Application Story

Carleton University's Advanced Cognitive Engineering (ACE) Lab

Focusing on the content, not the display

Christie custom-built 9 million pixel single image assists with isolating different variables that affect visual fidelity

Fidelity in simulation often refers to the degree to which a device can replicate an actual environment – or how "real" the simulation appears and feels. Within that realm there are many determining factors: how the device looks, sounds and feels; visual and auditory stimulus; the actual equipment, hardware and software; the motion cues; the communication and situational awareness; the tasks and maneuvers executed by the user; how the device functions, works and provides actual stimuli within an actual environment.

Visual and audio fidelity can be described as the level of visual and aural detail that the simulator displays, and how close to the real world is the experience.

When the task at hand is to provide substantive evidence about the actual requirements for visual simulation, the visual display itself should not be one of the variables under consideration. If your research is answering the question, "What affect does resolution have on the quality of training?" – the display you're basing your studies on needs to be the benchmark.

Carleton University's Advanced Cognitive Engineering Laboratory (ACE Lab) is associated with the Visualization and Simulation (VSIM) department. The lab, which is part of Cognitive Sciences at Carleton University, focuses on human perception and a major thrust of the research is fidelity in simulation.

The mission of the VSIM ACE Lab is to discover fundamental principles of human perception and cognition and to apply these principles to the design, implementation

Customer:
Carleton University Advanced Cognitive Engineering (ACE) Lab

Location:
Ottawa, ON

Industry/Market:
Education/Research

Requirements:
- Large scale high resolution visual display
- 180-degree horizontal field of view
- Flexibility to allow various simulation cockpits to be tested within the display

Products:
- Eight Christie Mirage HD4 (1920 x 1080) 3-chip DLP® projectors
- Christie Twist™ and Christie MotoBlend™
- Custom design, structure

Summary:
With a focus on human perception, Carleton University's ACE Lab's activities are designed around identifying what specific requirements belong in the specificaton determination of a training simulator. In order to focus on the content rather than the display, Carleton's ACE Lab chose a custom-built structure designed, engineered and installed by Christie. The blended 2 x 4 configuration of Christie Matrix HD4 projectors provides 9 million pixels in a single image to assist with isolating different variables that affect visual fidelity.

Results:
- Seamless single image with 9 million pixels
- Affords a 47-degree vertical FOV and a 180-degree horizontal FOV
- High-end display solution that achieves optimal performance
- Allows researchers to focus on the content, image generators, software packages and terrain databases as research parameters
- Custom-built structure provides flexibility
- Allows multiple simulator cockpits to be utilized with the same display

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and evaluation of advanced human-machine systems – in this case, large scale training simulators for jet fighters, helicopters and motor vehicles.

With a focus on human perception, the ACE Lab's activities are designed around identifying what specific requirements belong in the specification determination of a training simulator. "Historically, there have been many assumptions about what's required for visual simulation," explains Murray Gamble, Senior Simulation Architect, ACE Lab. "That may include field of view, the content of scenes – and the costs of these training simulators are all based on the 'requirements'. But most of these requirements are driven heavily by anecdotal and subjective information."

Under the direction of Dr. Christopher Herdman, with Carleton's Psychology Department and Director of the facility, the ACE Lab's current projects under study all approach various angles of cognitive recognition within a training and simulation environment. The facility works under contract with the Department of National Defense. Funding for the creation of the VSIM building was granted through the Canadian Foundation for Innovation (CFI). The CFI is an independent corporation created by the Government of Canada to fund research infrastructure. The CFI's mandate is to strengthen the capacity of Canadian universities, colleges, research hospitals, and non-profit research institutions to carry out world-class research and technology development that benefits Canadians.

In order to focus on the content rather than the display, Carleton's ACE Lab chose a custom-built structure designed, engineered and installed by Christie. The seamless single image is a blended 2x4 configuration of eight Christie Matrix HD4 3-chip DLP® simulation projectors mounted on a custom structure designed to accommodate the evaluation of various test bed/platform simulators. These simulators include a generic rotary-wing test bed, a Cessna fixed wing simulator, a fighter jet simulator configured to represent a CF18 and Saturn driving simulator. They are being used to test for fidelity in simulation and how it affects sound, motion, psycho-motor skills, and visual perception.

