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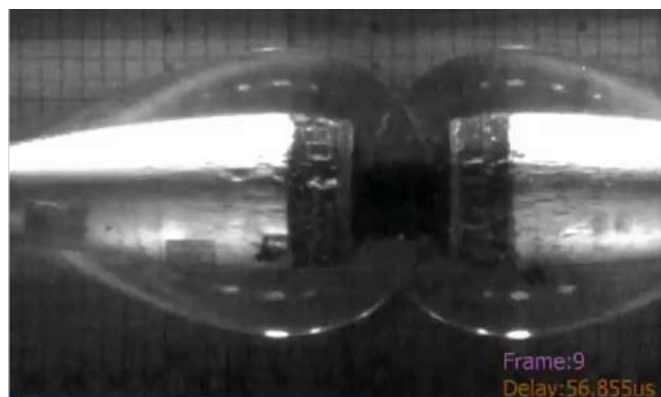
AXPRO NEWSLETTER

ISSUE 2: APRIL 2016

Dr. Petr and his Advanced Explosive Processing Research Group, AXPRO, have hit the ground running in 2016. The first of our biannual Practical Explosives Training School (PETS) short course was successfully completed in February with attendees from all over the state and from a multitude of career fields. Such a dynamic class illustrates the expanding need for explosives training outside of the traditional labor fields, which AXPRO intends to accommodate.

Over Colorado School of Mines' spring break, Dr. Vilem Petr and AXPRO team instructed the *Missouri University of Science and Technology's (MS&T) EXGN 6001 "Special Use of Explosives" long-distance learning* course. The 17 graduate students of the course learned emerging science around special uses of explosives and were given the opportunity conduct their own research through practical application in the field at the Explosive Research Laboratory in Idaho Springs, Colorado.

From *May 24-27, 2016*, AXPRO will host the *Ultra High-Speed Framing Imaging for Research and Experimentation* featuring Frank Kosel, President and CEO of Specialized Imaging Limited, manager, Chris Tenney, who will be instructing the course alongside Dr. Petr., Dr. Michael Murphy, from Los Alamos National Laboratory, will also be joining us. Dr. Murphy actively develops and implements advanced optical diagnostics to study the performance of explosive components using ultra-high-speed framing cameras, digital streak cameras, and photonics.



This course is unique in its hands-on education of ultra-high-speed framing imaging with a focus on experimentation techniques of explosives and ballistics. For more details and registration please visit : <http://www.csmSPACE.com/events/ultrahispeedimg/>

From *September 24-27, 2016* the *High-Speed Imaging Methods for Research and Experimentation* course will be taught in the fall. The course is sponsored by the world leader in digital high-speed imaging, Vision Research. Notable for its world class practical applications content, the course will cover a wide range of material, including but not limited to detonation and shock wave physics; an introduction to high-speed imaging, lighting and lens selection; triggering strategies; and analysis of high-high-



speed imagery. The course has been well-received in the past, and we're excited to continue our work with Vision Research's Learning Products Manager, Frank Mazella, who will instruct the course with Dr. Petr. For more information and registration top this class please visit: <http://csmspace.com/events/hispeeding/>

From *May 17th -19th and October 18th - 20, 2016* we will be teaching the new [Law Enforcement Explosives 101](#) course, the contents of which will cover IED familiarization and best practices for safety and security. This course is designed to give law enforcement personnel a familiarization with explosive materials and components that are commonly found in their AOR.



For more information and registration questions about this class, please visit: www.lawenforcementexplosives.com.

Note that this course does not teach students how to make an explosive device.

NOTE: Student Requirements

Students **must be U.S. citizens and full-time employees of a law enforcement or public safety agency.** Students must bring required personal protective equipment (PPE), including: steel-toed boots, ear protection, reflective vests, and safety glasses.

Spring 2016 Semester Student Research Projects - MNGN 444

PROJECT 1: CHARACTERIZATION AND VALIDATION OF A BLAST-SHIELD

The goal of this project is to conduct studies of blast overpressure inside and around the AXPRO blast shield. The blast shield was specifically designed and tested for protecting personnel against potential air blast and fragmentation during explosive operations.



David Harper stands next to a carefully positioned case charge.



Jessica Weyand smiles at the camera as she helps to prepare the area for a blast.



Susan Frazier, David, and Jessica all work together as a team at the ERL.



