



Virtual Reality Infrastructure (VRI) Laboratory Annual Report (2018-2019)

Jian Zhao

Introduction

The VRI Laboratory at the University of Wisconsin-Milwaukee (UWM) was funded by GRAEF and the Associated General Contractors (AGC) of Greater Milwaukee in 2018. Currently the lab has one equipment: a hologram projection table from Euclideon. The hologram table and software allow undergraduate and graduate students to visualize civil/structural engineering designs before the product shows up in the field.

The hologram table contains four HD projectors, installed at the four edge of the table (four slits are created right above each projector mainly for ventilation purposes), as shown in Fig. 1. Four location tracking domes, installed on the corners of the table, guide the projectors to provide two beams of light on the glass table. The location tracking devices track the position of two pairs of control glasses. Additional 10 auxiliary glasses are available for additional users. The projection table is the world's first that allows multiple users to view a 3D model simultaneously. Users with the auxiliary glasses (a total of three to four) must be near the user with a pair of control glasses to be able to see the 3D image on the table.

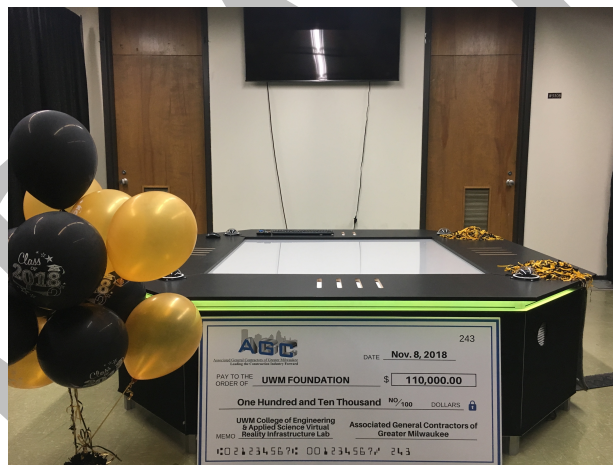


Fig. 1. Hologram projection table at VRI Lab

The hologram table was installed in September 2018, and later upgraded in November 2018 with four new HD projectors. The projection software was upgraded in January 2019. The conversion computer was obtained in October 2018 while the model conversion software has been upgraded many times. New model conversion software is being tested and will be available in spring 2019.

The hologram table is functioning as a digital sandbox for presenting 3D models of civil/structural engineering projects. The table runs well with either converted .uds files from scanned point clouds or .obj files from CAD programs. Conversion from point cloud files to the native .uds files is successful though we only have one set of point cloud data donated by the industry. Conversion from Autodesk models to .uds files is not successful though we have tried a variety of model files. Conversion from 3D finite element (FE) models to .uds files has not been successful because the FE software is limited: 3D models of objects are available while 3D models of deformed objects

after analyses are not available. Euclidean is working on updating their conversion software to meet our needs while the PI is also working on model generations.

Milestones

- July 18, 2017 Idea formulation, proposal development;
- August 2018 AGC and GRAEF provided funding;
- September 04, 2018 Installation of Hologram table;
- November 09, 2018 AGC visit to VRI lab, models donated by CG Schmidt Inc.;
- December 10, 2018 UWM class uses: CE571-23 students and CE573-5 students;
- December 18, 2018 VRI website online;
- January 25, 2019 VRI Lab Featured on UWM Front Page;
- March 12, 2019 VRI Lab Featured on 2019 UWM Research Magazine

