



# Experiments at Extreme Conditions

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**Assistant Professor**

# Doing Research with *IMPACT*

See the [video online here!](#)

# Our Research

**What are the effects of strain rate, temperature, and microstructure on mechanical behavior of materials**

- Plasticity, failure, viscoelasticity etc.
- Tension, compression etc.
- High strain rates, broad range of temperatures

**Addressing both industrial and basic fundamental science**

Experimental (and numerical) simulations of dynamic material behavior in industrial processes.

## Methodology

- Hopkinson Split Bar techniques
- Digital Image Correlation
- Multimodality (high speed) imaging

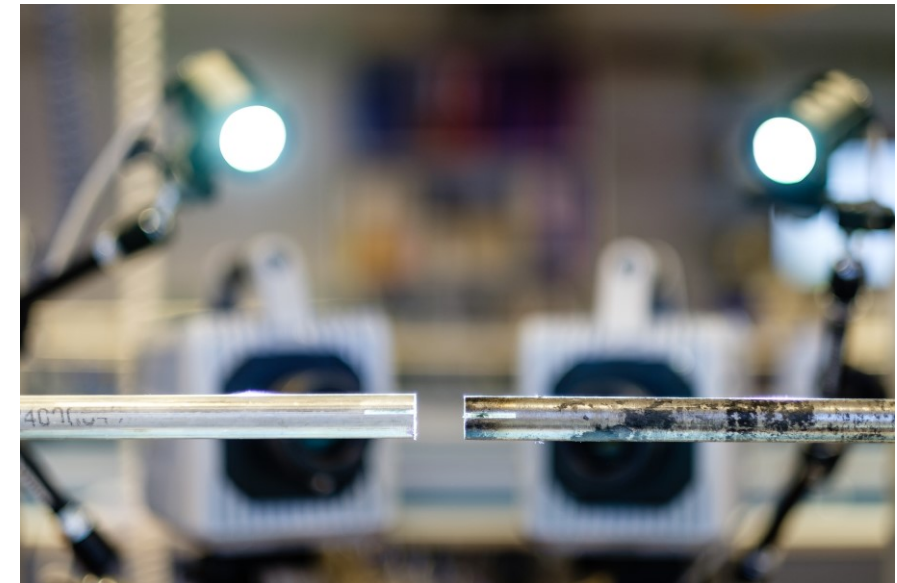


# Mechanical testing



## Hopkinson Bar devices

- Tension and compression tests at high rate. One test lasts 50-500 microseconds.
- Covers strain rates from about
  - Compression:  $3 \times 10^2 \text{ s}^{-1}$  to  $10^4 \text{ s}^{-1}$
  - Tension:  $3 \times 10^2 \text{ s}^{-1}$  to  $3 \times 10^3 \text{ s}^{-1}$
- Based on stress wave propagation in solids
- High and low temperatures from  $-150 \text{ }^{\circ}\text{C}$  to melting temperature





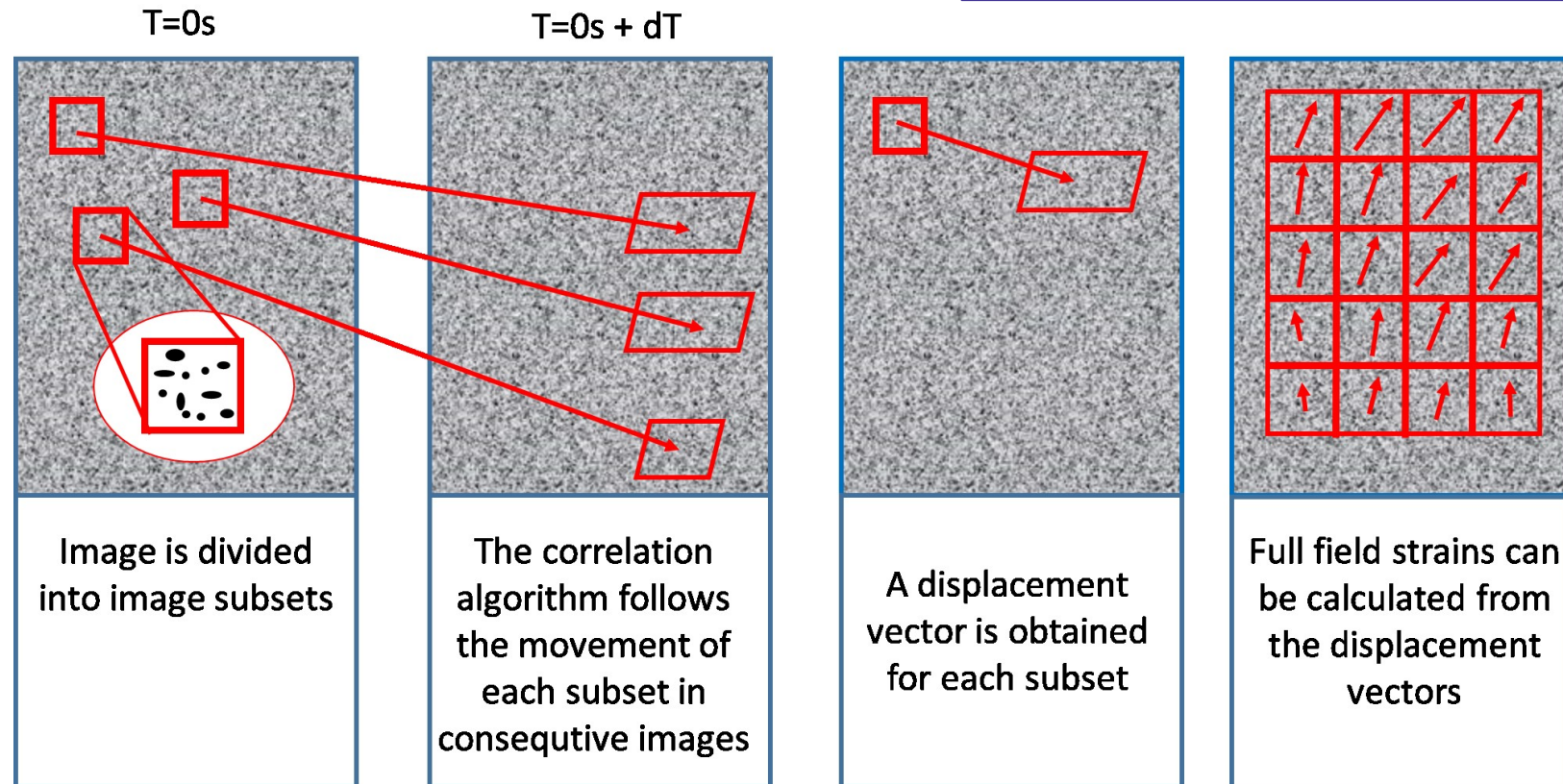
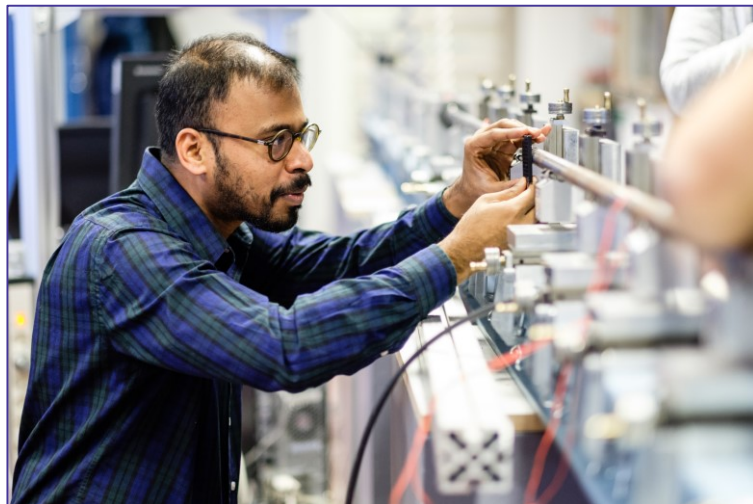
***The Future...***

