. Students select a project, they are provided training and by the end of the semester they use the technology

in the center to display their work efforts. An example is in the Motion Capture area where the students received training in both the hardware and software and at semester's end participated in a live project. There were similar groups working in modeling and animations.

Senior Projects

The Center staff worked with 6 different classes (25 students) on their senior project. The topics covered the base from nuclear engineering, to visualizing an 1860 Opera House that is being restored.

*** Engagement ***

In-reach and Out-reach

The Center hosted a variety of events during the year. A few of the most noteworthy are:

The Envision Center participated in the **regional robotics competition**, while the actual competition was occurring; the center engaged the student with displays of their model's in stereo, a presentation using Oil drilling software with interaction from a researcher in England, and a model of the 2006 GMC truck.

Envision Center hosted the annual **Homeland Security** event and the potential impact of an adverse action directed towards the United States populations. This event allowed over 90 participants from government, retailing and manufacturing to experience a real life occurrence. The center provided the backdrop using current technology and visual display effects to create this environment.





This event allowed an even greater number of participants including Under Secretary of Homeland Security Dr. Charles McQueary to attend and experience this type of simulation. This year's event has been expanded to include additional space needs and much larger group of observers.

Papers, Posters, Presentations and Panels Generated Through the Center

Madhavan, K. P., Arns, L. L., Bertoline, G. R., Gooding, L. (In press). The design of a distributed rendering environment to support classroom instruction in animation and scientific visualization, *Journal of Computer Graphics and Applications*.

Arns, L., Bertoline, G. R., and Caruthers, J. (2005). *HCI Issues in Catalyst Design by Discovery Informatics Visualization*. 9th International Conference on Information Visualization. Las Vegas, NV. (paper accepted).

Hartman, N. W. and Bertoline, G. R. (2005). *Spatial Visualization Tests and Their Relationship to Contemporary CAD Tools: Advocating More than Just Mental Rotations Tests*. 2005 ASEE Conference, Portland, OR. (Paper accepted)

Madhavan, K. and Bertoline, G. R. (2005). *Challenges to incorporating high performance computational tools into 7 – 12 grade science and mathematics curricula*. Society for Information Technology (SITE) annual conference, Phoenix, AZ.

Bertoline, G. R. (2004). *Integration of the support of computational science within the larger mission of the University*. Super Computing 2004 (SC04) Annual Conference, CIO Workshop, Pittsburgh, PA.

Bertoline, G. R.* and Bottum, J. (2004). *Reshaping the IT mission in research: Building a faculty-driven campus computational grid*. EDUCAUSE 2004 Annual Conference, Denver, CO.

Bullock, M. S.*, Field, W. E., and Bertoline, G. R. (2004). *Research review related to the utilization of graphic-based material to communicate important agricultural safety messages to youth with limited literacy skills*. 2004 Summer Conference of the National Institute for Farm Safety Inc. Keystone, Colorado, June 20, 2004.

Popescu, V., Hoffmann, C., Kilic, S., Sozen, M., Meador, W.S. (2003). Producing High-Quality Visualizations of Large-Scale Scientific Simulations. *Proceedings of the IEEE Visualization 2003 Conference*, Seattle, Washington.

Meador, W.S., Chourasia, A. (2003). Using 3D Computer Animation Tools to Render Complex Simulations. *Proceedings of the American Society for Engineering Education Annual Conference and Exposition*, Nashville, Tennessee.

Meador, W.S., O'Neal, K., Kurt, E. (2003). Collaborating: Virtual Technology and Motion Capture with Theatrical Dance. Sketches and Applications. SIGGRAPH annual conference.

Meador, W.S., Madhavan, K. (2003). Leveraging Super Computing Resources for Digital Content Creation. Poster session presented at the annual Mid-Western conference. *EDUCAUSE*, Chicago, IL.

Arns, L., and Cruz-Neira, C. "Effects of Physical and Virtual Rotations and Display Device on Users of an Architectural Walkthrough." To appear in Proceedings of VRCAI, Singapore, 2004.

