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Title:	Overview of LANL's Applied Acoustics Lab
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Intended for:	Acoustics Seminar Series - a summer event to foster future collaborations with Universities
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Los Alamos
NATIONAL LABORATORY

Overview of LANL's Applied Acoustics Lab

Cristian Pantea
Applied Acoustics Lab
Materials Physics and Applications, MPA-11

Acoustics Seminar Series
~online~

LA-UR-21-XXXXX

Applied Acoustics Team

http://www.lanl.gov/orgs/mpa/mpa11/AcousticsAndSensorsTeam

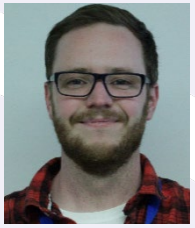
Cristian Pantea

Team Leader

Vamshi Chillara

Research Scientist
Electric Imp Spectr
Chevron)
Well Integrity Monitoring
CO_2 sequestration (DOE)
µarchitected Waveguides (LDRD-ECR)

John Greenhall

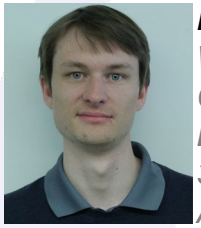


Research Scientist
Machine Learning
3DHEAT
Defects Thermoel Wafers
NDE weapons components
Electronics design

Craig Chavez

Research Technologist
Mechanical and Electronics Design, and System Configuration

Eric Davis



Postdoc
Well Integrity Monitoring
CO_2 sequestration (DOE)
D_2O content in heavy water
3DHEAT
Acoustic Monitoring of Pu
NDE of weapons components

Hung Doan

Postdoc
Corn stover acoustics sensor
Well Integrity Monitoring

Dipen Sinha

Visiting Scientist
Defects Thermoel Wafers
Welding inspection
NDE of weapons components
Electronics design

Christopher Hakoda

Postdoc
µarchitected Waveguides
Well Integrity Monitoring

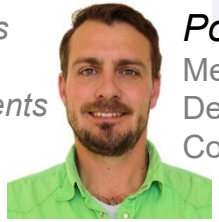
Milo Prisbrey

Postdoc
Machine Learning
Acoustic manipulation
Waveform inversion
**Joint w/ CCS-7*

Alan Graham

Research Associate
Defects detection in wafers
Welding inspection
NDE of weapons components

Pavel Vakhlamov



Post-Master
Mechanical and Electronics Design, and System Configuration

Sincheng Huang

Grad Student
Instrumentation development
LabView programming
D_2O content in heavy water

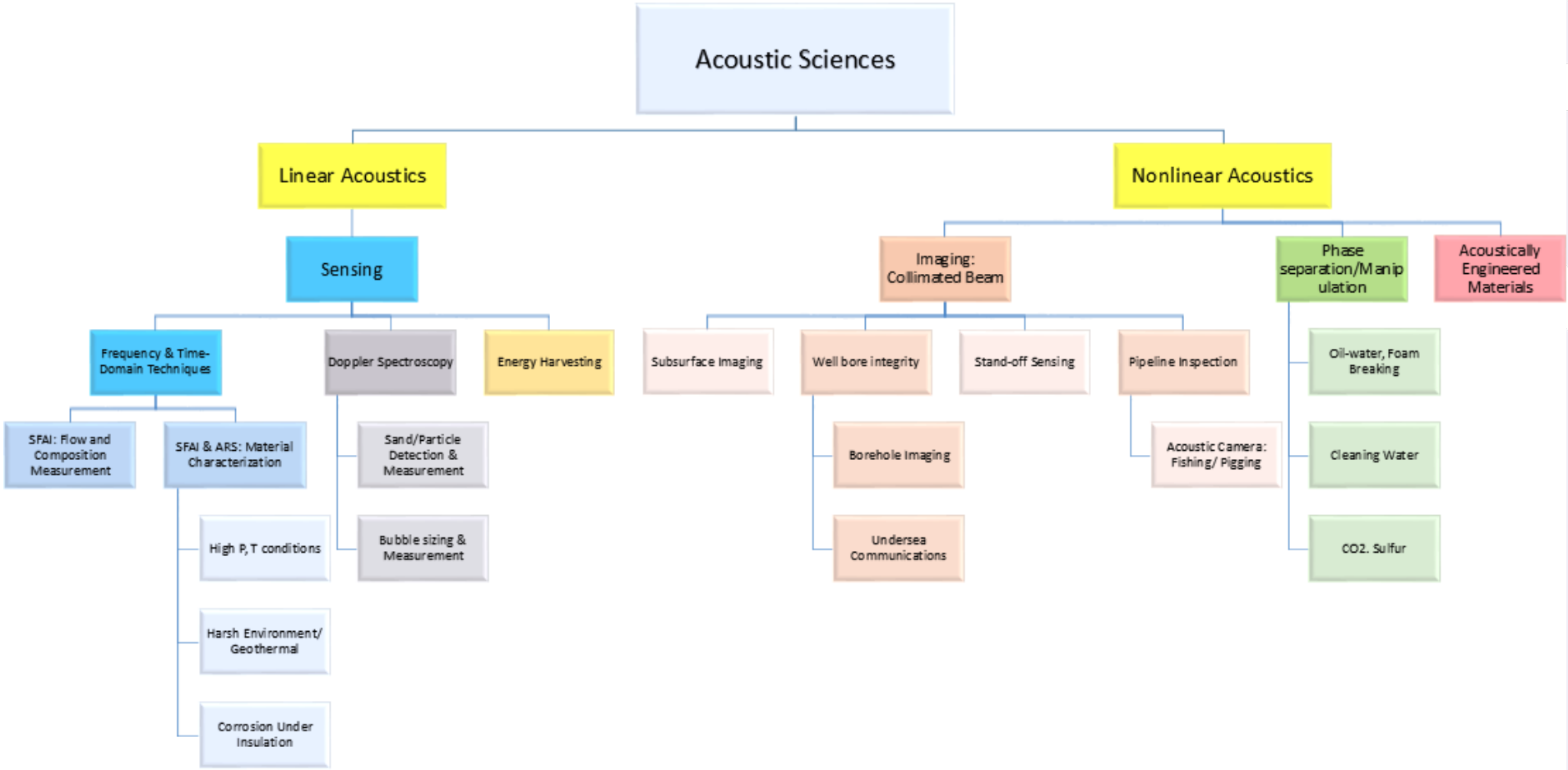
Our research - Applied Acoustics

Development of instrumentation, methods and sensors with a focus on difficult and challenging conditions (high pressure, high temperature, corrosive media, radiation, etc.)

