LA-UR-22-21304

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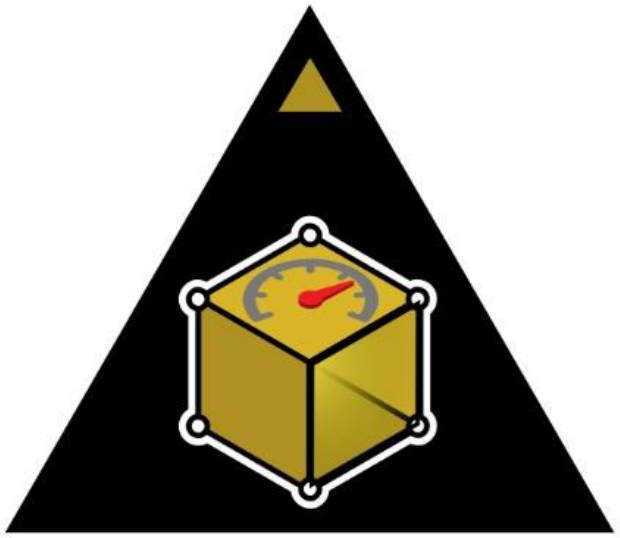
Title:	Capability Development at LANL
Author(s):	Walzel, Renita Kathleen
Intended for:	Recruiting at Texas Tech University
Issued:	2022-02-15

Capability Development at LANL

Texas Tech University



E-14
TEST
ENGINEERING

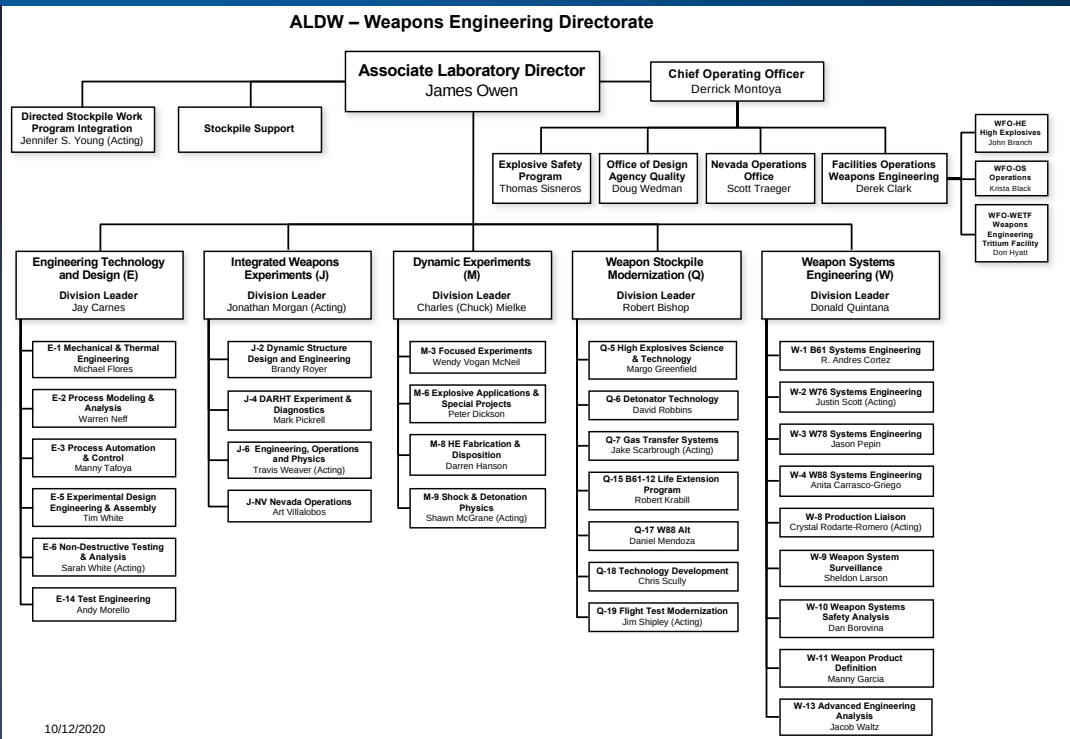
Renita Walzel

2/15/2022

Agenda

- LANL Organizational chart
- E-14 overview
- DIC testing on Blast Tube
- Questions

