

## CIVS Graduate Receives PhD



Dong Fu, a graduate research assistant at CIVS successfully defended his PhD thesis "Numerical Simulation of Ironmaking Blast Furnace Shaft" at Purdue University West Lafayette on Feb. 27th, 2014.

Supervised by Prof. Chenn Zhou in CIVS, Dong Fu conducted his senior design project, Master thesis and Ph.D thesis in the area of computational fluid dynamics (CFD). The CFD software packages he developed are currently used by steel industry to design, optimize, and trouble shoot the blast furnace operation. "The research experience in CIVS has well prepared me for the real-world problem solving skills. The projects I worked on in CIVS significantly enhanced my technical knowledge on modeling, simulation and visualization. Those are the key factors that helped me for the successful thesis defense and eventually got an excellent job offer even before graduation." said Fu, "I am very grateful to all CIVS faculty, staff and students. I really appreciated all the helps from them. CIVS is my family in US because I felt home here."

Fu came to the United States in fall of 2007 to complete his senior year of engineering at Purdue University Calumet as an English Training in Engineering (ETIE) student. He received a Bachelor's Degree from Beijing Institute of Technology, China, in 2008 and went on to complete his Master's Degree of Science in Engineering in 2009 from Purdue University Calumet. In addition to Professor Zhou (chair), Fu's PhD committee included Professors Fleeter (co-chair), Shi, and Choi at Purdue West Lafayette. Upon his graduation, Fu has accepted a full time position in 3M Company as a Senior Predictive Engineer where he did his summer internship in 2013.



## Other Highlights

- [International Organizations Visit CIVS to Discuss Potential Collaborations](#)
- [CIVS and U.S. Steel Give Keynote for AIST Midwest Chapter Meeting](#)
- [CIVS Demonstrates Technologies for Educational Talent Search Students](#)
- [Innovation Key to Region's Future, Leaders Say](#)
- [CIVS Students Win Four Awards at Student Research Day](#)
- [CIVS Supports Efforts of the Alliance for Regional Development](#)
- [CIVS Director Presents at 3rd ArcelorMittal CFD and Thermomechanical Days](#)
- [CIVS Develops Game for Reality University Conference](#)

*"We are proud to support Purdue University Calumet's Center for Innovation through Visualization and Simulation (CIVS). Our region is fortunate to have such a cutting-edge research facility and virtual learning and training resource, which has served as a catalyst to solving real world problems through creative applications."*

*- Jim Stanley, Nipsco*

## 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
- 2,900+ students used CIVS for experiential learning and virtual labs
- 80 external organizations collaborated with CIVS
- 119 completed projects
- 94 technical publications
- 267 graduate and undergraduate students employed and mentored
- 65 Purdue Calumet faculty and staff involved
- 11,000+ local, national and international visitors since October 2011



April 2014

**CIVS**

CENTER FOR INNOVATION THROUGH  
VISUALIZATION & SIMULATION

*"Where Ideas Become Reality"*

**PURDUE**  
UNIVERSITY  
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**Giving to CIVS**

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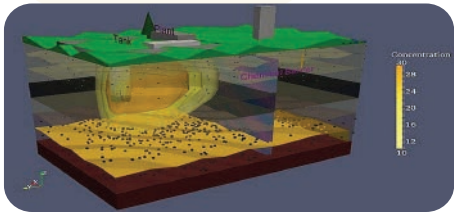

**Signature Areas and**
**Key Technologies**

- Virtual Design
- Virtual Learning/Training
- Simulation
- Visualization:
  - Immersive
  - 2D & 3D
  - Mobile
  - Online
- High Performance Computing