**Quantitative  
Visualization**



# Digital Image Correlation

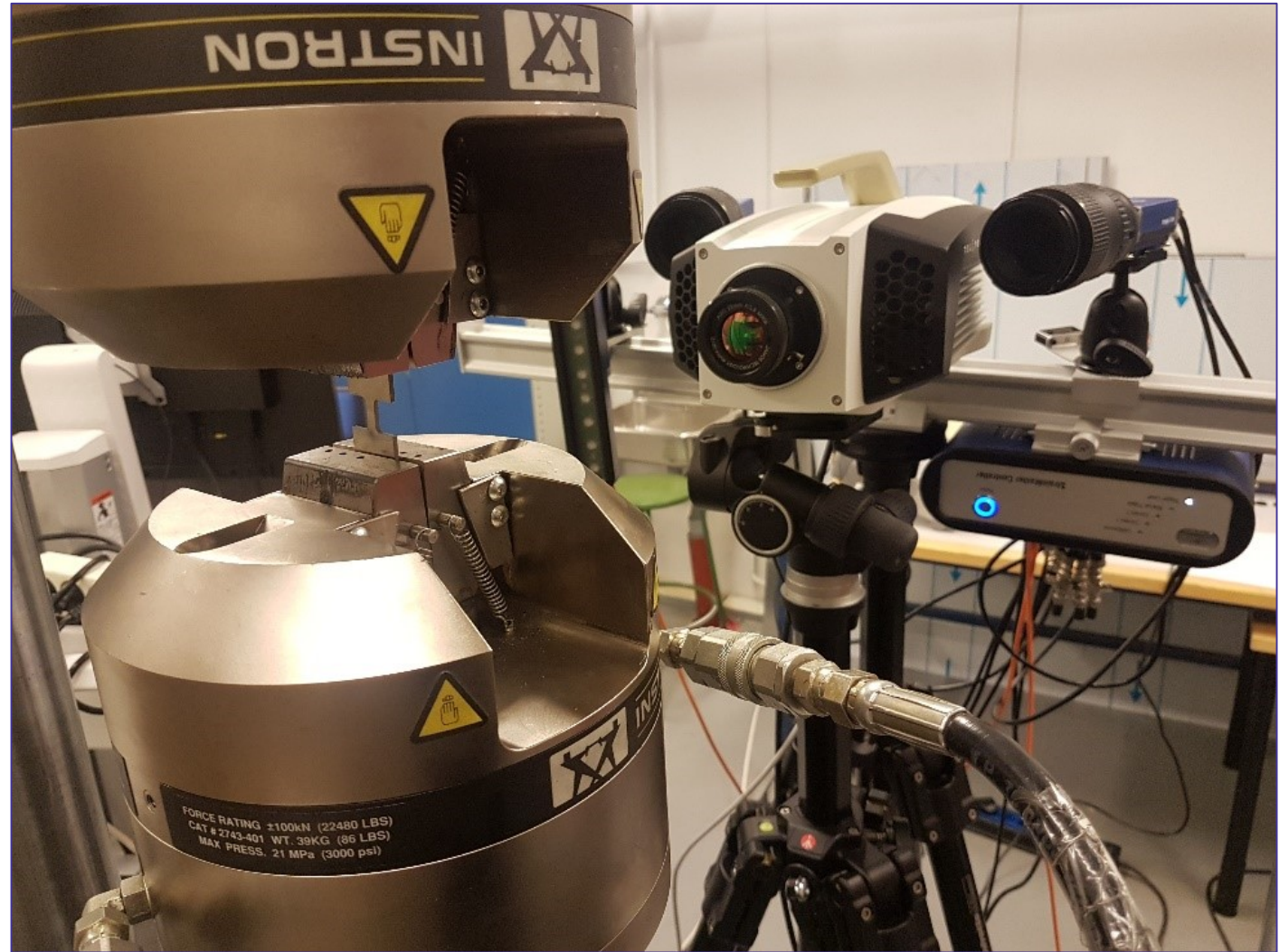
Image based non-contact full field displacement measurement method.