King, S.D., Arns, L., Moreland, J., Lowman, J.P., and Gable, C.W. "Stereo Visualization of Time-Dependent 3D Convection: Illustrating Scales of Motion for Students (and Colleagues)." Eos Transactions. American Geophysical Union, 84(46), Fall Meeting Suppl. Abstract ED31E-04, 2003.

Arangarasan, R., Arns, L., Bertoline, G. "A Portable Passive Stereoscopic System for Teaching Engineering Design Graphics." American Society for Engineering Education (ASEE) Engineering Design Graphics Division 58th Annual Midyear Meeting, November 2003, pp. 99-116.

Grants Involving the Center

Goasguen, S. (PI) and Bertoline, G. R. (Co-Pi). 2005. Teragrid Resource Partner. National Science Foundation. \$5,420,505. Proposal to fund Purdue's Teragrid initiative including infrastructure and application support.

Popescu, V. (PI), Bertoline, G. R., et al (Co-Pi's). 2004. Effective Distance Learning Through Sustained Interactivity and Video Realism. **National Science Foundation, Computer and Information Science and Engineering**. \$540,000. This project combines research in vision, image processing, robotics, and computer graphics to create a novel distance learning system that enables instructors and remote learners to feel a "sense of presence" in the classroom.

Delgass, N. (PI), Bertoline, G. R., et al (Co-Pi's). 2004. Improved Diesel Emission Reduction Catalysts by Discovery Informatics. **Indiana 21st Century Research & Technology Fund** \$1,744,014. A research project between Cummins Inc. and Purdue University will focus on the development of catalytic systems for reduction of diesel emissions.

Venkatasubramanian, V. (PI), Bertoline, G. R., et al (Co-PI's). 2004. Center of Excellence: Institute for Advanced Pharmaceutical Technology. **Indiana 21st Century Research & Technology Fund** \$1,948,866. Grant to develop a model-based informatics approach that will facilitate transfer of data, information and knowledge along the pharmaceuticals products pipeline to make it faster, more efficient and safe.

Caruthers, J., Delgass, N. and Bertoline, G. R. 2003. **Purdue University New Recruitment Initiatives Awards Program** grant from the Graduate School, to fund the recruitment of graduate students to support the Catalysis research project. \$12,500.

Laxer, C. and Bertoline, G. R. 2003. **ACM SIGGRAPH Education Committee**. Grant to conduct a curriculum development workshop titled: A Curriculum Development Workshop to Define a Computer Graphics Discipline. \$2500.

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Active Projects

Title: [Geographical Information System \(GIS\) visualization and Details Architectural Visualization](#)
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Gilbert Rochon, Associate VP Collaborative Research / Engagement; ITaP - Larry Biehl, Systems Manager, PTO, ITaP; Bernard A Engel, Agricultural and Biological Engineering; Larry Theller, Agricultural and Biological Engineering; Jie Shan, Civil Engineering
Summary: This is a multi-directional research initiative that involves several GIS researchers on Campus to develop hardware and software solutions to visualize very large data sets interactively in high resolution display systems.

Title: [Virtual Immersive Store for Consumer Science](#)
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Sandra Liu, Consumer Sciences and Retailing; Robert Melara, Psychological Sciences; K. J. Lee, Computer Graphics Technology
Summary: This research is a multi level initiative to address several issues in consumer and retail industry. In this research Tippecanoe shopping mall, Target Super store, and detailed products with in the store are recreated to simulate a virtual shopping mall and store. Hundreds of user subjects are tested in this virtual environment - their behaviors and patterns are analyzed and the results are used to improve the shopping experience and efficient design of the virtual mall

