

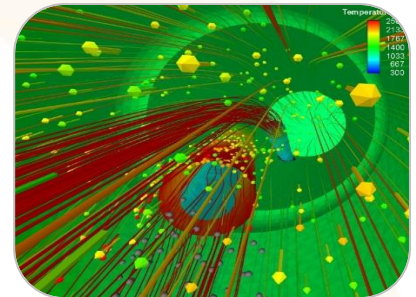
CIVS Gets Federal Grant for Steel Optimization Consortium

CIVS has received a **\$480,000** grant from the National Institute of Standards and Technology (NIST) to launch a national effort to ensure a leadership role for U.S. steel manufacturing in the global market by developing innovative technical solutions using advanced simulation and visualization technologies.

The specific objectives are 1) to establish a new and sustainable industry-led steel manufacturing Consortium that will focus on supporting the development and implementation of simulation and visualization technologies to address major technological issues and related barriers that inhibit the growth of advanced manufacturing in the steel industry; and 2) to develop a technology roadmap to identify and prioritize relevant research projects that will advance steel manufacturing competitiveness across the steel manufacturing value chain. Expected outcomes include capabilities developed for: 1) improved fuel consumption; 2) reduced emissions; 3) decreased downtime; 4) lowered production costs; 5) increased safety and 6) improved education/training for a critically needed workforce.

The two-year, advanced manufacturing technology planning grant is among 19 totaling \$9 million awarded by the National Institute of Standards and Technology to universities and other nonprofit organizations to further consortia development directed at strengthening U.S. manufacturing and innovation performance (<http://www.nist.gov/director/amtech-050814.cfm>).

Steel manufacturing plays a key role in the economic vitality of the United States, contributing over \$17.5 billion annually and supports more than one million jobs. CIVS is honored to lead the development of a national consortium to address critical issues in steel manufacturing. We appreciate our collaborators who have supported this proposed project and look forward to working with stakeholders throughout the steel manufacturing value chain on this very important mission. The project has received significant national attention, being highlighted by **more than 25 national news agencies** (see <http://webs.purduecal.edu/civs/2014/05/19/national-news-highlights-civs-nist-award-for-steel-consortium/>).



CIVS Students Take First Place at International Conference

A team of three CIVS students won first place in the Undergraduate Student Project Presentation held at this year's Association for Iron & Steel Technology conference (AISTech). Undergraduates Michael Garcia, Stephen Builta, and Hannah Amor presented on their project titled “Roughing Mill Vertical Edger and Strip Grade Analysis Using FEA” (see page 6). The University of Illinois at Urbana-Champaign received second place and The University of Toronto received third. This international competition is highly selective, with only one third of the total applications being selected to participate in the final contest, which included undergraduate students from many top universities all over the world. This is the third year in a row that CIVS has won first place.



Michael Garcia, Stephen Builta and Hannah Amor won 1st Place at AISTech 2014.

In addition to the undergraduate competition, CIVS also presented 3 technical papers, 2 graduate student posters, and hosted a booth which allowed conference attendees to get inside and experience simulations using immersive 3D technologies. CIVS booth highlights included a head mounted virtual reality display that transported visitors inside a plant for safety training and an augmented reality demonstration that let people hold a steel plant crane in the palm of their hand. AISTech is held annually by the Association for Iron & Steel Technology and had more than 6,900 attendees from 44 countries.



The CIVS booth at AISTech allowed conference attendees to tour a plant in virtual reality (top) and view high impact simulation projects in 3D (bottom).



CENTER FOR INNOVATION THROUGH
VISUALIZATION & SIMULATION

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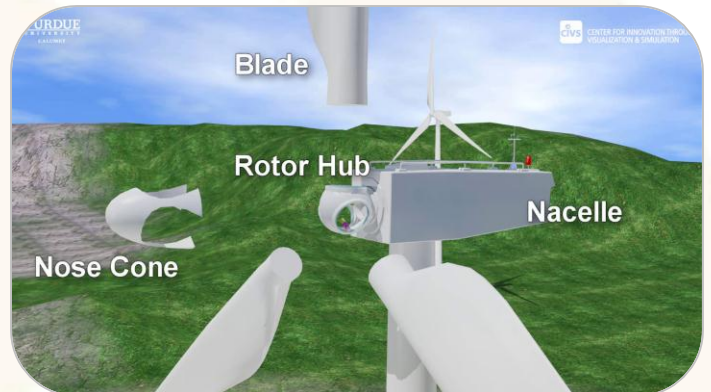