*Like using tens of thousands of mini-extensometers. It is the best thing to happen to mechanics since the invention of strain gages in the 50's.*

*Professor Amos Gilat, The Ohio State University*

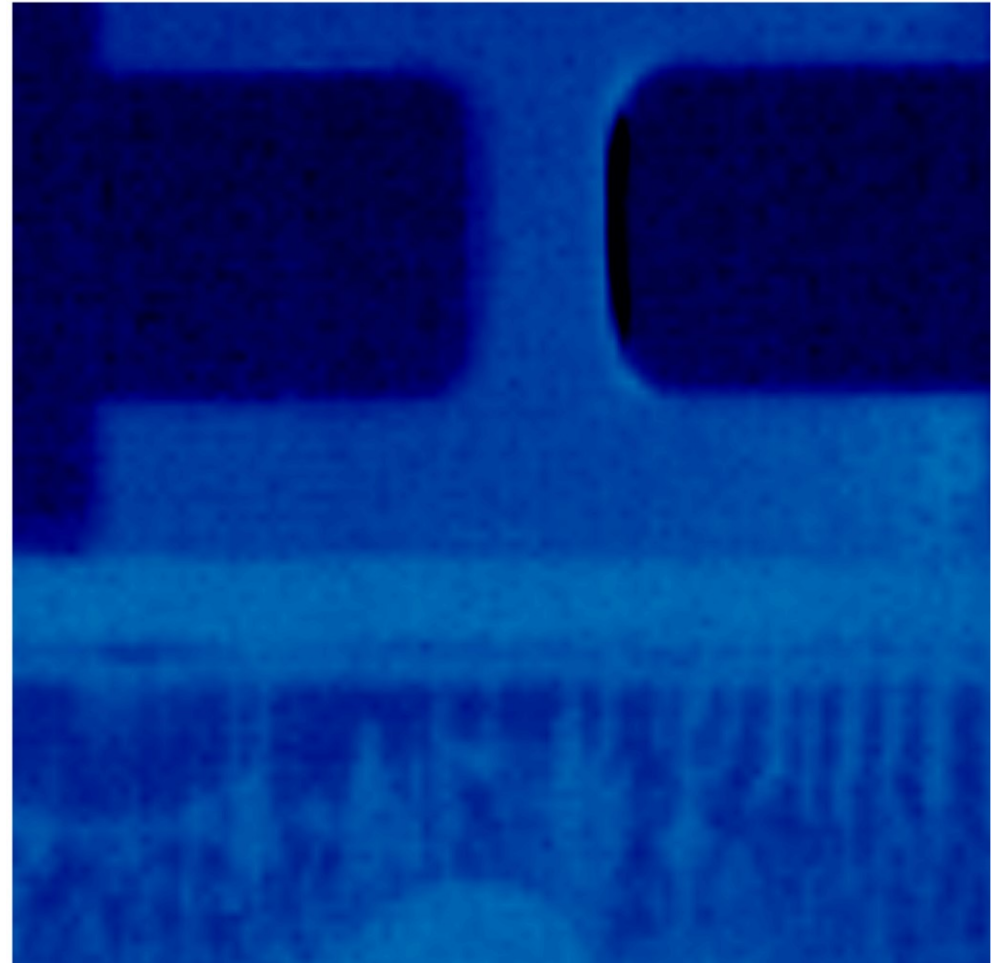
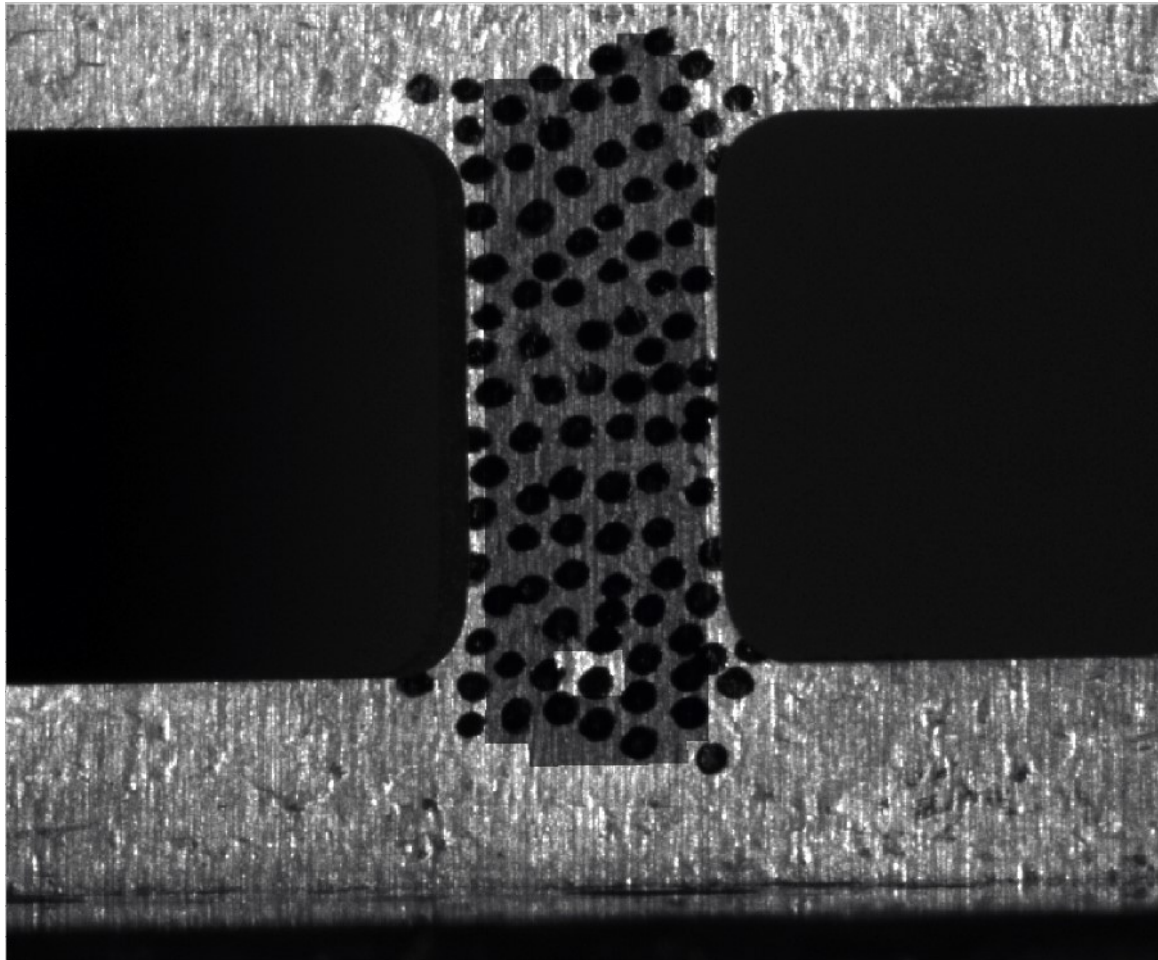
# Simultaneous DIC and IR