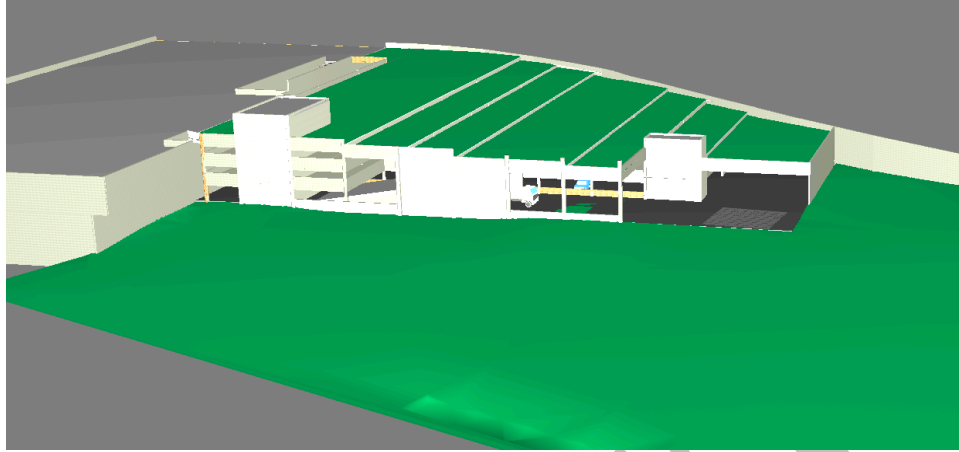
Educational Activities

The VRI lab has seen these activities since November 2018

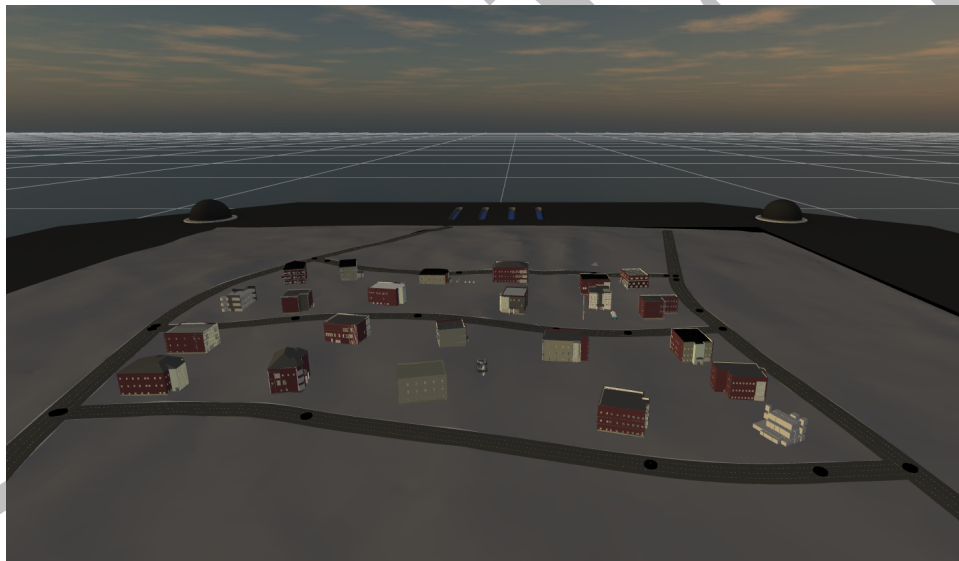
- 1) The VRI lab was open to 23 students from CE571-Design of Reinforced Concrete: a semester end presentation of a building structure that the students have worked on through their homework projects;
- 2) The VRI lab was open to 5 students from CE573 Design of Masonry structures: a semester end presentation of a building structure that the students have worked on through their homework projects;



- 3) The VRI lab was open to one senior design group presentation in fall 2018: the group worked on a parking structure for the Milwaukee public museum. The generated Revit model was converted to .obj files using Autodesk Infraworks, and the table, after software upgrade in January 2019, was able to show the 3D model with actual material tendering effects. The demo was later captured by the University Relationships for a promotional video;



4) The VRI lab was open to 27 students in CE 480: Software for Civil Engineering. Students' building models were placed on a subdivision, and students used the hologram table to explore their designs.



Outreach Activities

The VRI lab opened to these activities last year

- 1) five visits and lab tours for a variety of guests and University partners;
- 2) five visits (a total of 48 engineers) from the US army corps of engineers.
- 3) multiple internal demos and meetings with University Relations. A short clip is included in the opening video of the current UWM homepage. The VRI Lab is in the second video topic).

Research Activities

No project has been funded though the VRI lab has been included all proposals the PI has developed.

Future plans

We are requesting animation capabilities through Euclidean. With this capability, construction sequences may be shown on the table. The PI has a plan to generate building collapse simulations.

VRI lab does not have a laser scanner to create point cloud data. The PI working to get a laser scanner either through external grants and our internal tuition differential grants (less than \$20k). This scanner, with a resolution of 6 mm, will be used by students to scan environments for their design projects. The PI also worked with a group of interested faculty members on an NSF Major Research Instrumentation proposal to obtain one or two high-end scanners (\$160k each) with a resolution of 0.2 mm. We have tried the proposal in fall 2018 and failed going out of UWM.

In addition to focusing on generating content for the table, we plan to purchase VR goggles. This is to meet students' diverse needs on VR platforms. The models and simulation-based animations will be available for both the hologram table and the VR goggles.