LANL Org Chart



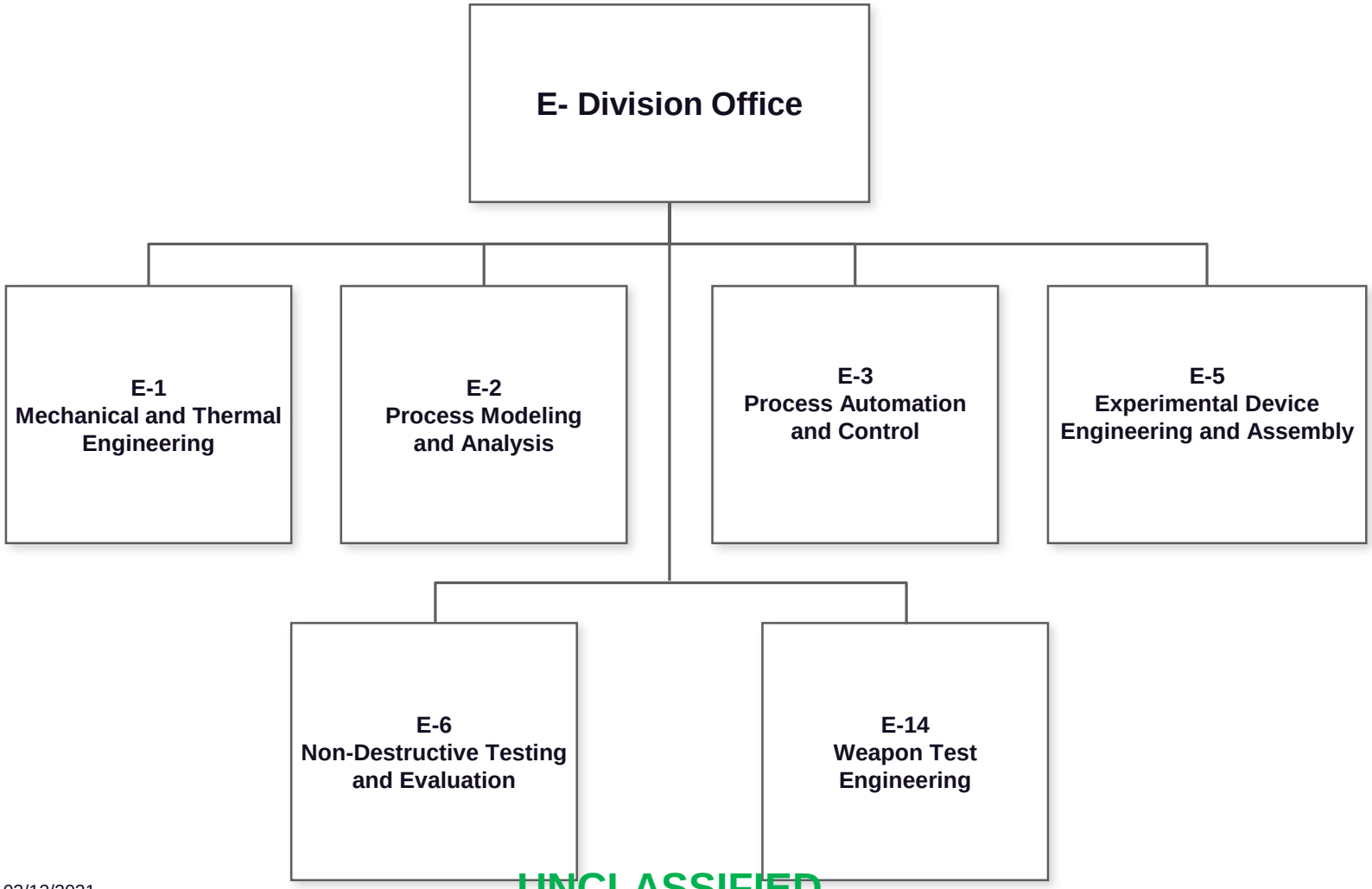
E W Q J M WFO

ALDW Consists of 6 Divisions

We Are Here

E Org Chart

Engineering Technology and Design Division (E)



03/12/2021

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E-14 Overview

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Test Engineering

The Test Engineering (E-14) group has a wide variety of testing personnel and facilities capable of fielding and/or supporting tests on everything from material samples to full weapon assemblies including HE and Rad materials.