Sensing **Manipulation with sound**

Applied Acoustics Lab

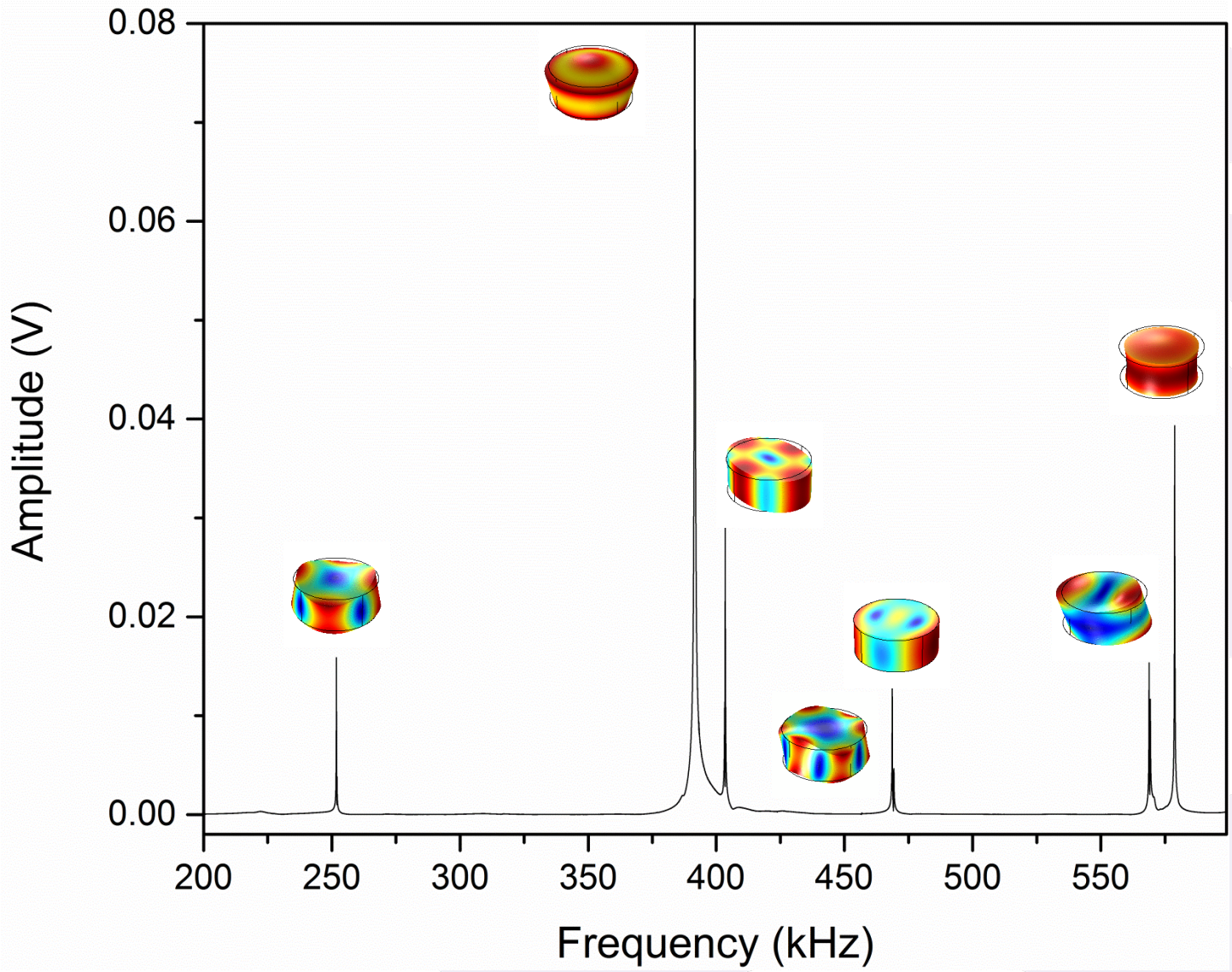
Capabilities



Elastic properties determination

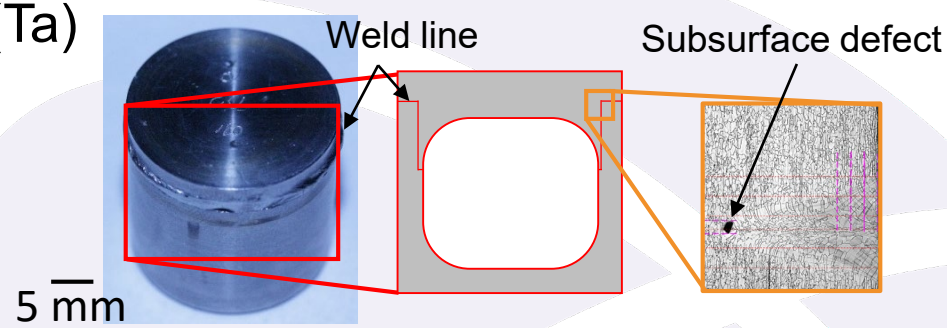
Observe mechanical resonances of objects to determine physical properties of fluids and elastic properties of materials