**Funding:** TAU, Academy of Finland, United States  
Air Force – Office of Scientific Research

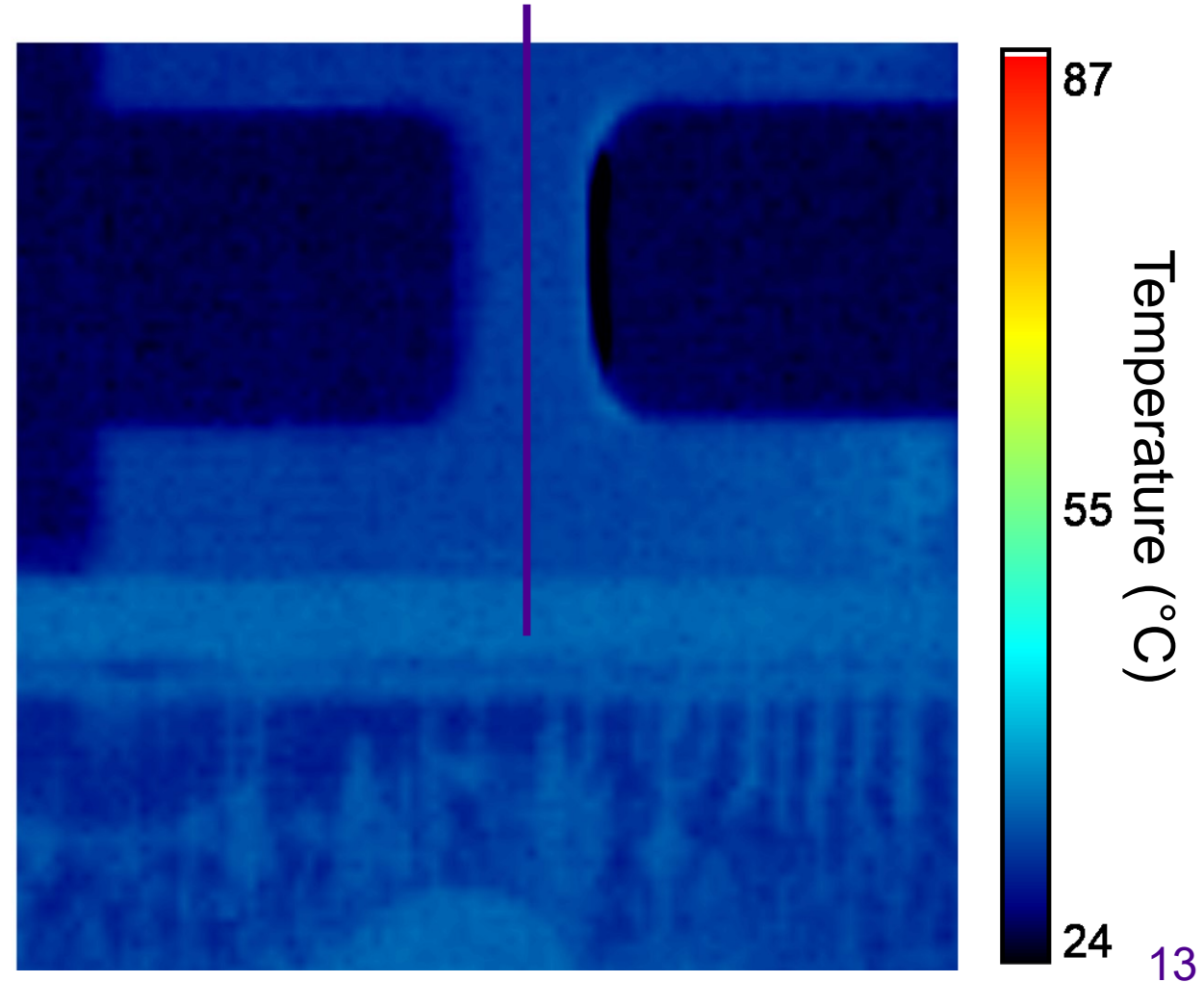


