Introduction to Envision Center Tour and Demos

- The Envision Center is an interdisciplinary, high-performance visualization showcase facility to support research and teaching at Purdue University.
- Opened on April 12, 2004
- Funded by an NSF MRI grant of $900,000, PI Chris Hoffmann from CS
- Purdue contributed over $2M for remodeling and equipment
- IBM and Intel donated hardware
- Interdisciplinary center with a Faculty Steering Committee and SIG
- Director Gary Bertoline and a staff of eight funded by ITaP
- The Envision Center is a unique blend of computer science, art, perceptualization, and technology that is used to process, display, feel, and interact with information through the use of computer graphics and haptics.
- Explain perceptualization; visualization, haptics, audio.
- Students will be exposed to the latest technology in visualization computing through the use of the facility for instruction and their active involvement in research projects.
- Purdue faculty will use Envision to display and visually interact with scientific data to improve the discovery process.
- Scheduling tours should be done by contacting Nancy Dietrich (offer business cards)
- Research, teaching, or industry related projects are handled by contacting the Director Gary Bertoline or his secretary Nancy Smigiel (offer business cards)

Mission of the Center – 3 fold

Discovery --- two types

- The first is the collaboration with researchers on campus – think about the amount of information that is available today compared to 5 years ago --- today's researcher has realized that same increase ---- our tools will assist them in the ability to understand this data
- The second is the internal research that we need conduct so that we can support researchers next year with their new problems

Learning

- Short courses – center will be offering 15 – 20 short courses on how to use the center and the different types of applications needed to support these tools
- Grad and Under Grad course offering
- Purdue Classroom support

Engagement

- In reach – engagement within the university
- Out reach – public, schools, and industrial awareness

What is a pixel?
An abbreviation of the term 'picture element.' A pixel is the smallest picture element of a 2D digital image. A typical desktop computer monitor runs at a resolution of 1280 pixels by 1024 pixels, for about 1.3 million total pixels.

What is a voxel?
A voxel is the 3D equivalent of the pixel. A voxel is the smallest element of a 3D volume.

What is the difference between stereo graphics and 3D graphics?
3D is an abbreviation for 3-dimensional and refers to images that appear to have depth as well as height and width. Objects in 3D images appear more like real objects to the viewer.

Stereo means that two images used to create the illusion of depth in 3D scenes. The process mimics the way your eyes function when viewing real objects. Because your eyes are located a few inches apart from each other, each eye actually sees a slightly different view of the world (a good way to convince yourself of this is to hold a finger near your face, then look at it using only one eye at a time). In stereo graphics, one image is created and presented to your left eye and one to your right eye. These two images are fused into a single scene by your brain just as if you were looking a real object. The stereoscopic effect has been known and used to create 3D scenes since the 16th century. Our modern stereo images are viewed using specialized display systems and glasses.

What are the different glasses used to view stereo images?
Three types of eyewear are used in the Envision Center to enable the wearer to see stereo imagery. All of them serve the same purpose: to ensure that each eye sees only one of the two stereo images presented.

1 - Red/Green or Red/Blue glasses are used to view anaglyph stereo images. These images encode the left and right eye images using different colors. This technique is often used for printed material such as comic books and some stereo movies, videos and computer displays. The use of color to encode the left and right images limits the range of color that can be displayed in the image. Anaglyph stereo is used primarily for print materials such as posters, where polarization and active stereo cannot be used. The anaglyph glasses are lightweight and inexpensive (a few cents per pair).

2 - Polarized glasses are used to view passive stereo images. These images encode the left and right eye images using polarized light. Images are displayed using two projectors, one for the left eye image and one for the right eye image. A filter in front of each projector polarizes the light in a specific direction. Matching filters in the glasses ensure that each eye sees the image from only one of the projectors. A special projection screen is necessary to prevent the projected light from depolarizing. Both linear and circular polarization are possible. With linear polarization, a viewer must keep his head aligned with the filters. Tilting the head to the side causes the stereo effect to be lost. Circular polarization does not suffer from this drawback. Passive stereo is slightly more expensive than anaglyph (glasses

are typically a few dollars per pair), with circular filters and glasses being more expensive than linear.

3 - Shutter glasses are used to view active stereo images. Active stereo encodes the left and right eye images serially, displaying the left eye image, then the right eye image one after the other in rapid succession. The battery powered, liquid crystal shutters in the glasses block the light from the screen from reaching the left or right eye, in pattern opposite to the display pattern. As a result, the viewer's left eye only sees the left image and the right eye only sees the right image. Active stereo produces a clear, bright image, but requires expensive and fragile shutter glasses for viewing (glasses are typically $400-$800 per pair).

All types of stereo glasses can create "ghosting" – the effect where one eye sees the image intended for the other eye. This ghost image is usually quite dim, but can reduce the stereo effect. Generally, the more expensive the stereo viewing technique, the less likely the user will notice ghosting.

Other stereo display systems are available, such as head-mounted displays and auto-stereoscopic monitors. However, they are not currently in use at the Envision Center.

What is virtual reality (VR)?

Virtual reality is a set of technology used for viewing and interacting with computer data. Despite the common misconception, VR is not just stereo graphics. And VR encompasses a much wider range of activities than wearing a head-mounted display and glove. VR must be interactive, immersive, and user-centered. Interactive means that a user must be able to change the virtual world in some way, in real-time, and preferably directly (not through devices such as a keyboard and mouse). 3D movies are not interactive, thus they are not VR. Immersive means that the user should feel he is inside the virtual world, and is part of it. Usually, displays which cover a large part of the user's field of view are more immersive, because the user can only see the virtual world and not the physical world. Stereo images on a computer monitor are typically not considered VR because the user feels he is outside the virtual world, looking in through a window. User-centered means that the computer knows where the user is located and what he is doing. If the user walks around a virtual piece of furniture, the display should change to reflect this action. The hardware that facilitates this is known as a "tracker."

Tracking

Trackers are devices that allow a computer to know a user's location and orientation. Often, a user's head is tracked so that the computer can draw images with the correct perspective. Sometimes a user's hand is tracked so the computer can tell if the user is touching a virtual object. Our VR Theater uses an IS-900 tracker from Intersense. This device uses ultrasonic waves in combination with inertial sensing to track a user's head and hand. The portable rear-projected system uses a smaller version of this device. These tracking systems cost approximately $20k-$50k depending on size and features such as wireless devices. Other types of tracking devices such as electro-magnetic (EM) are often used, though the Envision Center currently does not have them.