Selected Examples of Recent Funded Projects

Project Title	Sponsor
Advanced Simulation and Visualization for Steel Optimization Consortium	NIST
Analysis of Torpedo-Car for Improved Mixing Process	ArcelorMittal
Mobile Slab Reheating Furnace Optimization	SSAB
High Rate Injection of Natural Gas in Blast Furnace	U. S. Steel
Educational 3D Modules for Contamination from Underground Fuel Pipeline Failure (in collaboration with Dr. Chandramouli Viswanathan (PI), Associate Professor of Civil Engineering, and others)	Indiana Department of Natural Resources
Power Plant FGD Training Model	NIPSCO
Steel Industry Safety Training through Incident Visualization	AIST Foundation
“Canstruction” Planning with 3D Visualization	Lake Area United Way



An incident in the steel industry caused a heavy bin to drop on an employee’s foot. 3D animation was used to recreate the incident for safety training.



An Interactive 3D Virtual Wind Turbine developed for Wind Energy Education Virtual Training (funded by U.S. Dept. of Education FIPSE Grant P116B100322)

Virtual Blast Furnace Highlighted at International Academy

The CIVS Virtual Blast Furnace was featured at the 23rd Blast Furnace Ironmaking Course held at McMaster University in Ontario, Canada in May 2014. The bi-annual Blast Furnace Ironmaking Course is an in-depth, week-long course. It covers every aspect of blast furnace ironmaking, making it invaluable to managers, operators, engineers, researchers and suppliers of equipment, refractories and raw materials. The lecturers in the course are acknowledged experts in their fields and the delegates come from diversified industrial backgrounds from various countries. Approximately 100 industry professionals from five continents attended the course this year.

CIVS Director, Dr. Chenn Zhou, gave a lecture on “Blast Furnace Modeling and Visualization” and demonstrated a virtual blast furnace in a 3-D lecture hall. The presentation received tremendous positive feedback. A blast furnace, converting iron ores to liquid metal, involves significant capital and energy intensive processes. Due to the difficulties of taking measurements inside a blast furnace, simulation and visualization technologies are essential for the process design, troubleshooting, optimization, and training. CIVS in collaboration with our industrial partners has developed several Virtual Blast Furnace simulators by integrating computational fluid dynamics (CFD) simulation with virtual reality visualization.

A Virtual Blast Furnace simulator provides a virtual environment of a real process. It allows people to “walk” inside and provides a more intuitive and comprehensive understanding of the complex phenomena. It has been used for providing cost-effective and timely solutions. For example, CIVS has worked with the U.S. Steel Company to improve the performance of a blast furnace by examining ways to inject pulverized coal, resulting in over \$8.5 million annual savings and 50 percent less downtime. It has also provided a new effective approach for virtual training. This interactive virtual blast furnace simulator can be presented in multiple platforms, including desktop computers, mobile devices and on-line.



41 CIVS Students Present Research at Student Research Day

Forty-one CIVS students presented 25 projects at the Purdue Calumet 2014 Student Research Day including four award winners out of the 12 awards presented at the event:

- 1st place in Graduate Oral Presentations: Tenghao Wang for *Development of a Virtual Blast Furnace Training System*
- 2nd place in Graduate Oral Presentations: Jichao “Mike” Wang for *Flood Modeling 3D Lab for Civil Engineering Curriculum.*
- 3rd place in Graduate Oral: Tenghao Wang and Yunpeng Chang won presentations for *NIPSCO Schahfer FGD Training System.*
- 3rd place in Graduate Poster Presentations: Lucas Phillips for *Development of a Reference Tool for Calculated Material Values for Use in PBR.*

Student Research Day is an annual event in which many departments at Purdue University Calumet have students present their research in oral or poster form. Over 250 Purdue University Calumet students presented their research during this year’s event.



Student Research Day Winners pictures with their research advisors.

Final Results Presented from HAST Project Lead the Way Collaboration



HAST students Marc Suarez and Neftali Arteaga discuss results of their 3-D printing research project.

Four groups of seniors from the Hammond Academy of Science and Technology (HAST) made final presentations for their year-long Project Lead the Way projects at CIVS on Tuesday, April 29. The audience included representatives from HAST, Purdue Calumet, government organizations, and family members of the students.

The HAST students worked with and were given guidance by CIVS student researchers (Tyamo Okosun, Tenghao Wang, and Jerry Dekker) on their projects. These were “Virtual Downtown Hammond” by David Castillo and Ivy Westerhoff, “Simulation, Modeling, and Visualization of an Industrial Boiler” by Jeremy Amft, “Educational Wind Energy Game” by Matthew Brown, Brandon Swart and Jose Rodriguez, and “3-D Printing Techniques” by Marc Suarez and Neftali Arteaga.