Christian Peterson focuses on getting the best high-speed camera settings possible.

PROJECT 2: ANALYSIS OF CASE CHARGE BLASTING PARAMETERS FOR AVALANCHE CONTROL

A case charge contains two components: ANFO and a booster. CDOT personnel place the charge at the bottom of an avalanche zone, and then initiate it to artificially trigger an avalanche with the use of air-blast overpressure. In general, this method demonstrated positive results during the last season but some of the technical challenges still remain unsolved. Students working on this project will need to profile the slope at the ERL (slope angle and slope distance), and based off of this, determine the effects of various angles and distances on the case charge blast.



Blaster's Station at the ERL in Idaho Springs, Colorado



Eduardo Lozano surveys the experimental setup.



A pressure gage is placed inside AXPRO's blast chamber.



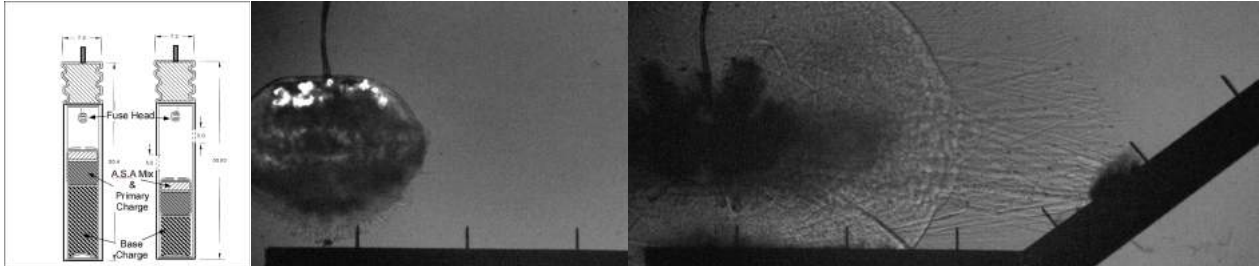
A view of the Project 2 setup.



John Godfrey ensures the high-speed camera is properly aligned.

MNGN 598B Project: Determining the Strength of Electric Detonators No.6 and No.8

This project collected and summarized the different direct or indirect methods of detonator characterization to be used by the industry. Students used high-speed imaging technology to validate the detonator performance and collected all the technical parameters to be able to analyze and summarize the test results. Students will provide a final presentation with recommendations for simple inexpensive techniques methods to determine the strength of different detonators No. 6 and No.8.



STUDENTS ACTIVITIES

Students from MNGN 444 and the Rocky Mountain Pyrotechnics Guild organized by Mark Williams from Night Music Fireworks will be working together to offer lectures on Fireworks and invited MNGN 444 class on Saturday April 2, 2016, between 3:00-4:00 PM to tour the CSM E-Day firework display prior the night E-day show.

Current research includes continued improvements to our new post blast fumes laboratory and a technical report titled, "CDOT Case Charge for Avalanche Control." AXPRO's graduate researcher and teaching assistant, Eduardo Lozano, will be presenting his paper, "*Shadowgraph Optical Technique for Measuring the Shock Hugoniot from Liquid-Desensitized Function Detonators,*" at SEM 13th International Congress & Exposition on Experimental and Applied Mechanics in Orlando, Florida, June of this year.

Recently completed paper, "*Characterization of ANFO using Aquarium Test and Numerical Modeling Methods,*" to be presented at the 42nd International Pyrotechnics Society Seminar in July of this year. AXPRO's undergraduate researcher, Erika Nieczkoski, is actively working on her research with detonator characterization.

Technical Reports Submitted and approved
CDOT Case Charge for Avalanche Control (February 2016)

Conference Papers

SEM 13th International Congress & Exposition on Experimental and Applied Mechanics (Orlando, Florida - June 2016)

V.Petr, E.Nieczkoski, E.Lozano, "Shadowgraph Optical Technique for Measuring the Shock Hugoniot from Liquid-Desensitized Function Detonators"

42nd International Pyrotechnics Society Seminar (Grand Junction, Colorado - July 2016)

E. Lozano, V.Petr, "Characterization of ANFO using Aquarium Test and Numerical Modeling Methods"

Publication

V.Petr, E.Lozano, E.Nieczkoski, "Shadowgraph Optical Technique for Measuring the Blast Wave Energy Generated by a Standard Detonator" Shock Waves Journal.