# Simultaneous DIC and IR

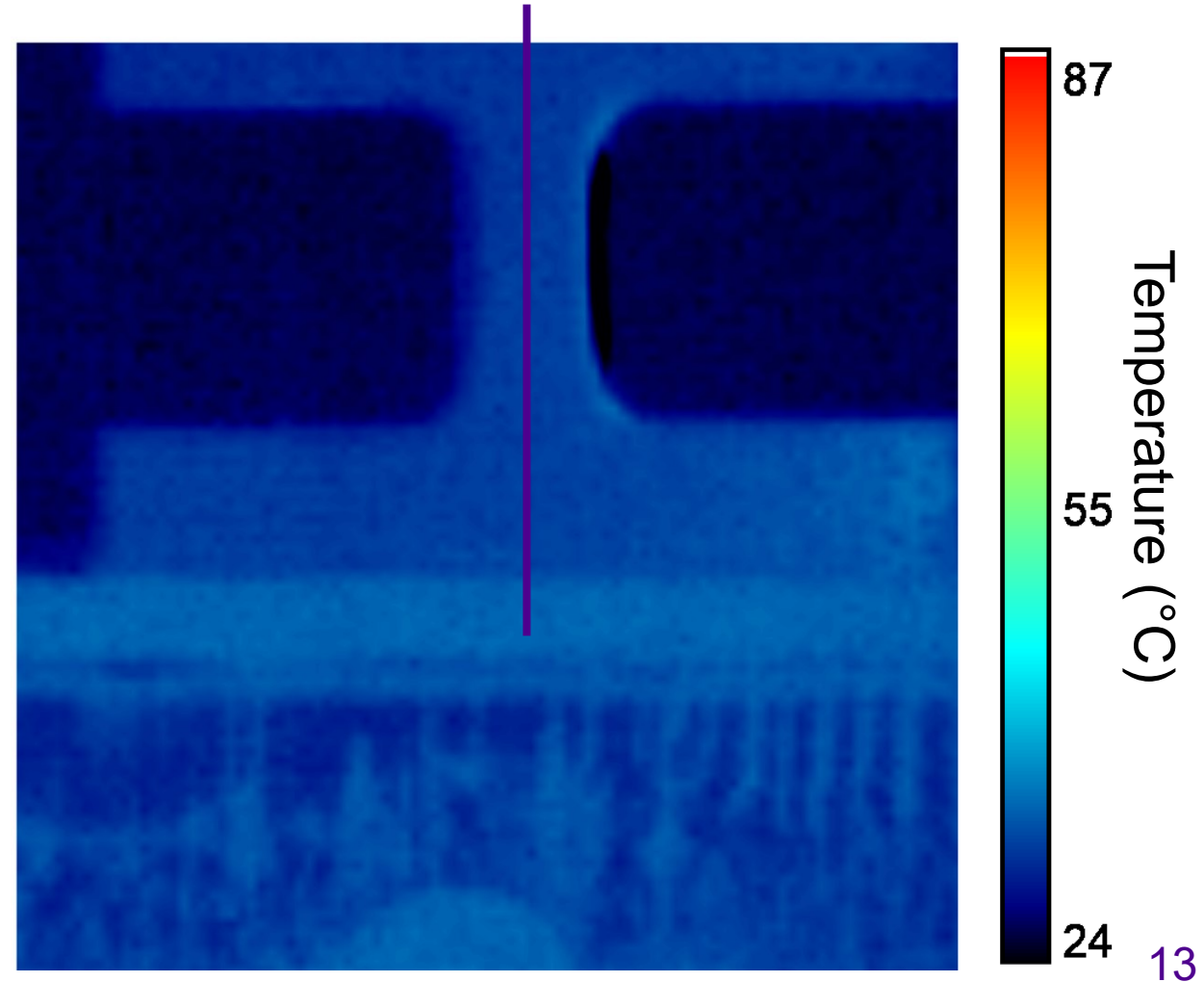
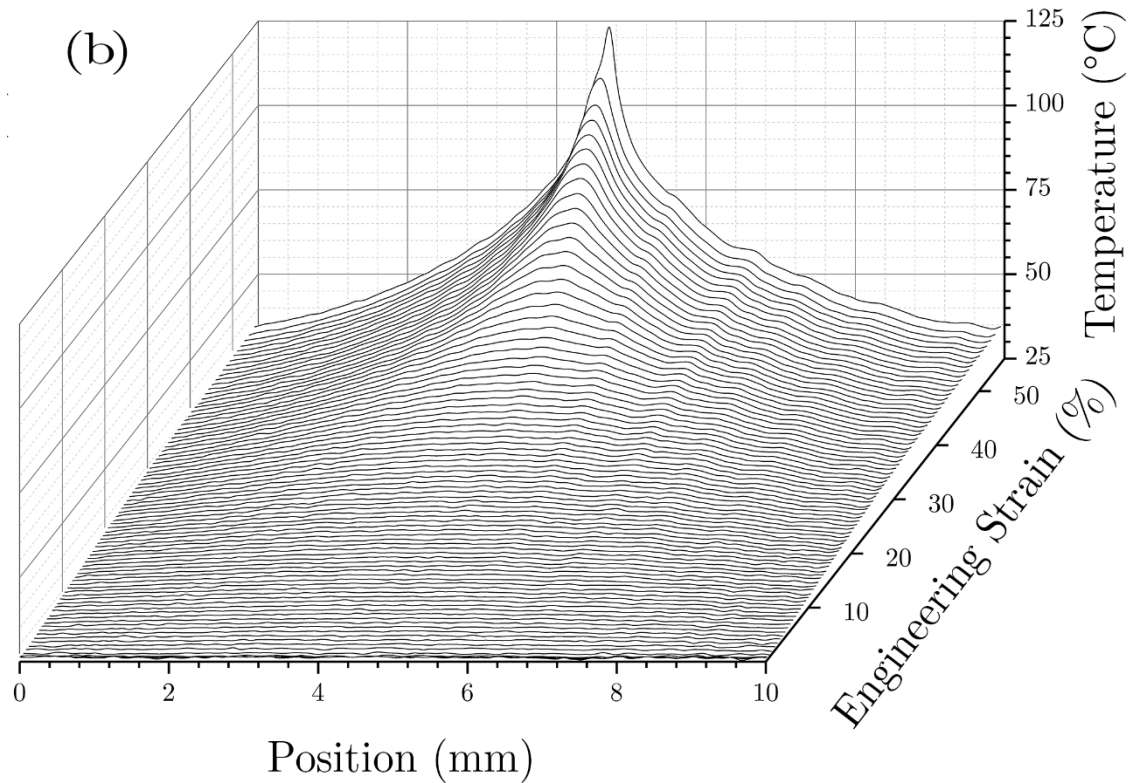