E-14 owns and operates a wide variety of experimental equipment including thermal conditioning units, shakers, load frames, data acquisition, air bearing, centrifuge and blast tube to support

E-14 Teams & Expertise

Shock and Vibration

- Small to large Shakers
- Mechanical Shock Machine
- Modal Testing
- Combined Thermal-Mechanical Testing

Mechanical and Thermal

- Small to Large Chambers
- High Ramp Rates
- Material Compatibility
- Long Term Aging
- Multi Segment Chamber Compression
- High Speed and 360° DIC
- Combined Environment Testing

DAQ

- High Speed Reliable Data Acquisition
- Component and Assembly Instrumenting
- Explosive Testing Data
- Calibrated Sensors

Data Analysis

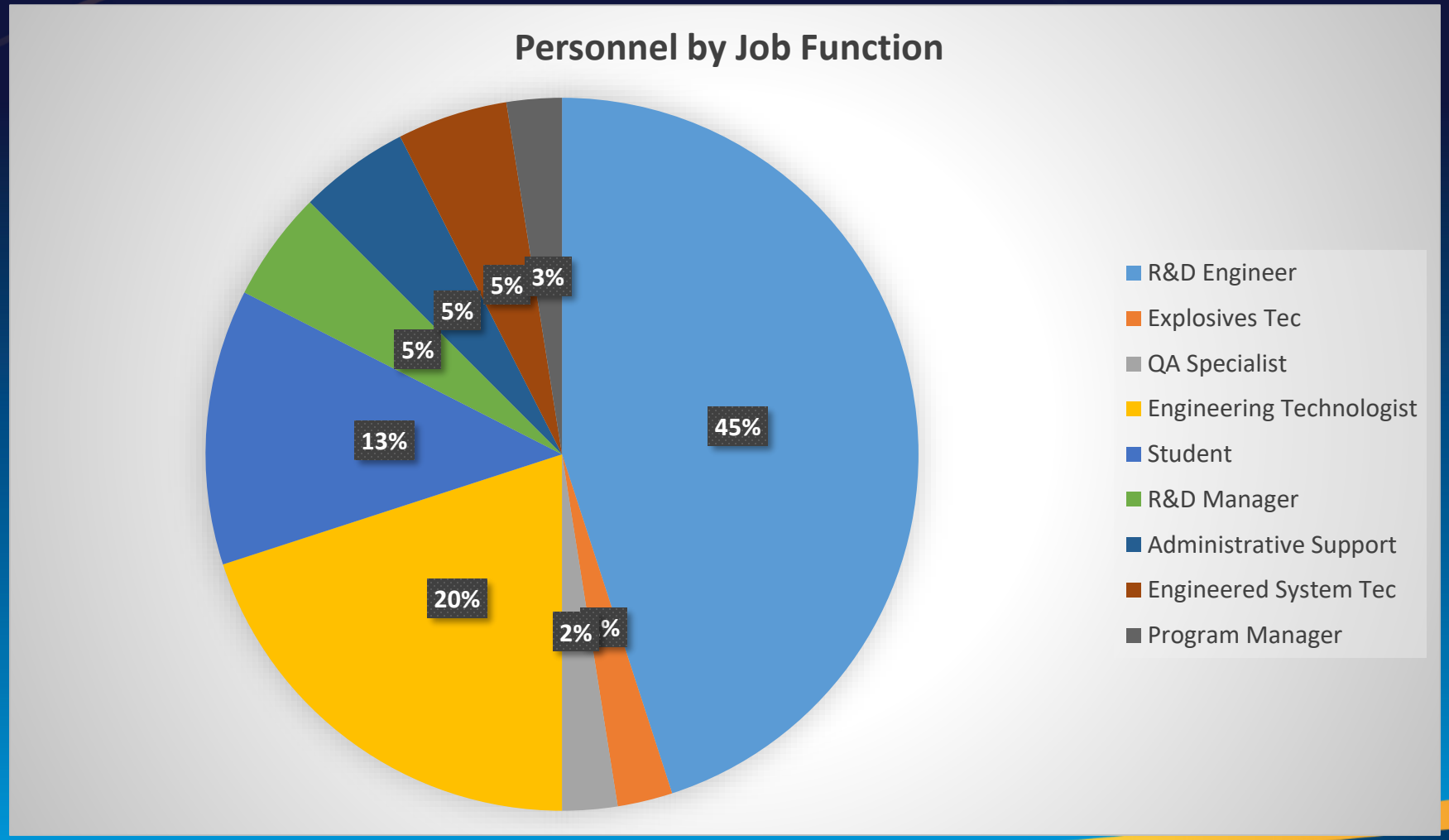
- Environmental Specifications
- Test Data Analysis, Archival and Storage