Fluid inside pipe

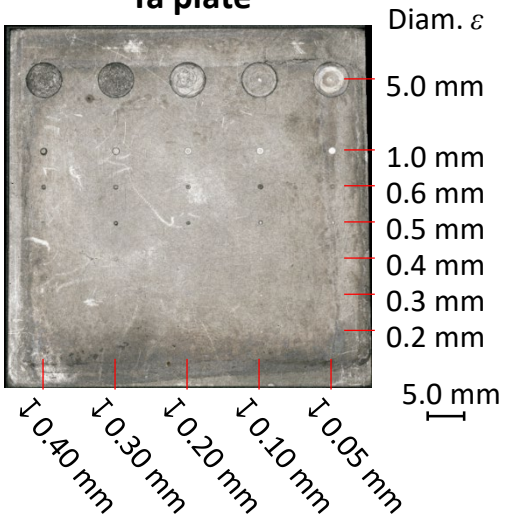


Acoustic weld defect detection

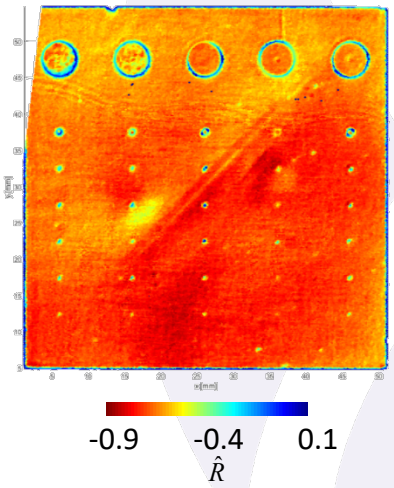
- Weld detection in dense materials (Ta) challenging for radiography
- Solution: scanning acoustic microscopy



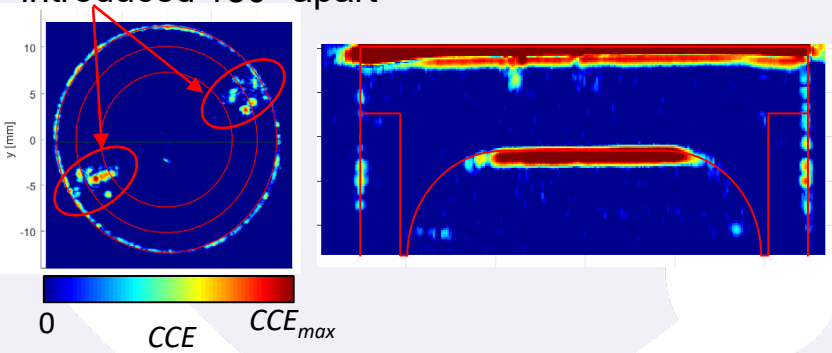
Optical microscopy of Ta plate



Acoustic microscopy of Ta plate



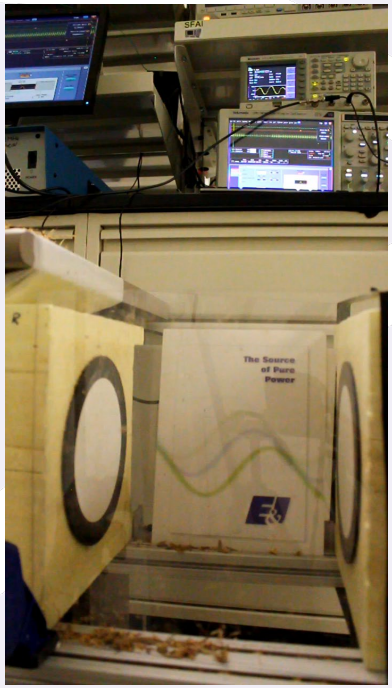
Inclusions intentionally introduced 180° apart

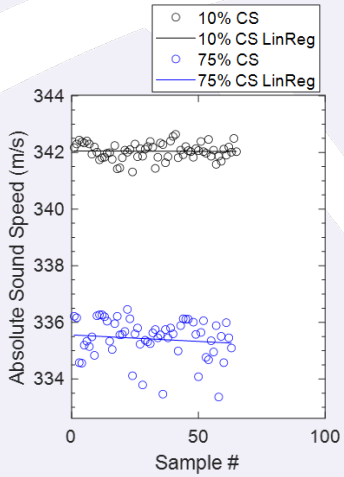


“Smart” Transfer Chutes with In-line Acoustic Sensors for Bulk-Solids Handling Solutions

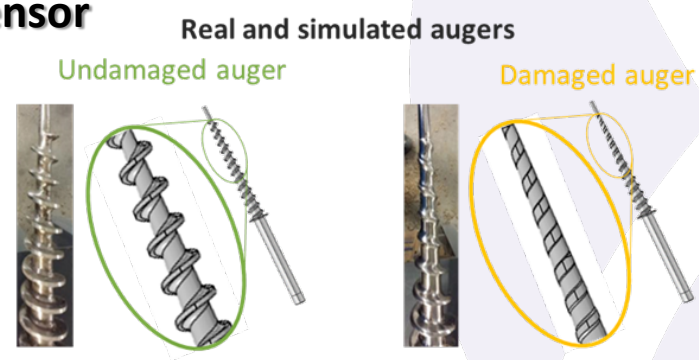
- **Objective:** Develop innovative solids handling equipment (1) and unique in-line acoustic measurement sensors (2, 3) that improve operational reliability, safety, throughput, and yield of biorefineries.
- **Current limitations**
  - moisture sensing: cost, durability, complexity, reliability, sampling volume, and continuous monitoring.
  - no known commercial sensors for real-time monitoring of plug-screw feeder wear
  - no commercial chutes with the ability to change configuration to discard problematic feedstock.