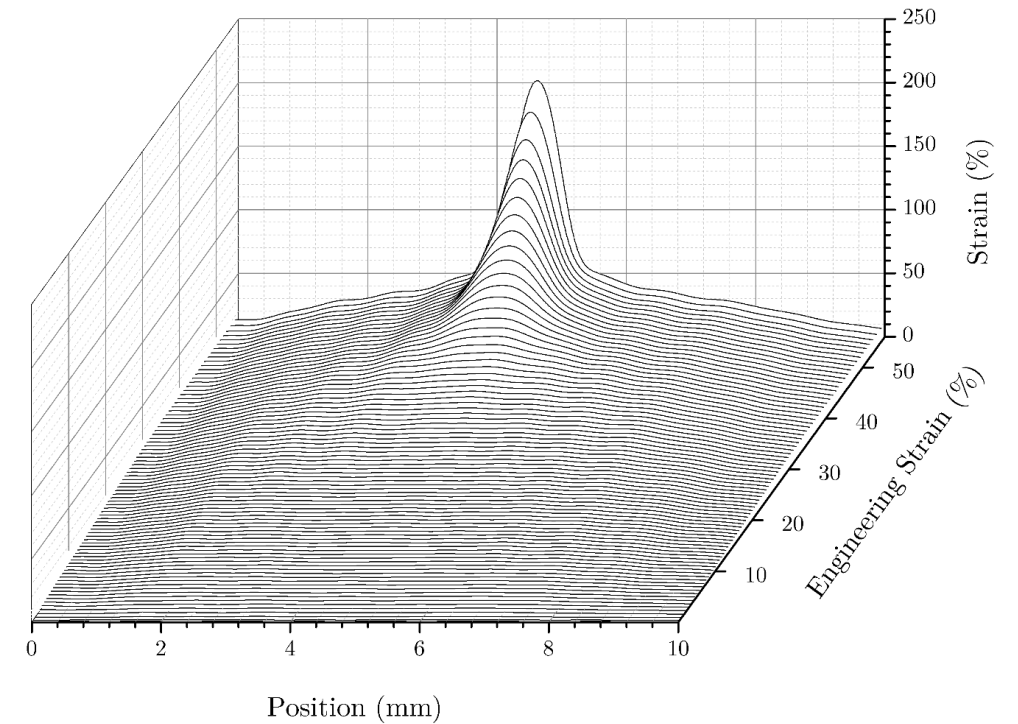
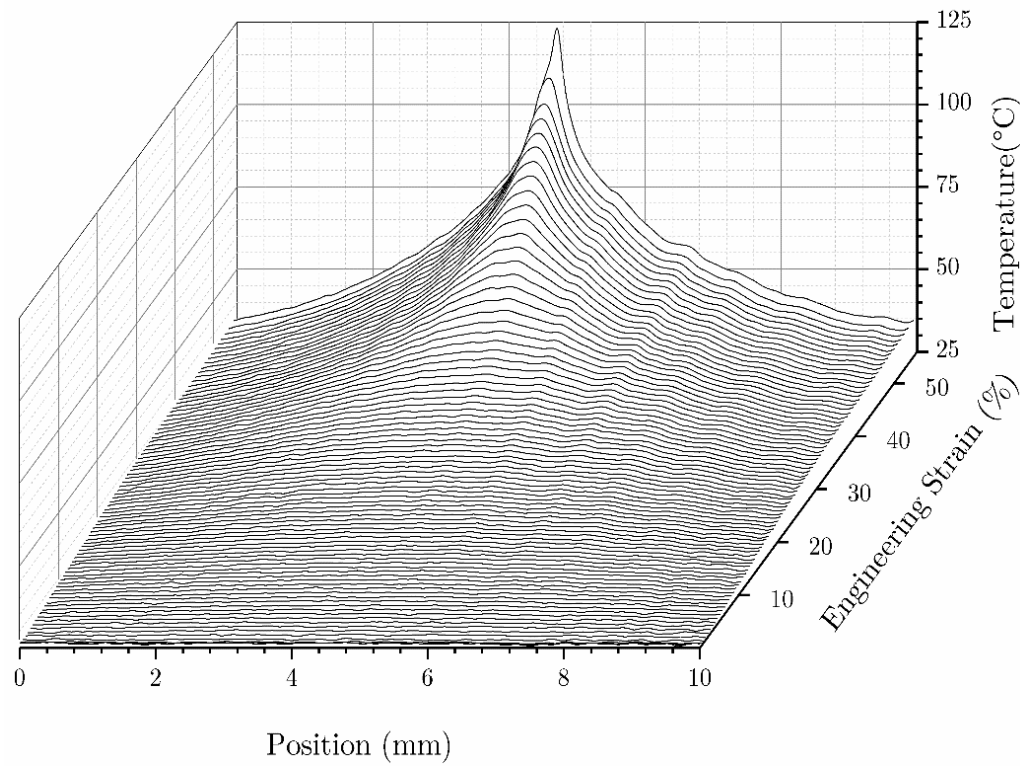
# Simultaneous DIC and IR