Flight Properties

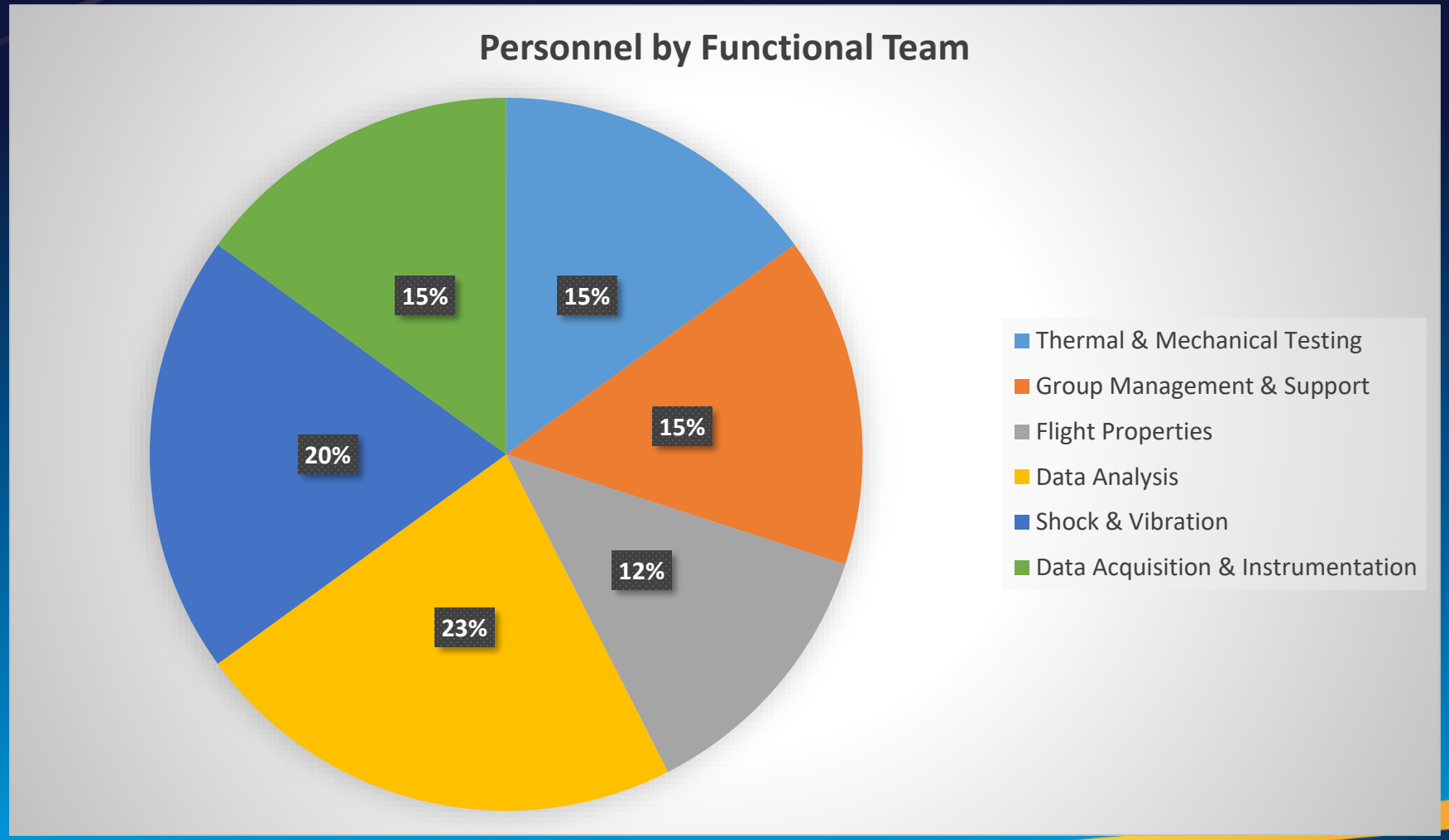
- Centrifuge
- Products of Inertia
- Horizontal Air Bearing
- Blast Tube
- Separation Shock