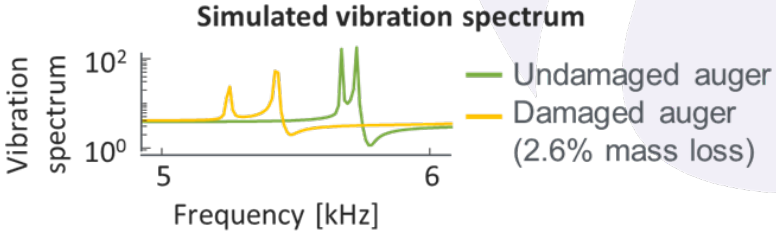
Moisture Sensor (corn stover)



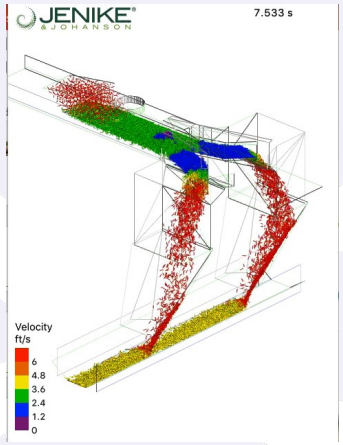


Wear Sensor





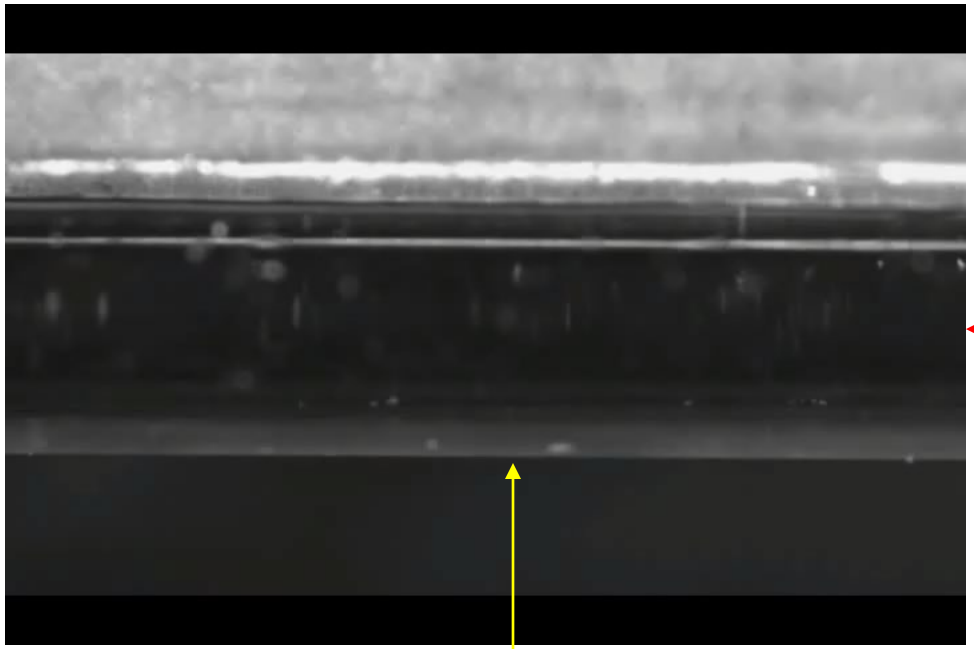
“Smart” Chute



Concentration of Particles in a Tube

Sound field is turned ON and OFF.

Piezoelectric Transducer @ 1.5 MHz

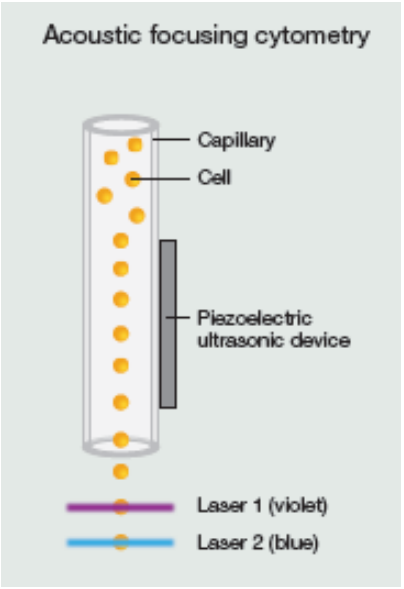


600 μm capillary, Flow~ 200 μL/min

20 μm polystyrene beads

Real Time Video

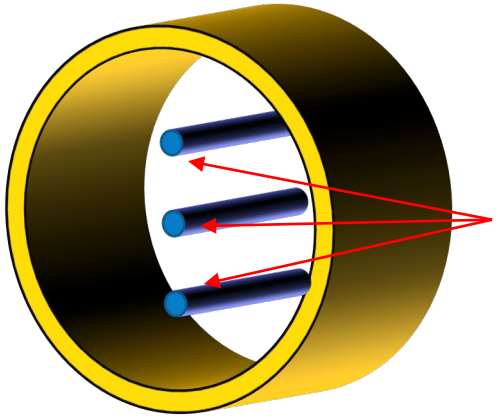
Acoustic Flow Cytometer



Biological cell analysis

Thermo Fisher Scientific

Acoustic Separation of Humidified Air



Nodal lines

The video (real-time) shows the separation of mist from humidified air and concentrating the mist acoustically inside a hollow cylinder using sound. Once the mist is concentrated, It can be taken out of the system. Various types of implementation are possible and this is simply a proof-of-concept to show what is possible with sound.