Title: [Homeland Security \(Measured Response\) \(Visualization and Interaction of Simulation in Large Virtual Environments\)](#)
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Alok Chaturvedi, School of Management; Shailendra Mehta, School of Management
Summary: This research is a multi-directional research initiative to develop advanced visualization solutions and simulations for PHSI (Purdue Homeland Security Institute). The current tasks are:
 1. Model the (Ft Muscatatuck) buildings, detailed information in one building (or one floor or part of the floor – depending upon the building size), surround these buildings with very detailed GIS data sets. Implement the combat simulation (sniper shooting and/or to show dirty bombing scenario) in this environment.
 2. Reuse ground zero simulations and models, and simulation of dirty bombing. Build a prototype platform that will allow rapidly moving these blocks of buildings, environments (i.e. small region) and dirty bombing simulation to different cities and/or countries. We will have a prototype system to showcase in one city (probably in Ft. Muscatatuck or Lafayette/West Lafayette region) but will not be able to showcase for different cities and/or countries this summer.
 3. Use of Tivo live video feed to the control monitoring system

Title: Visualization and Manipulation of Nano-Level Chemical Processing
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Stephen P. Beaudoin, Chemical Engineering
Summary: The goal of this project to visualize nano-level chemical processing and the interaction between different materials at nano-level.

Title: Catalysis – Discovery System
Envision Lead: Laura Arns, PhD and Steve Dunlop
Project Type: Faculty Research
Collaborator(s): Jim Caruthers and Nick Delgass of Chemical Engineering; ITaP groups; Discovery Park
Summary: The development of new materials for new applications is one of the outstanding technical challenges in science and engineering. This project combines pre-processing of large amounts of chemical data with high-resolution computer graphics to visualize resulting data to discover and design new materials.

Title: Art on the Grid
Envision Lead: Laura Arns, PhD and Steve Dunlop
Project Type: Faculty Research
Collaborator(s): Carol Cunningham - VPA
Summary: This project performance incorporate theater, text, music, performance art, virtual reality, and motion capture which are concurrently captured, mixed, digitized, encoded and streamed onto the network.

Title: Homeland Security Communications
Envision Lead: Laura Arns, PhD and Krishna Madhavan, PhD
Project Type: Faculty Research
Collaborator(s):
Summary: n/a

Title: PLM Showcase Workstations
Envision Lead: Gary Bertoline, PhD and Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): PLM Center of Excellence
Summary: Integrate 4 node PC clusters to run Flex Wall and configure different PLM software suites to run in this cluster and display configurations. This hardware and software facility will serve as a showcase facility for internal and external PLM related visitors and researchers, and a host site for PLM related events.

Title: PLM Pharmaceutical Manufacturing Simulation
Envision Lead: Gary Bertoline, PhD and Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): PLM Center of Excellence, Rex Reklaitis Chemical Engineering
Summary: This is a multi-directional research initiative to stream line the drug manufacturing processes in pharmaceutical industry using proven time efficient PLM methodologies.

Title: PLM Pharmaceutical- molecular crystalline structure visualization and the simulation of blending the particles
Envision Lead: Gary Bertoline, PhD and Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Prabir Basu E-enterprise Center; Kamal Kuriyan Chemical Engineering

Summary: The goal of this project is develop a method to visualize molecular crystalline structure and the simulation of blending particles.

Title: Intensity Radiation Therapy Simulation

Envision Lead: Gary Bertoline, PhD and Raj Arangarasan

Project Type: Faculty Research

Collaborator(s): Regenstrief Center and Seza Orcun, Discovery Park

Summary: The goal of this project is to develop a simulation application that integrates volume data set of real-world human organs and the mathematical model that simulates the IMRT process to predict measure and define better treatment approach.

Title: Patient Centered Design Concept

Envision Lead: Gary Bertoline, PhD and Raj Arangarasan

Project Type: Faculty Research

Collaborator(s): Regenstrief Center, Discovery Park

Summary: n/a

Title: Motion Capture Hardware Development

Envision Lead: Steve Dunlop

Project Type: Faculty Research

Collaborator(s): Carol Cunningham - VPA, Nicoletta Adamo-Villani – CGT

Summary: Development of mobile Motion Capture system, including expanded project development

Title: Validation of the Virtual Build Methodology - Ford Motor Company

Envision Lead: Steve Dunlop

Project Type: Faculty Research

Collaborator(s): Vincent Duffy

Summary: A virtual interactive design analysis will be performed on five workstations from Ford production facilities.

