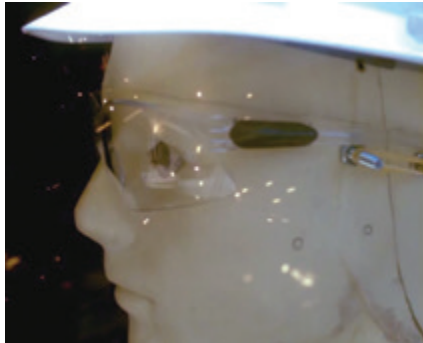


CASE STUDY

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Vision Research High-Speed Digital Cameras Instrumental in Teaching Construction Site Safety



Dr. Hallowell and his team demonstrate the importance of wearing safety equipment on a job site utilizing the Phantom® Miro® M110.

WHEN IT'S TOO FAST TO SEE, AND TOO IMPORTANT NOT TO®

There is a good reason construction workers are asked to wear hard hats, gloves, safety goggles, and various other safety equipment while on the job; construction sites are dangerous. Filled with heavy and sharp objects, platforms of varying heights, flying sparks and debris, and a number of other potentially dangerous elements, it's no wonder so many injuries occur on construction sites. Unfortunately, too many workers are either unaware of the risks, or exhibit a high risk tolerance, often coupled with an opposition to what they see as burdening or cumbersome safety equipment.

Determined to help educate construction workers on the perils of the job in a way that would elicit a healthy fear of key dangers and increase the likelihood of the information being retained, a team of student researchers who are part of the [Colorado Construction Safety Laboratory](#) has dedicated itself to changing the way the construction industry handles safety. The team, led by Beavers Endowed Professor of Construction Engineering, Dr. Mathew Hallowell, is a division of the Construction Engineering and Management Program at the University of Colorado at Boulder. The program's mission "is to conduct innovative and rigorous research that transforms hazard risk management in the construction industry and to integrate hazard identification, assessment, and response within all facets of civil engineering education."

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Construction Site Safety

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In the fall of 2013, Dr. Hallowell and his team knew they wanted their next project to encourage workers to take protective equipment more seriously, but they were also aware of a major looming challenge. Research indicates that the only consistently effective way a worker’s risk tolerance decreases is if he or she either experiences an injury or witnesses one firsthand. How would the team demonstrate to workers what it’s like to suffer a serious injury without actually injuring anyone? The answer was to develop and produce a series of realistic live demos that could be used to *show* construction workers just how dangerous certain aspects of their work can be, and demonstrate how effective safety equipment is at lessening and protecting against injury.

“The live demo itself sets our project apart from current construction safety education tools in the industry today,” said Hallowell. “We could have easily conducted research and compiled a report of our findings, but in order to make sure the message was received, we needed to be able to deliver the content in a way that could be *experienced* rather than taught.”

The team needed a way to record the demonstrations at high speed so they could slow the footage down in the upcoming safety video series. To accomplish this feat, the team selected a Vision Research Phantom Miro M110 camera which would allow them to slow the footage down to approximately 1/1000 of its original speed.

“This project is a collaboration among industry and academia that was developed as a mutual interest in trying to deliver a ‘real’ safety experience to workers in the field,” said Hallowell. “The Phantom camera allows us to do just that. We’re now able to capture every detail of an injury which is invaluable to us as researchers in addition to being an excellent resource to us as producers of safety content. Safety training, when delivered in the form of lecture or PowerPoint, is generally boring, but we’ve seen that workers find our demos to be far more engaging.”



Dr. Hallowell’s Live Safety Demos captures the injury that can happen to an unprotected hand as a result of a falling chisel.

According to information supplied to the team by energy corporation and project partner ConocoPhillips, just under 50% of construction related incidents involve the hand. Additionally, 20% of construction site incidents result from falling objects. With that in mind, for its first demo, the Colorado Construction Safety Laboratory chose to assess and analyze the damage done to a human hand when impacted by a concrete chisel dropped from an elevated position.

With the concept solidified and the means of recording in place, the team next had to tackle the challenge of securing its materials. They quickly found that there are currently no products available which replicate human body parts accurately enough for the purposes of this project, forcing the members of the team to create the models themselves.

“This was my first experience with a high speed camera, but I was really impressed with what we were able to capture once we familiarized ourselves with the technology. The Vision Research customer service was a great resource for us as we were learning the software and even provided us with some demonstrations that helped us out a lot.”