The students came to CIVS twice per week for the school year to work on the projects. All students graduated and are now college bound, with several having been accepted to Purdue University Calumet.

CVIS Mission

- To foster innovation through advanced visualization and simulation using multidisciplinary approaches
- To conduct cutting edge applied research using state-of-the-art computer simulation, visualization technologies, and high performance computing to solve challenging problems and promote economic development
- To educate individuals and organizations in the use of modeling, simulation, and visualization

This research was partially supported by U.S. Department of Energy Grant DE-NA000741 under the administration of the National Nuclear Security Administration.

Franciscan Health Visualizes New Emergency Department

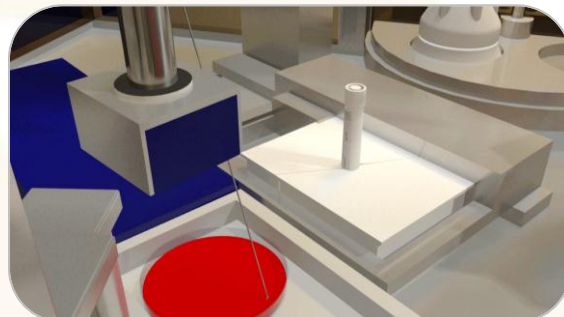
A virtual tour video and web-based interactive virtual environment were created for the new Emergency Department under construction at Franciscan St. Margaret Health, Dyer. 3D models of the space were made based on architectural drawings, equipment and wall layouts. The video and the virtual environment can be used for demonstration and walkthrough of the facility before and during construction as well as for promotion.



A still rendering showing some patient beds from the Emergency Department virtual tour.

IMAX 3D Showcases Microbiology Equipment in Boston

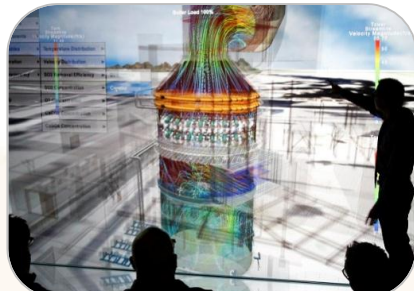
CVIS developed an **IMAX 3D movie** that provides a flythrough of the WASPLab™, an automated specimen processing system developed by COPAN Diagnostics that is used in microbiology labs. The movie was shown at the New England Aquarium's Simmons IMAX Theater to an audience of attendees from the American Society for Microbiology General Meeting.



A 3D flythrough took viewers inside of automated microbiology lab equipment.

Interactive Power Plant Module for Virtual Training Completed

CVIS developed a 3D training package of the Unit 14 flue gas desulphurization (FGD) at NIPSCO's Schahfer Generating Station. The objective of the project was to provide a more efficient training method for the FGD operators and demonstrate the operation of key systems during potential failure scenarios. The package combined simulation and 3D visualization, using computational fluid dynamics to determine flow characteristics, absorber reactions, and SO2 removal. The package was made for multiple systems including Personal Computer, Mobile Device, Online, and Immersive Virtual Reality. It is currently being used for introductory employee training and visitor tours. The initial feedback has been excellent. It is planned to be used for experienced operator training for startup and shutdown, failure scenario studies, and prediction of liquid level with variables.



NIPSCO received the completed training package in the CVIS immersive theater where they viewed the power plant in virtual reality (left and center). CVIS later showcased the PC version of the training package to additional personnel at NIPSCO headquarters (right).

Student Successes

We are very proud of Hannah Amor, who received her B.S. in mechanical engineering this spring. She was a Chancellor's Scholar and ArcelorMittal Scholar. During her internship with ArcelorMittal, she identified a research project and convinced her supervisor and other engineers to make it as a funded project to CVIS. She also formed a senior design team with fellow students Michael Garcia and Stephen Bulta to conduct the project, solving a problem with a recent vertical edger failure (see page 6). The project received 1st place at the 2014 AISTech conference (see page 1). Hannah was also very active in student organizations and student village. She accepted a position with Honeywell International, Inc. in South Bend, IN as Engineer I Product Design on the Aerospace Wheel and Brake and Aerospace Fuel and Actuation teams. We wish her success in her bright future.



National Science Foundation Flood Modeling Grant

CVIS is working with Professor Chandramouli Viswanathan (Civil Engineering), Dr. Emily Hixon (Education), and Dr. George Nnanna (Water Institute) to develop an NSF funded interactive 3D flood model simulator. Students at Purdue Calumet and three other universities (University of the District of Columbia, Florida Atlantic University, and University of Kentucky) are using the simulator to better understand and identify strategies to prevent flooding and protect lives and infrastructure. The simulator has already been used to recreate a 2008 flood that caused major damage to Northwest Indiana, and allowed students to evaluate the levee system put in place by the U.S. Army Corps of Engineers to help prevent such disasters in the future.