Title: K-12 Chemistry Training

Envision Lead: Carlos Morales

Project Type: Faculty Research

Collaborator(s): n/a

Summary: Grant to develop science-based teaching application

Title: Nano-Tech – Museum Animations

Envision Lead: Carlos Morales and Steve Dunlop

Project Type: Faculty Research

Collaborator(s): George Adams and Jon Bricker

Summary: Development animations (9) to view and understand life and functions at the nano scale level.

Title: Dynamic reconstruction of Dinosaurs physical function

Envision Lead: Carlos Morales and Steve Dunlop

Project Type: Faculty Research

Collaborator(s): Richard Hengst - North Central Campus

Summary: Development animation to view / interact with Dinosaurs physical functions, create application where input variable will allow for physical limit testing.

Title: PLM in Pharmaceutical Industry (21st Century)

Envision Lead: Gary Bertoline, PhD and Raj Arangarasan

Project Type: Faculty Research

Collaborator(s): Venkat Venkatasubramanian, et al, and Eli Lilly Inc.

Summary: n/a

Title: GIS Visualization of Scandinavia Ice Sheet
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): John Harbor
Summary: The goal of this project to visualize the glaciology and the dynamics of ice formation and deformation, using mathematical models from several hundreds of thousands of years ago to date, and future predictions. This is a multi-directional research initiative that involves several GIS researchers on Campus to develop hardware and software solutions to visualize very large data sets interactively in high resolution display systems.

Title: ORAD / DVG Systems
Envision Lead: Raj Arangarasan
Project Type: Industrial Project
Collaborator(s): ORAD Inc.
Summary: The goal of this project is to develop hardware and software solutions that uses cluster based computing and video compositor based rendering technology to achieve high performance computing visualization using COTS components.

Title: High Performance Classroom- Distributed Rendering Environment (DRE)
Envision Lead: Gary Bertoline, PhD and Laura Arns, PhD
Project Type: Faculty Research
Collaborator(s): Instructional Computing Services, faculty from technology, agriculture, and liberal arts
Summary: This project provides a set of distributed computers that function as a rendering "farm," where students, faculty, and staff can submit rendering jobs. Currently the system uses Pixar's Renderman software. Future goals including adding support for Open Source software and making the tools available via TeraGrid.

Title: AG Juggler in the Access Grid
Envision Lead: Laura Arns, PhD
Project Type: Faculty Research
Collaborator(s): n/a
Summary: The goal of this project is to create a set of Open Source tools that build on the existing VR Juggler software for creating virtual environments, enabling VR Juggler applications to be run in a distributed and collaborative manner via the Access Grid.

Title: Entomology Visualization Project
Envision Lead: Laura Arns, PhD
Project Type: Faculty Research
Collaborator(s): Jeff Holland
Summary: n/a

Title: Mars Life Support Simulations
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): NSCORT
Summary: n/a

Title: Virtual Spatial Visualization Assessment
Envision Lead: Gary Bertoline, PhD, Nate Hartman and Laura Arns, PhD

Project Type: Faculty Research
Collaborator(s):
Summary: When completed, this project will provide a working prototype of a virtual reality-based version of the Mental Cutting Test (MCT). The MCT is an instrument that examines spatial visualization skills relative to a cutting plane passing through an object, which corresponds to a key operational construct in many computer graphics software tools. Data will be gathered from a pilot comparison of the virtual version and the traditional version of this instrument. The format of the virtual reality-based version of the MCT can then be used to develop additional virtual computer graphics assessment instruments.