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Phantom® Miro® M110

“One of the most important aspects of this project is to replicate injuries as accurately as possible. Keeping in mind that these are meant to be hands on demonstrations, we focused on creating an incredibly realistic model of a human hand; a process that turned out to be surprisingly difficult,” said Hallowell.

Through trial and error and several adjustments along the way, they developed a process which eventually yielded what Hallowell refers to as “hyper-realistic” models.

The hand, as well as the other body parts used in future tests, were created using a silicon-based gel mold. When making the replicas, the researchers poured their gel in two parts, first filling the molds only halfway. At this point they inserted tubing and sacs referred to as “blood bladders” before pouring the second layer over top. The “blood bladders” were later injected with an artificial blood mixture so as to simulate major arteries. In future tests, the team inserted acrylic rods, along with the “blood bladders” to represent bones.

Almost ready to record their first demonstration, the team took the time to acquaint themselves with the Phantom camera. Even with its small light weight design, the Phantom Miro M110 can still record at up to 1,200 frames per second, making it well suited for the team’s first jump into the world of high-speed digital recording.

“This was my first experience with a high speed camera, but I was really impressed with what we were able to capture once we familiarized ourselves with the technology. The Vision Research customer service was a great resource for us as we were learning the software and even provided us with some demonstrations that helped us out a lot. Once we mastered the lighting, shooting with the Phantom gave us the ability to observe and show details of injuries that have never been captured before,” added Hallowell.

For the actual drop, the team chose a chisel because of its relatively high mass and very small surface area which would result in a high concentration of force. In order to ensure that the chisel would land with the pointed end down, the team built a 10 foot drop column suspended directly above their hand model.

In the video, the moment of contact is slowed down to approximately 1/1000 of its real time speed, slow enough to clearly see the chisel pierce through the hand and strike the radial artery. The “blood” can be seen spraying from both the top and bottom of the hand, indicating total penetration. For its safety equipment test portion, the team outfitted the hand with a safety glove and proceeded to drop this chisel again from the same height. Since the gloves increase the contact area of the chisel, it did not have the pressure necessary to pierce the hand, drastically lessening the severity of the injury.

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About Vision Research:

Vision Research designs and manufactures high-speed digital imaging systems used in applications including defense, automotive, engineering, science, medical research, industrial manufacturing and packaging, sports and entertainment, and digital cinematography for television and movie production.

The Wayne, N.J.-based company prides itself on the sensitivity, high-resolution and image quality produced by its systems, robust software interfaces, and reliability and versatility of its camera family – all which continue to stand as benchmarks for the high speed digital imaging industry.

Vision Research digital high-speed cameras add a new dimension to the sense of sight, allowing the user to see details of an event *when it's too fast to see, and too important not to™*. For additional information regarding Vision Research, please visit www.visionresearch.com.

Vision Research is a business unit of the Materials Analysis Division of AMETEK Inc., a leading global manufacturer of electronic instruments and electromechanical devices.



100 Dey Road
Wayne, NJ 07470 USA
+1.973.696.4500
phantom@visionresearch.com

www.visionresearch.com



The Miro M110 helps Dr. Hollowell and his team show the benefits of wearing safety gloves on a construction site.

“We are screening these demos with 1,200 workers this fall and so far we’ve been thrilled with the response,” said Hollowell. “Workers display emotional and physical reactions when viewing the footage and experiencing the demos – reactions that I find most rewarding because it lets

me know that our work is having the desired effect. Although the footage may be difficult to watch, there is no doubt that it speaks to the importance of safety equipment and is far more impactful on the viewer than any mere explanation or combination of slides in a deck could ever be.”

Hollowell and the team have since recorded videos demonstrating additional falling objects as well as the dangers of soil collapses, pinch points, and eye injuries. With the Live Safety Demos project still in its first year, Hollowell is working to collect feedback from the field tests with the hopes of developing and releasing new demos, including one focused on box cutter injuries, in the coming months. To keep up to tabs with Dr. Hollowell and the progress of the Colorado Construction Safety Laboratory, visit their website at www.safetylaboratory.org. For those interested in viewing any of the team’s safety demonstrations, including the slow motion Phantom camera footage, they can be found at www.youtube.com/user/professorhallowell, and this specific video can be found at www.youtube.com/sharp_dropped_object.

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