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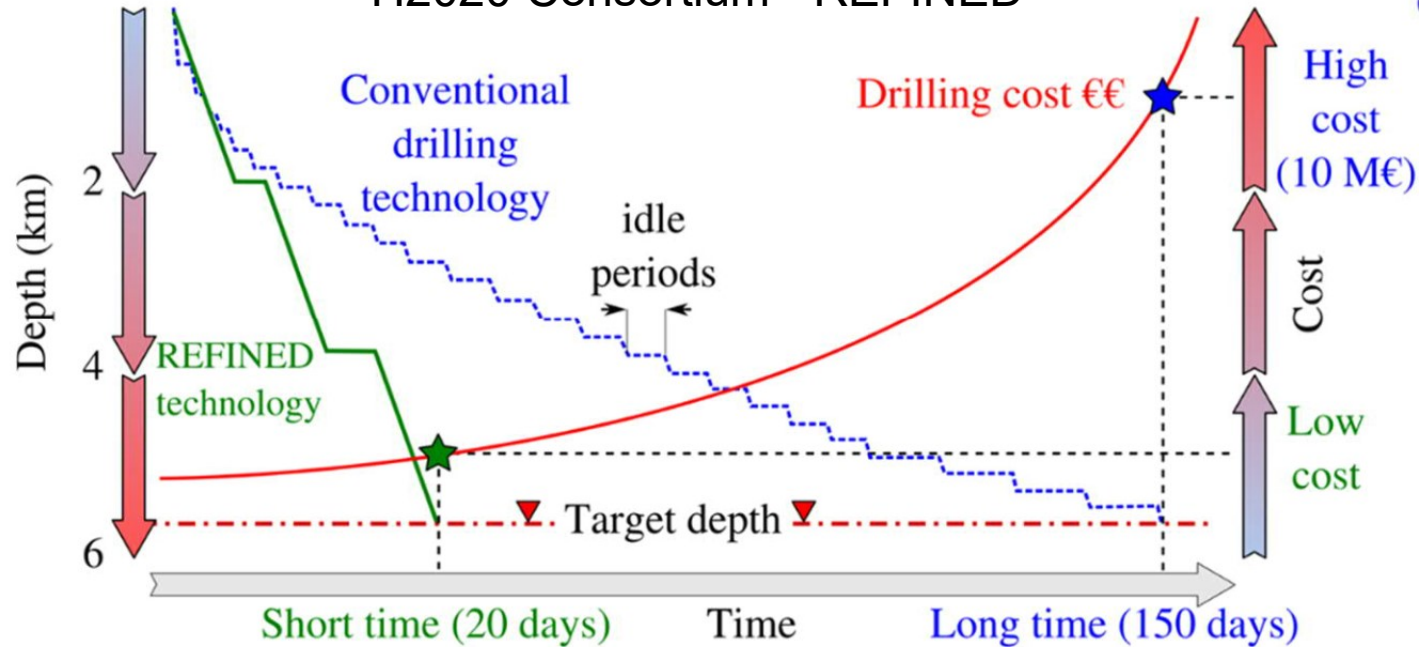


G. C. Soares, et al.  
Conference of Experimental  
Mechanics. June 2018



# Percussive Drilling

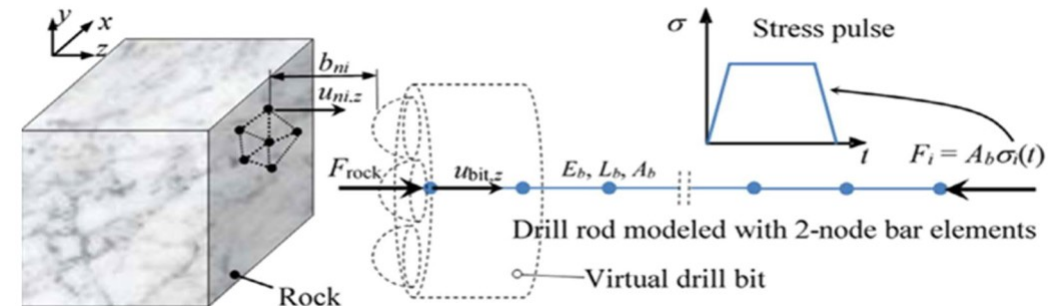
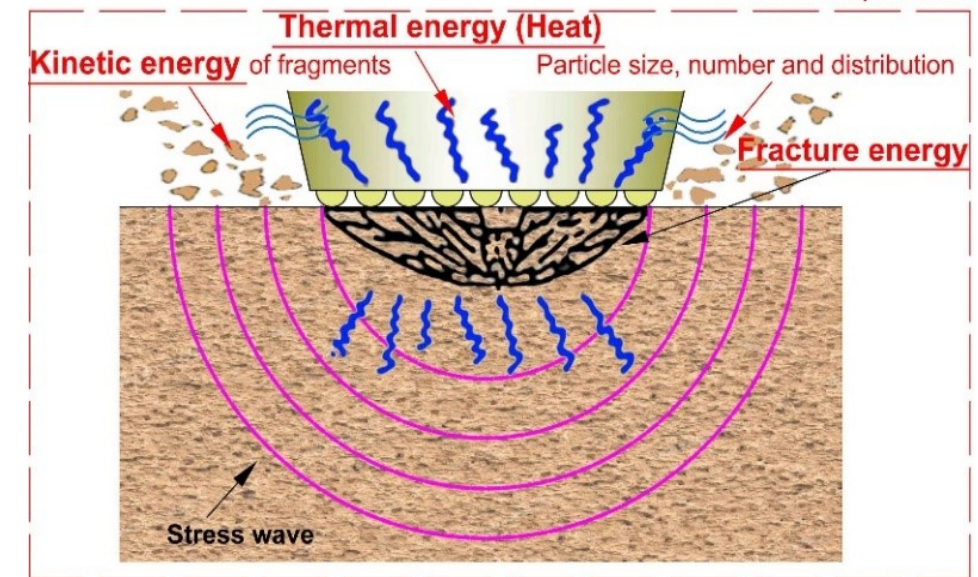
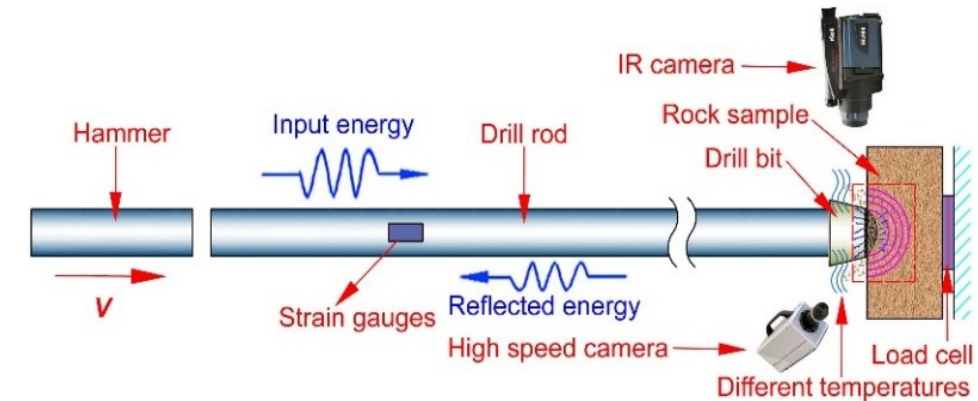
H2020 Consortium - REFINED