**CIVS Research Fields**

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

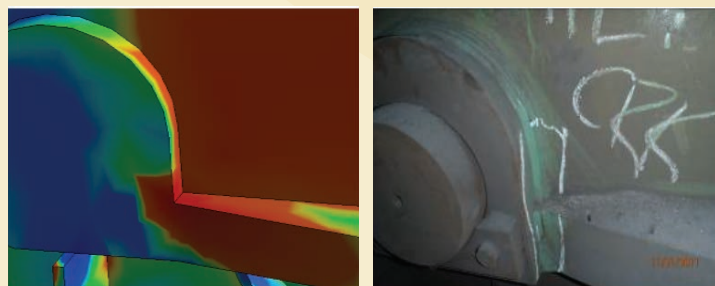
## Selected Funded Projects

Project Title	Sponsor
Wasplab™ 3D IMAX Experience	Copan Diagnostics
St. Margaret ER 3D Visualization	Franciscan Alliance
Equipment Longevity Extrapolation Based on Finite Element Analysis	U.S. Steel
Vertical Edger and Strip Grade Analysis	ArcelorMittal
CFD Evaluation of Wind Turbine Designs	Avstar
Comprehensive Wind Energy Program	Dept. of Energy
EZ-Pad Heater Tube Skin Thermocouple CFD Model	Daily Thermetrics
CFD Study of Fired Heather Ductwork Pressure Swing	BP
SCR Flow Analysis	NiSource
Planck Visualization Project Revisions for Distribution to Planetariums	University of California, Santa Barbara
NWI Regional Impact Video	NWI RDA
CFD Modeling for High Rate Pulverized Coal Injection to Blast Furnaces	AISI
Development of User Interface Software for Blast Furnace Shaft CFD Model	U.S. Steel
<div style="display: flex; justify-content: space-around;">   </div> <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <p><i>A virtual lab for Civil Engineering allows students to test strategies to deal with groundwater contamination.</i></p> <p><i>3D visualization and flythrough of existing and proposed airport extension for the City of Gary.</i></p> </div>	

## CIVS Develops Technique for Industrial Equipment Life Prediction

Many large-scale industrial processes require scheduled maintenance and repairs which are costly and can often be dangerous due to environmental hazards. Some of these processes utilize equipment that was designed manually in the past without the benefit of computational techniques such as Finite Element Analysis (FEA). This manual design method continues to impact the operation and maintenance of such equipment. Collaborating with one of the largest steelmakers in the US, CIVS developed a new methodology to improve scheduled maintenance.

This study introduced a six-step methodology to analyze stress and fatigue levels in manually designed equipment using a combination of FEA based structural simulations, fatigue life modeling based on standard operations, and three-dimensional visualizations. The simulation results are subsequently validated using actual structural inspection and operating data for the equipment. The final product can be used by operators and engineers to optimize existing equipment designs, reduce downtime and lost production, improve equipment inspection plans, and identify areas for new equipment designs. This research won 1st Place at the 2013 AISTech (Association for Iron and Steel Technology) Conference, Graduate Student Poster Competition. The latest findings will be presented at AISTech 2014 in Indianapolis.



*Comparison of fatigue simulation results between inspection cases colored by estimated remaining life (left). Photograph from the inspection reports (right).*



## How to Work with CIVS

CIVS performs applied research projects with university faculty, industry and other partners. The Center has a variety of resources available and is able to collaborate on projects in many opportunities and many ways.

### What does CIVS offer?

- Writing joint proposals as Principle investigator (PI), Co-PI, and participant to funding agencies
- Helping with proposal development including developing ideas, identifying collaborators, identifying funding sources, organizing and reviewing proposals, and providing supporting letters, etc.
- Providing resources (such as research assistants and facilities) to Purdue Calumet faculty to develop preliminary results for joint proposal development (one-page proposal is required)
- Conduct funded projects from sponsors
- Offer short-courses, workshops, summer camps, and summer internships



### What are CIVS's expertise?

- Develop interactive virtual learning/training modules and curriculum by combining simulation and visualization based on real phenomena;
- Create 3-D interactive video and software for education, planning, marketing, and presentation with multiple platforms including immersive virtual environment, mobile, or web in all disciplines.
- Conduct computational simulations and data visualization for CFD, FEA, GIS, traffic simulation, logistics, and others in various disciplines
- Provide solutions to real world problems on the issues of energy, environment, productivity, quality, safety, and training
- Develop the application of cutting-edge technologies such as virtual reality, augmented reality, 3D Printing, and motion tracking (Kinect, LeapMotion, and others).

### What are CIVS's Hardware and Software resources?

In addition to facilities and expertise, CIVS also has a variety of hardware and software resources available for applied research.

#### **Hardware:**

**Head Mounted Displays (HMD):** Google Glass, Oculus Rift, Vuzix VR920

**Cameras:** Canon EOS Rebel T2i, FujiFilm 3D Camera, Panasonic HC-V700, Sigma fisheye lens (360o photos)

**Input Devices:** ART TrackPack (Optical Tracking), iPad, Kinect, Leap Motion, OptiTrack (Optical Tracking), Wiimote

**Displays:** 3D Projection system (portable), 4K Planar High-resolution video wall, Flex CAVE VR System, LG 55" 3D-TV (portable), Vizio 80" 3D-TV, VisBox VR System

#### **Simulation & Software Development:**

**Simulations:** Computational Fluid Dynamics (CFD), Geographic Information Systems (GIS), Finite Element Analysis (FEA), Logistics Modeling

**Interactive:** 2-D & 3-D Software, Serious Game Development, Virtual Training

**Visualization:** 3-D Flythroughs, Data Visualization, Video Production

**Platforms:** PC, Mac, Linux, Android, iOS, Virtual Reality

#### **High Performance Computing:**

Access to 8.4 TeraFLOP PC Cluster



## Student Successes



Tom Roesel joined the research group that became CIVS as a freshman in 2007. During his four-year study, Tom was involved in numerous industry sponsored projects and worked directly with many engineering professionals from different companies in steelmaking, oil refining, manufacturing and power industries. Working on real projects and interacting with industry motivated Tom throughout his degree.