Title: [Distance Education](#)
Envision Lead: Gary Bertoline, PhD / Laura Arns, PhD / Carlos Morales
Project Type: Faculty Research
Collaborator(s): n/a
Summary: The goal of this project is to improve distance education through the use of immersive environment technology.

Title: [Purdue Portable Haptic Display Phase 2](#)
Envision Lead: Enktoushin Dorjgotou
Project Type: Internal Project
Collaborator(s): Hong Tan ECE
Summary: The project of Purdue Portable Haptic Display is aimed at developing a platform-independent haptic rendering system that can be easily integrated into large immersive visual displays in the Envision Center.

Open Projects

Title: [VR avatars for sign language education](#)
Envision Lead: Laura Arns, PhD and Steve Dunlop
Project Type: Faculty Research
Collaborator(s): Nicoletta Adamo-Villani
Summary: Using Motion Capture technology for sign language education

Title: [Location Based Learning using the Purdue campus model in the FLEX](#)
Envision Lead: Gary Bertoline, PhD and Laura Arns, PhD
Project Type: Faculty Research
Collaborator(s): Sorin Matei, Communications
Summary: This project is studying the effectiveness of situated learning through immersive interactive environments

Title: [EON Reality Software Suite for Virtual Reality Display Systems](#)
Envision Lead: Raj Arangarasan
Project Type: Industrial Project
Collaborator(s): EON Reality Inc.
Summary: Integrate EON Reality's non-programming immersive VR application suites in different high resolution display systems – such as in Flex Wall, Tiled Display Wall. Develop a model for industrial collaborative effort to develop software technologies and content development that will be shared between Envision Center and EON Reality Inc.

Title: [Virtual Visit/Campus Walkthrough](#)
Envision Lead: Laura Arns, PhD
Project Type: Faculty Research

Collaborator(s): CGT department faculty
Summary: The goal of this project is to create a virtual model of the Purdue campus. Users can perform a walkthrough of the virtual campus, and the model is also being used as a test bed for other research projects.

Idle Projects

Title: The Display of CATIA and Delmia Models in the VR Theatre
Envision Lead: Gary Bertoline, PhD and Raj Arangarasan
Project Type:
Collaborator(s): Isaac Chang and Sumantra Nandi
Summary: The goal of this project is to display CATIA and Delmia models in mono and stereo in the Envision Center's VR Theatre. Images and stereo walkthroughs using wireless tracking and haptic interactions will be displayed in both the Power Wall and CAVE configurations.

Title: Stereo IC Chip
Envision Lead: Laura Arns, PhD and Steve Dunlop
Project Type: Faculty Research
Collaborator(s): Mark Johnson
Summary: The goal of this project is the development of a stereo IC chip which will be used in education and the classroom

Title: Multivariate Data Visualization
Envision Lead: Gary Bertoline, PhD and Laura Arns, PhD
Project Type: Faculty Research
Collaborator(s): Bill Cleveland, Statistics
Summary: The goal of this project is to develop a software solution to visualize complex information in high resolution display systems using Cleveland's information sorting algorithms.

Completed Projects

Title: Modeling and Visualization of GIS/Glaciology
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Jacob Napieralski and Jonathan M. Harbor, Department of Earth and Atmospheric Sciences
Summary: The goal of this project to visualize the glaciology and the dynamics of ice formation and deformation, using mathematical models from several hundreds of thousands of years ago to date, and future predictions. This is a multi-directional research initiative that involves several GIS researchers on campus to develop hardware and software solutions to visualize very large data sets interactively in high resolution display systems.

Title: Visualization and modeling of molecular structures
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Clark Gedney, Biological Sciences
Summary: The goal of this project to develop software solutions that will allow modeling and visualization of molecular structures and dynamics of these structures interactively.