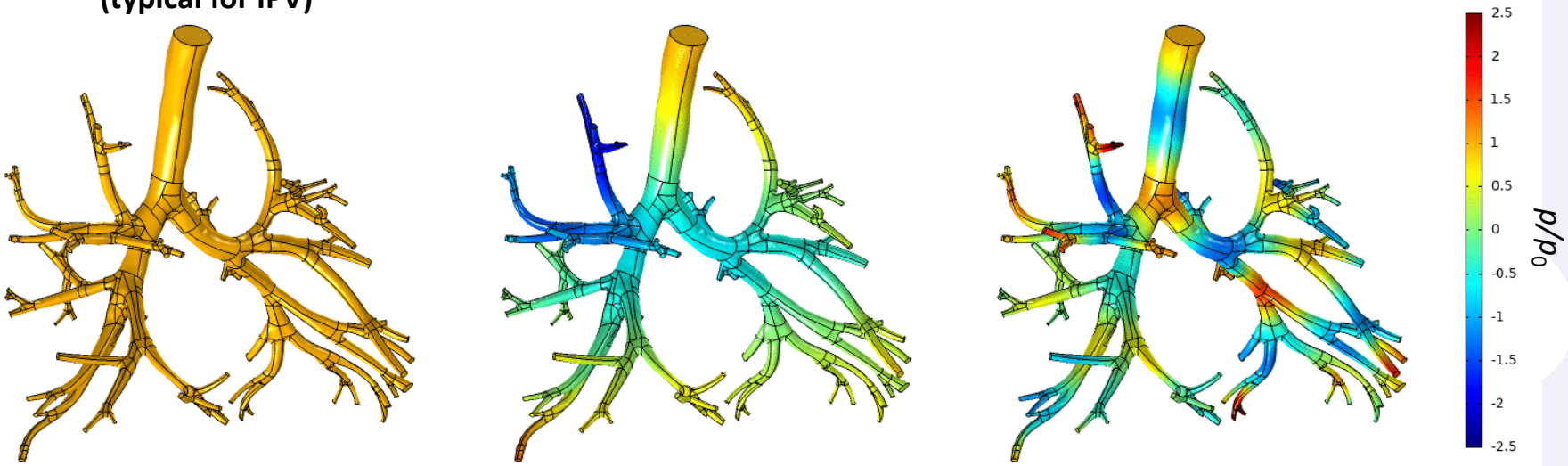
IPV – targeted excitation of lungs

- Intrapulmonary percussive ventilation (IPV): Applies periodic bursts of air/aerosolized medication down the trachea to improve air absorption and mucus clearance
- Currently, no good understanding of optimal parameters (frequency)
- We simulate how frequency affects sound penetration in lung bronchi

0.001 kHz (typical for IPV)

1.54 kHz

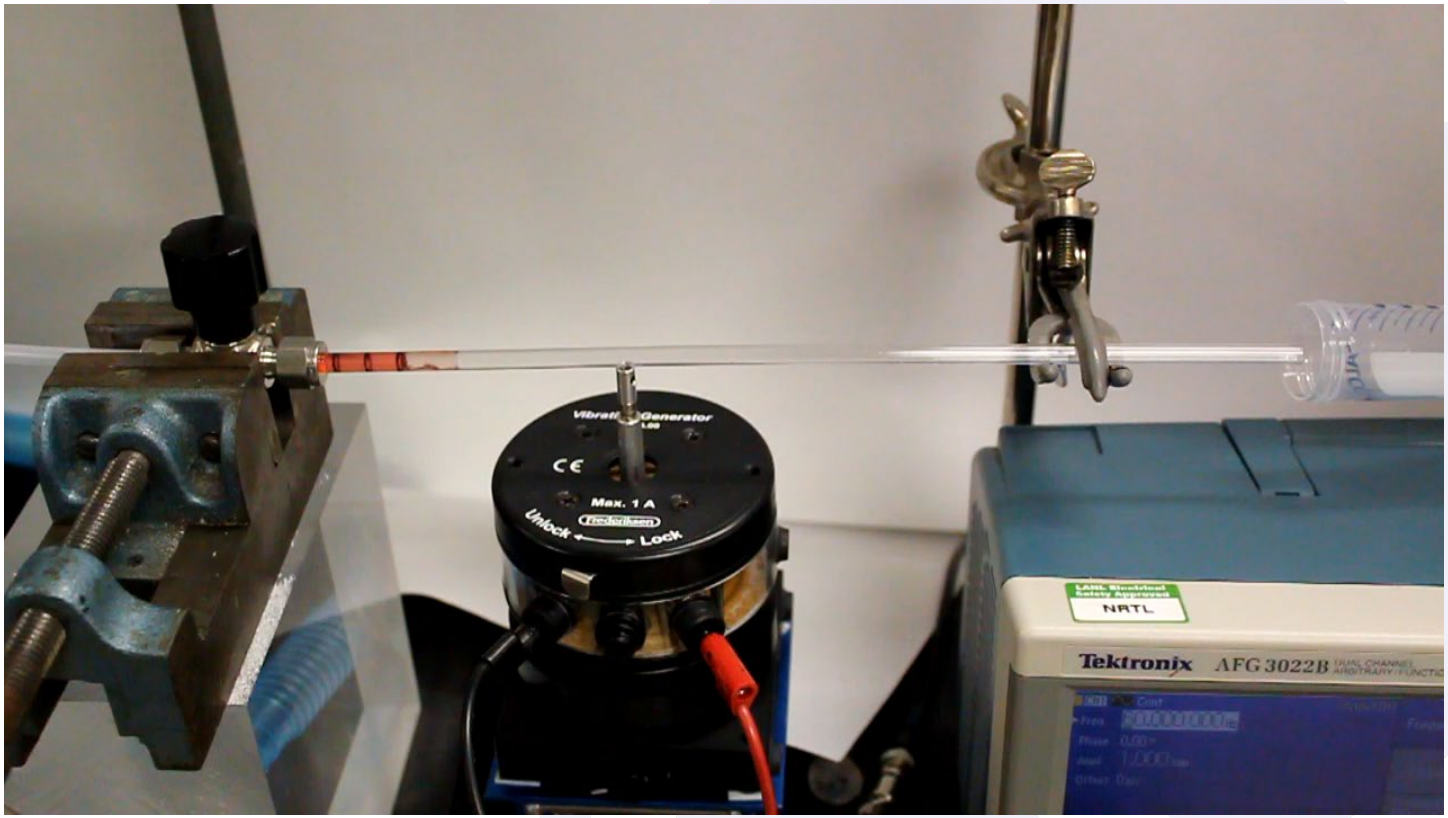
7.44 kHz



Funded by DOE Office of Science through the CARES Act (the Coronavirus Aid, Relief, and Economic Security Act)

