Princeton University and Plasma Physics Laboratory Display Walls

Hadar Lazar

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Introduction

Eliot Feibush from the Princeton Plasma Physics Lab knows that images can be a powerful tool in understanding the behavior of systems. With this in mind, he works to manipulate numerical data of electron densities and magnetic fields in plasma in order to generate a visual of the plasma's motion. In the end, he manages to transform seemingly meaningless numbers into coherent visual forms. Of course, he values high-quality display technology to achieve this task, and he has been working on upgrading the PPPL Visualization Wall to make his images more accessible and detailed.

Feibush's efforts accord with a trend in modern science; research is experiencing an overflow of data. Gone are the days when a poster could display all the necessary information on a topic. Today, ultra-high-resolution display walls play a vital role in presenting output generated by complex computing systems. These systems can filter noise, tilt, and detect features, producing data that stationary images cannot always represent. For these reasons, the Princeton Plasma Physics Lab has invested in its data analysis and visualization capabilities by enhancing its display walls.

PPPL Visualization Wall

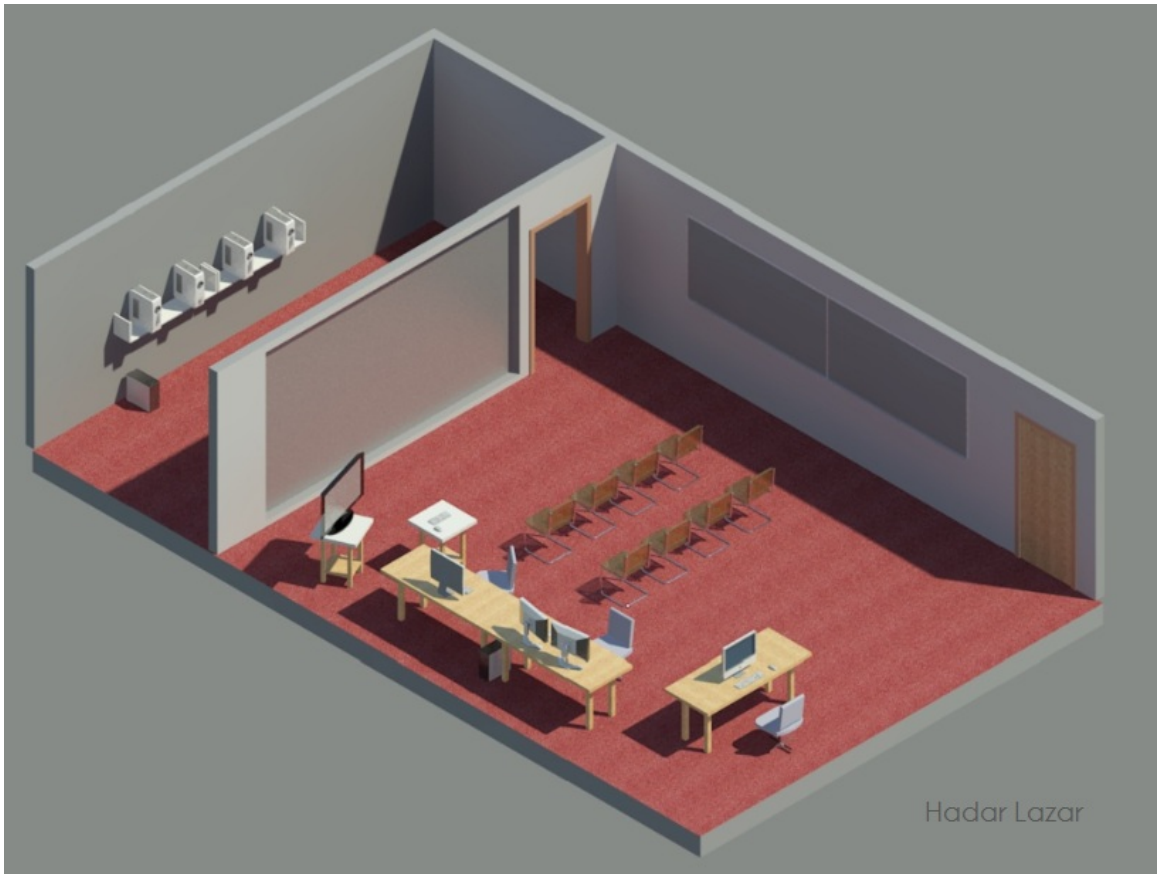
Eight million pixels stretch across a screen, providing details unavailable before 2009. Suitable for smaller audiences outside PPPL's auditorium, the Lab's Visualization Wall was designed for private presentations and, recently established by PPPL Media Services Head Carl Scimeca, audio-video conferences. The display room hosts presentations that require animations, simulations, images, and computer programs.