The display also integrates both Christie Twist™ internal warping and blending and Christie MotoBlend™ technology for optical blending of the eight channels. Each projector offers full 1920 x 1080 HD resolution creating a single image of approximately 9 million pixels. If it were flat, the screen would measure 31'5" x 8'5".

Gamble explained that Carleton is interested in isolating different variables that affect visual fidelity including parameters such as: field of view; resolution; brightness and contrast ratio; update rate and scene content. The first three parameters are a function of the display system, while the last two tend to be tied to the image generation system and associated data sets.

> "Historically, there have been many assumptions about what's required for visual simulation... most of these requirements are not driven by data to back them up - they are merely anecdotal and subjective."
>
> *Murray Gamble, Senior Simulation Architect, ACE Lab*

"We've hit a reasonable high-end display solution so we can take it out of the loop and focus on the content – the terrain database," says Gamble. "It's not eye-limiting, but it's up there. If time and money were infinite – we could put in 16 projectors and we could achieve eye-limiting resolution," Gamble explains.

With the guesswork of the display out of the equation, Gamble and his colleagues can now focus on the issues at hand, key to their research and studies. For purposes of studying the quality of display hardware and quality of display content, they plan to research different image generators, software packages, terrain databases and purpose-built databases with specific terrain or content to evaluate.

Christie's seamless, blended screen with approximately 9 million pixels assists in the evaluation of various test bed/platform simulators for fidelity in simulation at Carleton University's ACE Lab

Each tier of projectors sits on its own curved pipe, directing the projectors towards the screen. Each support leg is fitted with a 5.5" diameter vibration damping and leveling foot increasing the structure's stability. The self-supporting curved screen is constructed from five molded fiber glass segments and is joint-filled and painted. Cylindrical cable trays connect the projector mount structure to the screen, and to the image generator behind the screen.

The display affords a 47-degree vertical field of view (FOV) and a 180-degree horizontal FOV. The eye level of the user is set relatively high to accommodate a tall F-18 cockpit – smaller cockpit cabins will be raised up on platforms to the optimum viewing angle.

The Christie display system will be used to support a variety of studies. The nature of the design of the screen and projector support structure was driven by a requirement to allow numerous simulated operator environments to be mated to the display system. Carleton's ACE Lab is currently engaged in a research project that requires the display system to be configured for use with a representation of a commercial helicopter cockpit. This study will be providing an immersive visual environment, but will be focusing on the usability of the in-cockpit display formats. Future studies related to pilots and aging will all utilize a Cessna cockpit being integrated. The driving simulator is used to support a variety of different study areas including driver distraction related to the use of cell phones for voice calls and text messaging, in-car navigation systems, heads-up displays and glass cockpits/dashboards in cars.

Concludes Gamble, "We feel that the Christie display system will allow us to isolate the latter parameters by achieving a level of performance in the former that can be considered (within reason) to be "optimal". Of course, we can degrade the display system parameters in an attempt to isolate those variables as well. "

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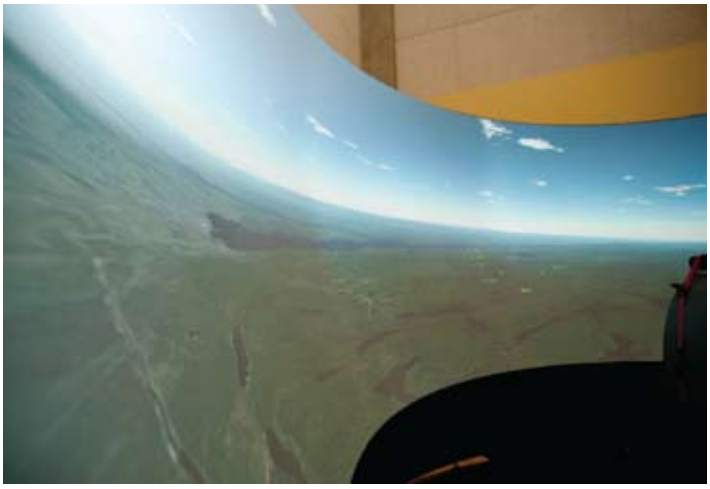

Below - Carleton University's ACE Lab
Top right - Christie Matrix HD4 with Christie MotoBlend™ blinders
Middle right - Self-supporting screen constructed from five molded fiberglass segments
Bottom right - Display structure offers flexibility to utilize multiple simulators

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