IPV – targeted excitation of lungs

- Proof-of-principle: use vibrations to improve mucus clearance from a channel

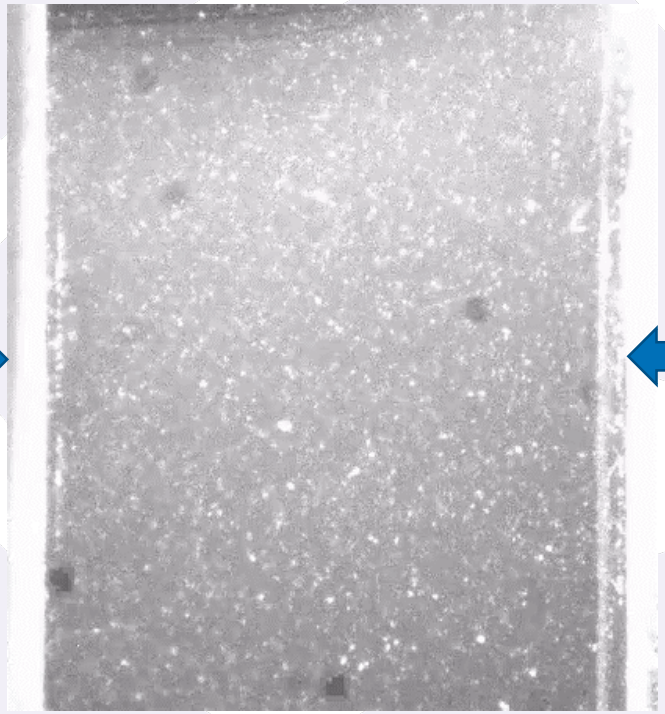


Acoustic Separation

Non-invasive mechanical separation of any two-phase system (e.g., liquid-liquid, liquid-solid, gas-liquid, etc.,) using sound