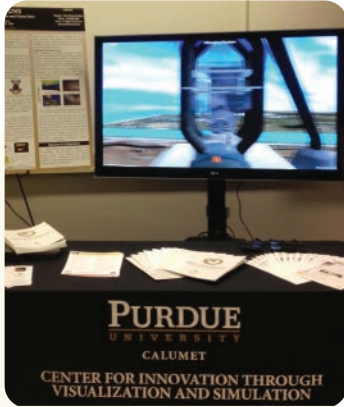
Tom's role grew from a simple drawing reader up to a lead researcher analyzing complex real-world engineering applications through the use of numerical simulation and 3D visualization. When he graduated in 2011, Tom had already worked on numerous industry projects and was well prepared to work as an engineering professional with minimum training required. He was promptly hired by a local engineering company as a design engineer, and later went on to work as a performance engineer at NIPSCO, the largest power company in the Northwest Indiana region.

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

## CIVS Showcases Capabilities at Purdue Expo

CIVS used 3D and interactive displays to present educational and industrial research capabilities at Purdue University's Education and Outreach Expo held on March 13 in West Lafayette. The Event was hosted by the Purdue Office of the Vice President for Research.

[Click here for more information.](#)



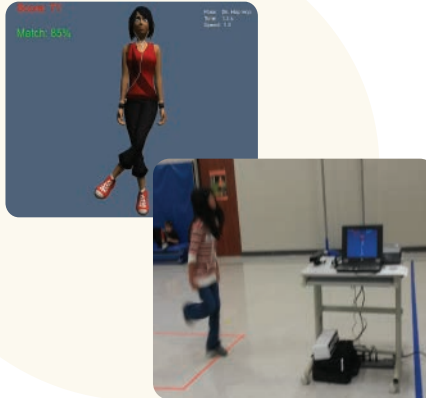
## CIVS Simulator Encourages Area Students to Pursue College

Reality University was a day-long conference targeted at local students in the 7th, 8th, and 9th grades. The event took place at Purdue Calumet on February 7 and featured presentations of various pathways to college degrees. CIVS designed and hosted a game which exposed students to the rewards of college education as related to career choice.

[Click here for more information.](#)



## CIVS Develops Virtual Dance Program for Kids



CIVS partnered with Dr. Meg Rincker and Dr. Sue Misner from Purdue Calumet, and Katie Hughes from the Hughes Academy of Irish Dance to develop a virtual dance simulator that was used for 400 grade schoolers to teach an Irish Jig! The week-long physical education instruction was part of a pilot study to evaluate the effectiveness of virtual, face-to-face, and hybrid instruction.

[Click here for more information.](#)

## CIVS Projects Showcased at Student Research Day

A total of **41 CIVS graduate and undergraduate students** presented 25 projects at the Purdue University Calumet Student Research Day. Students made both oral and poster presentations on projects including industry sponsored research, virtual education development, and other simulation and visualization research.



## Students Visit Steel Company to Develop Virtual Safety Training

Senior Design students being mentored by CIVS traveled to Crawfordsville, IN in February to visit a Nucor Sheet Mill Group plant. The students are creating animated visualizations to improve safety training in the steel industry.



## CIVS Hosts Homeland Security Meeting

CIVS hosted NWI District 1 Homeland Security Information Sharing Working Group (ISWG) monthly meeting on February 7, 2014. Attending the meeting were over 25 emergency response leaders from across the state. During discussion, CIVS and ISWG identified several projects for collaboration that will support and enhance ISWG's mission to provide essential emergency medical care and patient evacuation during times of natural or man-made disaster, or in time of a national security emergency.

[Click here for more information.](#)



*"CIVS has helped me prepare for the future that just classroom education could not. It provided me experiences with industry and practical engineering application. It took the equations off of the page and turned math into a reality."*

- Nicholas Walla  
Recent CIVS Graduate  
MS in Mechanical Engineering

### Office of Institutional Advancement

It begins with an opportunity to GIVE something back to a University you care about. It ends with the realization that you helped that University GROW into something even more worthwhile than before. Are you ready to be a leader and INSPIRE others? Make a gift today by visiting us at [www.purduecal.edu/civs](http://www.purduecal.edu/civs) and clicking the "Give to CIVS" button. Your INVESTMENT in CIVS at Purdue University Calumet is an investment for your future.

For more information please contact Renee Feldman, Coordinator of Annual Giving Programs, 219.989.2930 [annualgiving@purduecal.edu](mailto:annualgiving@purduecal.edu)

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