Title: Interactive Visualization of Large Particle Simulation
Envision Lead: Raj Arangarasan

Project Type: Faculty Research
Collaborator(s): Joseph F Pekny, Director E-Enterprise Center, Chemical Engineering; Jennifer Curtis, Chemical Engineering; Clark Gedney, Biological Sciences
Summary: The goal of this project is to develop compute efficient algorithms, and rendering methodologies to visualize very large particle simulations in a virtual environment interactively and dynamically.

Title: Visualization and Manipulation of Nano-Level Molecular Structures
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Amy M McGough, Biological Sciences
Summary: The goal of this project to integrate haptic interface to manipulate nano-level molecular structures and feel the forces generated within and among these nano-level structures.

Title: Access Grid course: Introduction to Virtual Reality
Envision Lead: Laura Arns, PhD
Project Type: Faculty Research
Collaborator(s): Iowa State University, Indiana University
Summary: This course is offered through the CGT Department, in collaboration with Iowa State University and Indiana University. Shared class lectures take place in the Access Grid, and each site hosts an independent lab.

Title: Public Speaking Apprehension
Envision Lead: Laura Arns, PhD
Project Type: Faculty Research
Collaborator(s): Melanie Morgan of the Communications Dept
Summary: This project aims to use VR technology to help alleviate anxiety associated with public speaking, by exposing Purdue speech students to a virtual classroom in which they can practice their speeches. This environment is less stressful than practicing in front of a “live” audience.

Title: Volume Visualization of Medical Data Set
Envision Lead: Raj Arangarasan
Project Type: Industrial Project
Collaborator(s): Unity Healthcare, Lafayette, IN
Summary: The goal of this project is to develop volume rendering algorithms and applications that runs in interactive mode in high resolution display systems – such as Flex Wall and Tiled Display Wall.

Title: E&S SimFusion Systems
Envision Lead: Gary Bertoline, PhD and Raj Arangarasan
Project Type: Industrial Project
Collaborator(s): Evans & Sutherland Inc., 600 Komas Drive, Salt Lake City, UT 84108
Summary: The goal of this project is to integrate E&S proprietary hardware and software solutions that use cluster based rendering technology to achieve high performance computing visualization.

Title: Commercial quality high resolution tiled wall display
Envision Lead: Gary Bertoline, PhD and Raj Arangarasan
Project Type: Industrial Project
Collaborator(s): Thomson Inc., Indianapolis, IN; Ed Delp, Electrical and Computer Engineering
Summary: This project is a collaborative effort between Envision Center, Thomson, and Ed Delp to combine the technical knowledge to build commercial quality high resolution tiled display wall and software suites to achieve this quality.

Title: Cluster based Stereoscopic 3x4 Tiled Display Wall
Envision Lead: Raj Arangarasan
Project Type: Internal Project
Collaborator(s): Internal Envision Project
Summary: development of 12 tile wall -- hardware project

Title: Purdue Portable Haptic Display Phase 1
Envision Lead: Seungmoon Choi, PhD
Project Type: Internal Project
Collaborator(s): Hong Tan ECE
Summary: The project of Purdue Portable Haptic Display is aimed at developing a platform-independent haptic rendering system that can be easily integrated into large immersive visual displays that the Envision Center has. The project was conceived to resolve significant incompatibility existing between both hardware and software of the haptic interfaces and the visual displays, thereby facilitating the use of the haptic interfaces with the large immersive visual displays in order for multi-modal data perceptualization.

Title: Homeland Security (Measured Response) 2005
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Alok Chaturvedi and Shailendra Mehta, School of Management
Summary:

Title: Homeland Security (Measured Response) 2004
Envision Lead: Raj Arangarasan
Project Type: Faculty Research
Collaborator(s): Alok Chaturvedi and Shailendra Mehta, School of Management
Summary: n/a

Title: Under the Sea – 411 class project
Envision Lead: Laura Arns PhD and Steve Dunlop
Project Type: Faculty Research
Collaborator(s): Terry Burton
Summary: This application demonstrates a virtual coral reef that users can explore. The primary purpose of the application is to demonstrate the current state of VR technology and real-time CG.