Multi-projector display walls require synchronization between several computers so that the animated imagery will appear seamless. However, without the proper physical design and quality materials, a successful display of data is difficult for the cluster of computers to achieve. Ever since 2000, the PPPL worked to enhance the display capabilities at the Princeton Computer Science Department by finding an effective and cost-efficient setup.

Previously, a collection of 12 projectors provided the detail of eight million pixels. Each projector was controlled by a computer, with a thirteenth computer to monitor the cluster of 12. Ultimately, the setup did not meet expectations: images were tilted, and projectors drifted out of alignment and varied in brightness and color. A spare projector was provided by Scimeca in 2009 to replace the multi-projector display, but its plastic screen also proved less promising. The warped plane produced images that were out of focus, and it absorbed more light than it transmitted.

Feibush, who was previously experienced with the display wall at Princeton University, suggested a translucent vinyl screen. Installed by Larry Jones and Ray Whitley, it transmits 75 percent of light and improves the brightness and contrast of the display. Because he replaced

the 12 projectors with four projectors and placed them behind the screen, people and objects in the room do not cast shadows on the images.



Moreover, Feibush improved the setup of the four projectors used in order to reduce seams (see diagram). Each Epson PowerLite Home Cinema contributed 1920x1080 pixels, and is very affordable. Now the display wall is driven by one PowerMac with two graphic boards, each with three video outputs. The outcome: a display wall with the same eight million pixels, one-third the original number projectors, and one sixth the cost!

NSTX Control Room Wall

Every time PPPL runs an experiment that produces a shot of plasma, the Lab is introduced to a massive amount of information to be recorded and interpreted. Cameras and diagnostic instruments connected to the National Spherical Torus Experiment (NSTX) record thousands of images and statistics every ten minutes. The resulting information includes a variety of graphs, replays of images, and animated movies of the magnetic field data. These many features can complement one another when viewed simultaneously. The PPPL looked to add another display wall to accommodate the high demand for data analysis on a large screen.

The efforts to improve the PPPL Visualization Wall have encouraged researchers at the Lab to also advance the National Spherical Torus Experiment (NSTX) display. The plastic films protecting the projectors' light bulbs, otherwise known as the polarizers, have been scorched as

a result of the frequent use of the NEC GT6000 projectors. Consequently, the colors projected appeared to be distorted and faded.

Feibush found a cost-effective solution for the display: instead of replacing the expensive projectors, he negotiated a replacement for the polarizers with the manufacturers. Now each projector offers a brilliant display of 1400x1050 pixels with increased brightness.

Princeton University Display Wall

"Turbulence is a very difficult thing to measure," Michael Chupa, a visualization analyst in the Princeton Institute for Computational Science and Engineering (PICSciE), explains. In the field of astrophysics, Chupa works to shape numbers and data into form and figure. The turbulence that he models involves entropy, which is sometimes defined as a measurement of disorder and can ironically be organized into a coherent visualization. Chupa assigns colors to represent different regions and behaviors, forming visual representations that are more comprehensible to the human eye. The resulting images and animations require the high quality displays, a necessity fulfilled by the new single-projector system.

Last December, the Lewis Library and PICSciE received its own 9-by-17 foot display wall, a collaborative project with PPPL. Feibush had recommended a single-projector like the Sony SRX-T110 Projector, and now the model facilitates presentations, with a brightness of 11,000 lumens and a 4096x2160 pixel display.

Researchers invest in advanced displaying technology because astrophysical and geospatial data requires visualization in order to process. Like Feibush's simulations of plasma movement, the display walls brilliantly capture both motion and perspective of astrophysical data.

Projectors
PPPL: http://www.projectorcentral.com/Epson-PowerLite_Home_Cinema_8700_UB.htm
NSTX: http://www.projectorcentral.com/NEC-GT6000.htm
University: http://www.projectorcentral.com/Sony-SRX-T110.htm