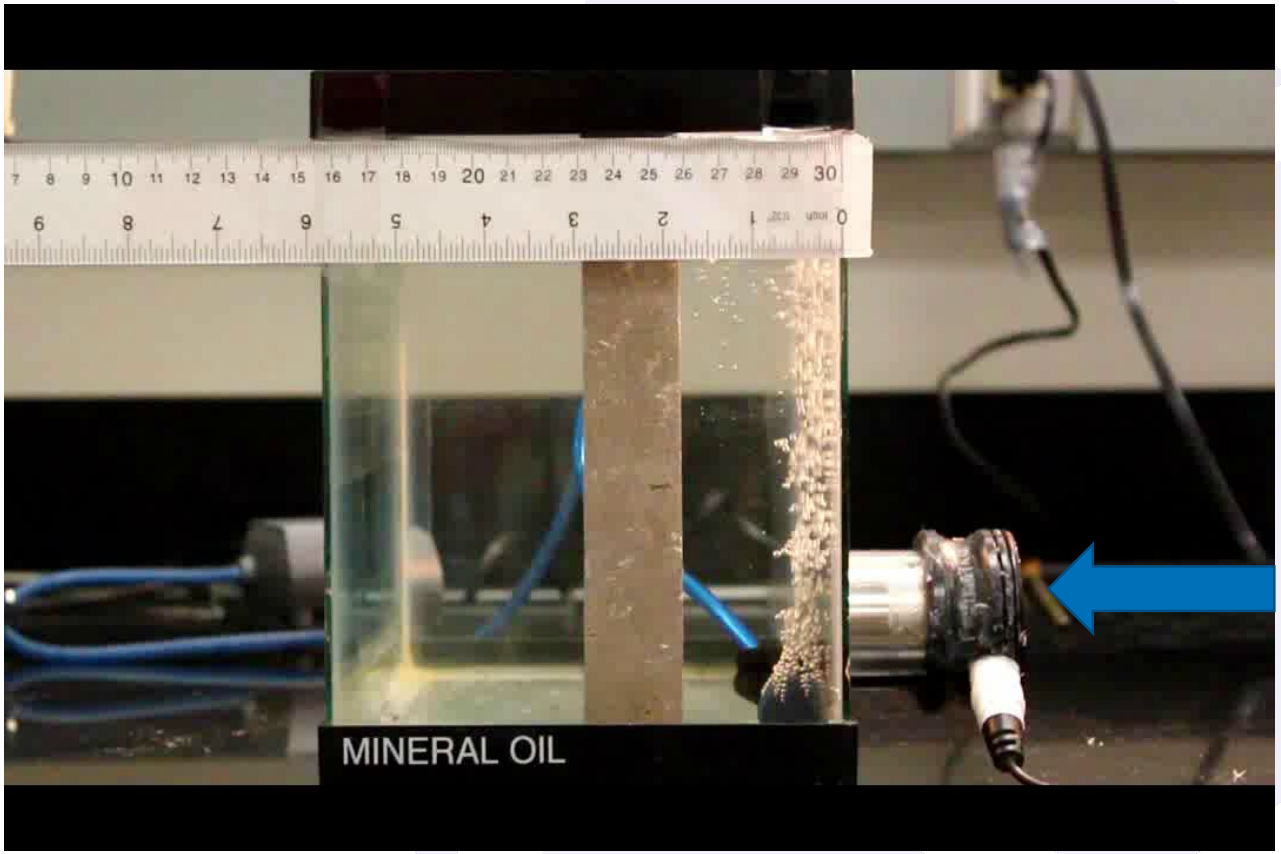
Liquid-Liquid

Solid-Liquid

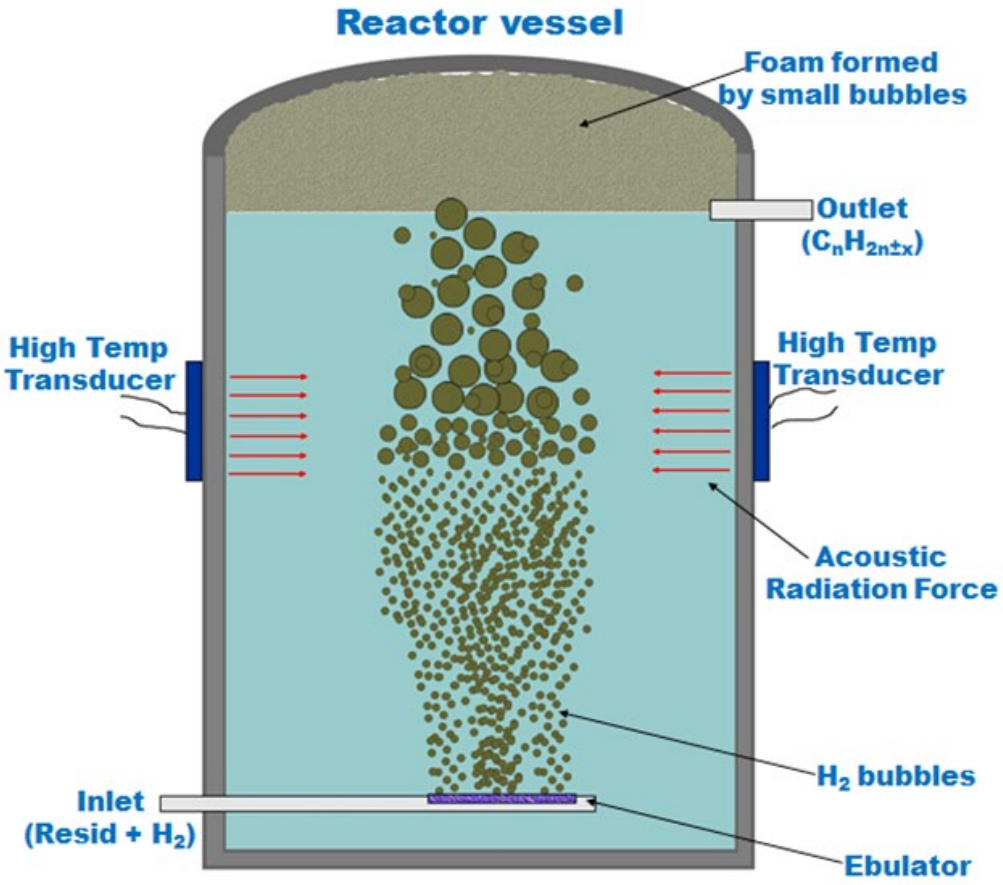


Acoustic manipulation

Manipulation of gas bubbles, liquid droplets, and solid particles with sound

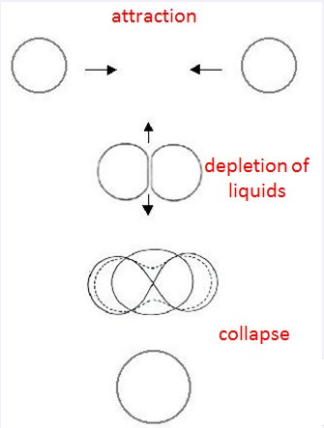


Ultrasonic foam mitigation



Particles/bubbles suspended in the liquid, will be moved to the nodes/antinodes of the standing waves by the **Acoustic Radiation Force**