Academy postdoctoral research project:

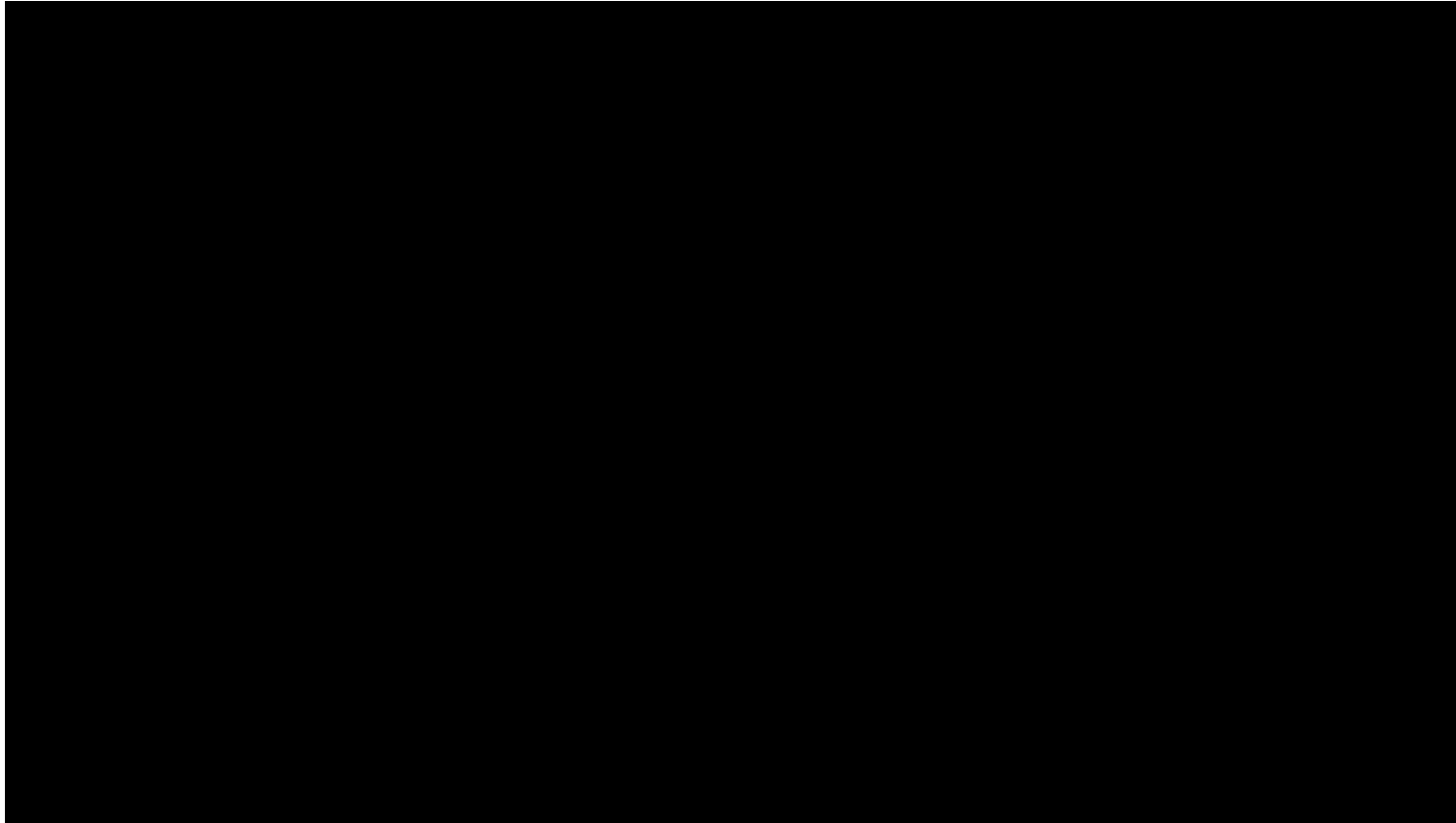
Dr. **Wei Yao** from Univ. Of Toronto starts in November, 2019.

**Funding:** Academy of Finland





# CardiomeDIC®



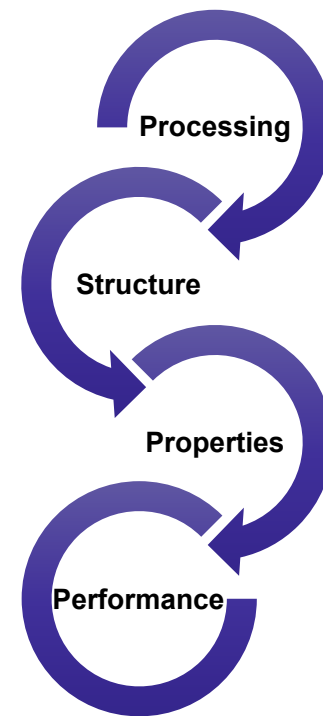


# Outlook for Future



# Aiming at high *IMPACT*

- Building of unique research infrastructure for multiscale mechanics
- Use of large scale research facilities such as synchrotron centers – *Quantitative Visualization*
- International collaboration
- Balanced research profile between high level basic research and applied mechanics
- *Engineering the Materials Science*
- Addressing the needs of **material producers** and **materials technology** in Europe
  - Metals, ceramics, polymers, biomaterials, hybrids...**Future materials!**
  - Components, machines, tools, systems
  - Plasticity, elasticity, fracture, viscoelasticity, fatigue etc.
- Making the best out of the materials => **Extreme conditions**



# *IMPACT*

*We are driven to  
make the world  
a better place, hit  
by hit.*