Interactive 3D software is being used by students at four universities to help teach flood modeling.

Signature Areas and Key Technologies

- Virtual Design
- Virtual Learning/ Training
- Simulation
- Visualization
- High Performance Computing

CVIS Research Fields

- Biomedical
- Construction
- City Planning
- Economic Development
- Education
- Engineering
- Energy
- Environment
- Healthcare
- Liberal Arts
- Advanced Manufacturing
- Marketing
- Safety
- Science
- Supply Chain
- Transportation

CVIS and US Steel present at AIST Midwest

Representatives from over 300 steel industry companies attended the April dinner meeting organized by AIST (Association for Iron & Steel Technology) Midwest Chapter for a presentation by CVIS and collaborator Jamie Lash of U.S. Steel. The presentation titled “Process Optimization and Cost Savings for U.S. Steel Provided by the Center for Innovation through Visualization and Simulation” focused on recent research projects on the virtual blast furnace for training, the QBOP vessel for minimizing kidney formation and life prediction in industrial equipment.

During his talk, Jamie Lash commented that “just by giving CVIS the parameters, they found what we found, without us telling them what was happening in vessel. They validated what was happening in the real-world and helped us to fully understand why the formation was happening.”

This collaborative research has provided economic benefits to the company from increasing yield, improved approaches to inspections, and improved training and education. The presentation given by Dr. Chenn Zhou provided an overview of how the Center is helping industry to address their challenges and how advanced simulation and visualization are essential to meet the needs for the future. The presentation has generated tremendous interest and has resulted in multiple projects.

“These models will undoubtedly form the basis for awesome training modules, removing some of the ‘mystery’ and ‘rules of thumb’ that have dominated the blast furnace practice for decades.”
 - Neil Macfayden,
 Strategic Industrial



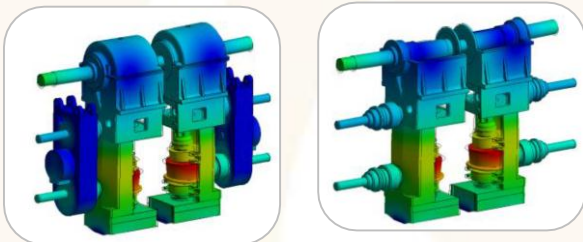
CVIS Research Engineer, Bin Wu, presents on the life prediction simulations used for an overhead crane used in the steel industry.

CIVS Facts and Impacts

CIVS's multidisciplinary research projects are having substantial economic and intellectual impacts on local and global communities as well as providing great research opportunities for Purdue Calumet faculty and students. Following are highlights since 2009.

- \$30++ million savings for companies
- 80 external organizations collaborated with CIVS
- 121 completed projects
- 2,950+ students used CIVS for experiential learning and virtual labs
- 277 graduate and undergraduate students employed and mentored
- 94 technical publications
- 33 awards of best student paper
- 11,500+ local, national and international visitors since October 2011
- 126 national and local news

Vertical Edger Project Utilizes Methodology for Life Prediction



FEA analysis showing deformation distributions of the vertical edger.

A vertical edger is responsible for molding steel slabs into much longer, thinner strips in preparation for going to a finishing mill. A recent failure in a vertical edger gear housing at a steel mill was the catalyst for a senior design project mentored by CIVS. To analyze the failure, the students created a 3D comprehensive FEA model specifically to simulate the vertical edger. The results of the structural analysis revealed several areas with higher degree of deformation and stress which likely led to the failure.

Visualization Developed for Teaching Retirement Planning

CIVS collaborated with Pat Obi from the Purdue Calumet Business College to create a video and interactive education module to teach retirement investment planning. The module will be used in a finance class and for investment workshops.



3D graphics and animations make investment planning more enjoyable and easy to understand.

CIVS Hosts Alliance for Regional Development Meeting

The Alliance for Regional Development consisting of members from Indiana, Illinois, and Wisconsin held its June meeting at CIVS. The Alliance is working to form tools and methods to make real impact to benefit the Tri-state region.



The Alliance for Regional Development held its quarterly meeting in CIVS.

"Working together with the team of CIVS researchers was a learning experience that went both ways and was truly a great experience for our company."
 - Michael J. Finissi, COO
 Northern Indiana Public Service Company (NIPSCO)

Office of Institutional Advancement

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