Outcome of attracting bubbles

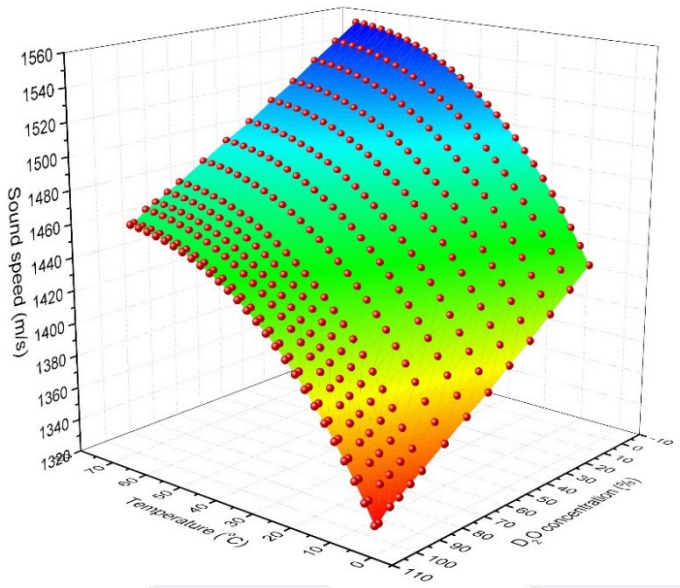


Underwater manipulation with sound

Heavy Water Production Monitoring

A New Challenge for the IAEA

Arak Heavy Water Production Facility
Girdler sulfide process + distillation

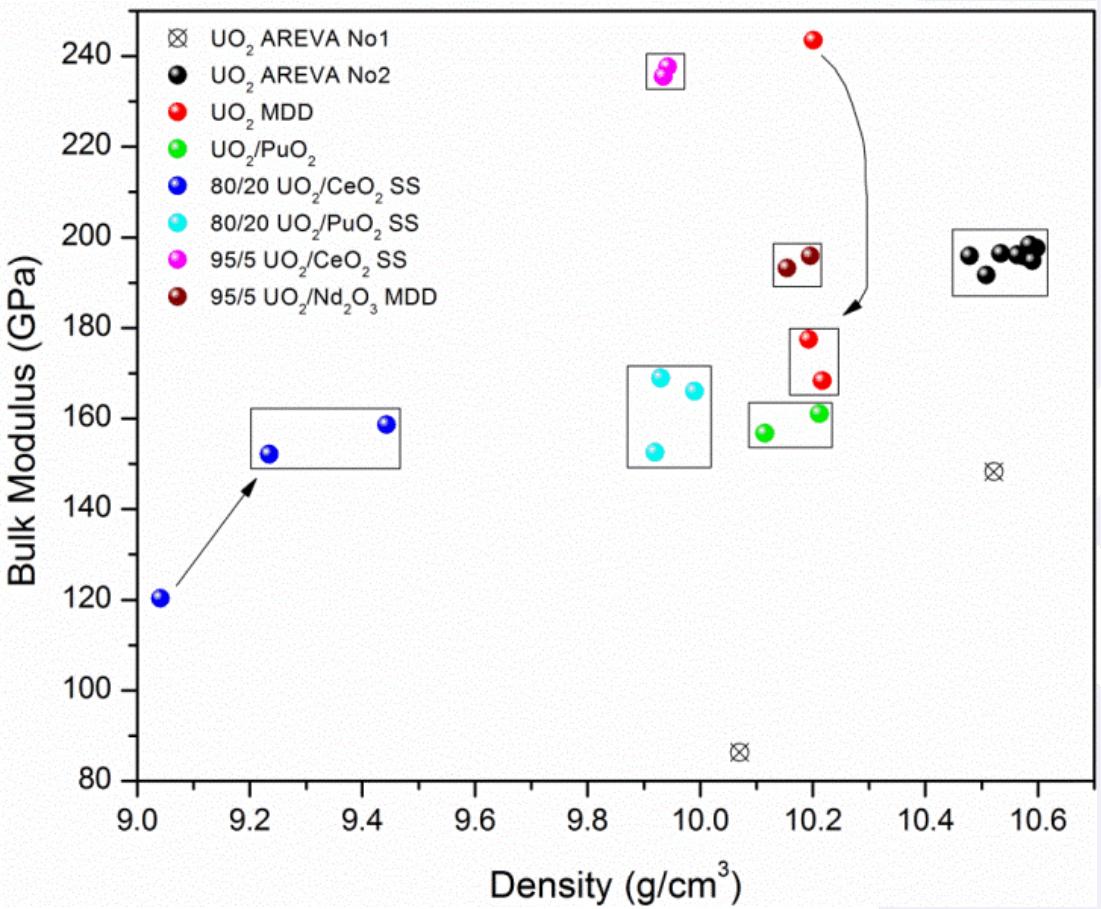


We can measure accurate and precise sound speed, to the first decimal point

→ high precision/accuracy for D_2O concentration, ~ 0.1%

Nuclear materials identification

- **RUS - a nondestructive, very difficult to spoof, well-tested measurement method.**

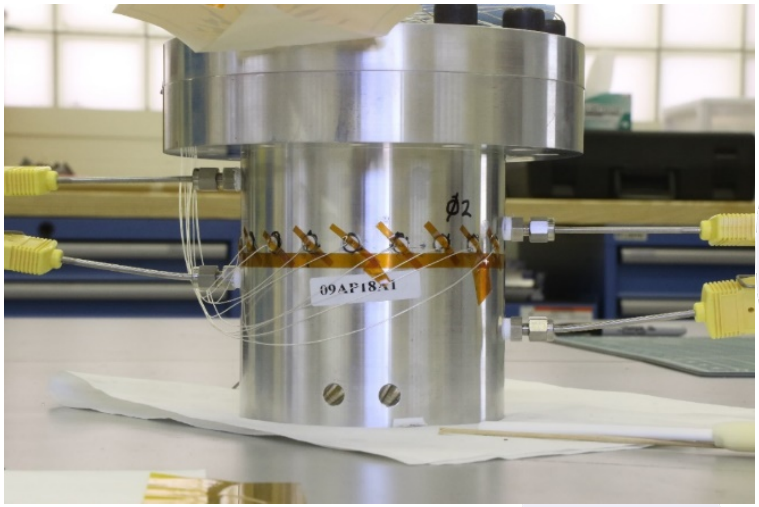


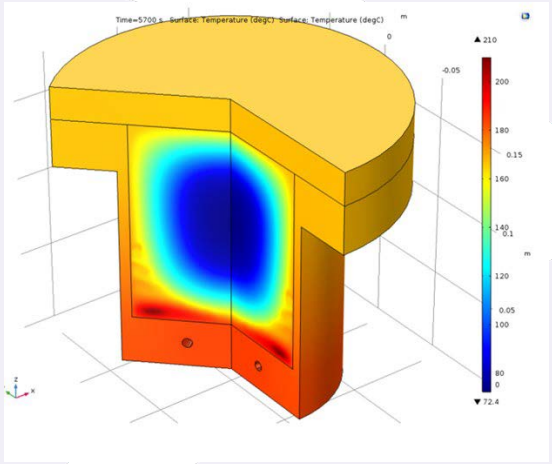
Good correlation between the elastic moduli and density for samples of different compositions/origins.

Able to identify nuclear material composition, fabrication method and source by measuring its RUS properties.

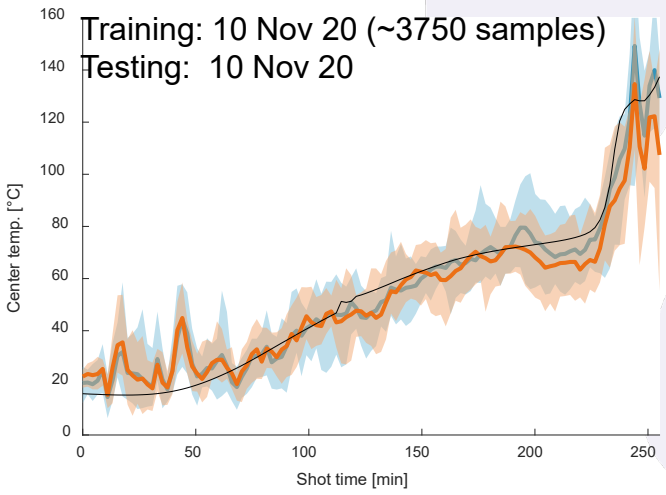
3DHEAT (3 dimensional high explosive acoustic temperature)

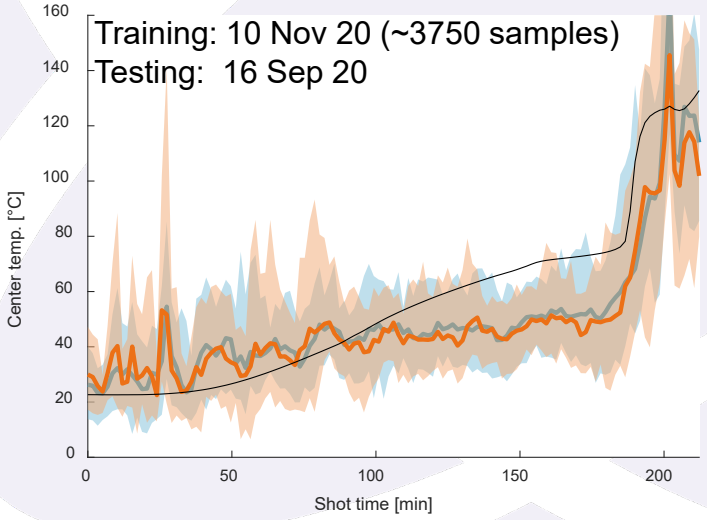
Acoustics diagnosis of thermal damage in Pentolite





Machine learning, CNN (convolutional neural network)





Thank you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