- **Experimental evaluation of weapons materials, components and assemblies**
  - Thermal, shock & vibration, and mechanical testing
    - Expertise in non-intentional explosives evaluation
  - Unique data acquisition and diagnostic deployment
  - Management and assessment of complex data and data sets

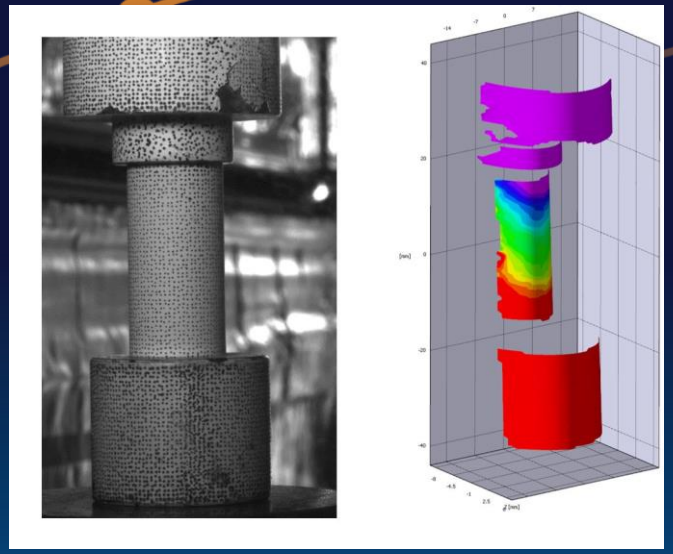
Group Breakdown by Job Function

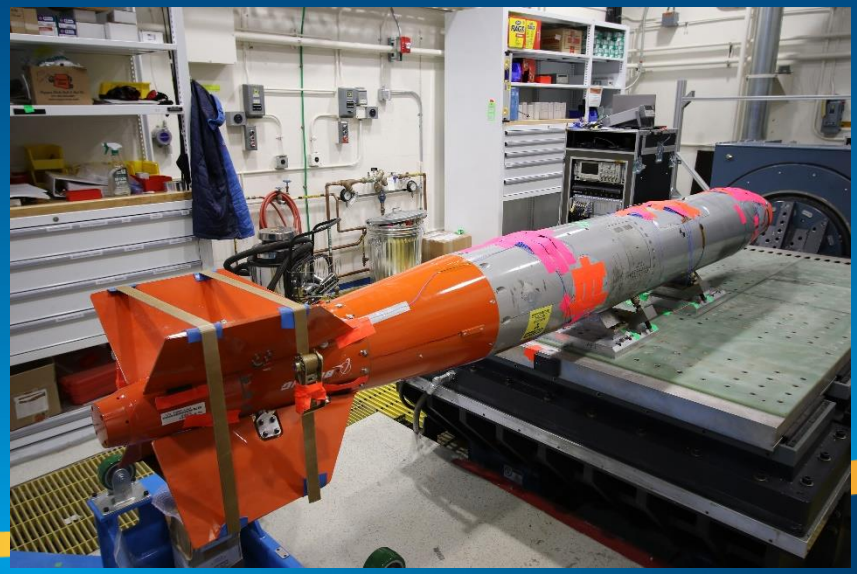


Group Breakdown by Team



Extraordinary Visuals





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DIC testing on the Blast Tube

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The Blast Tube

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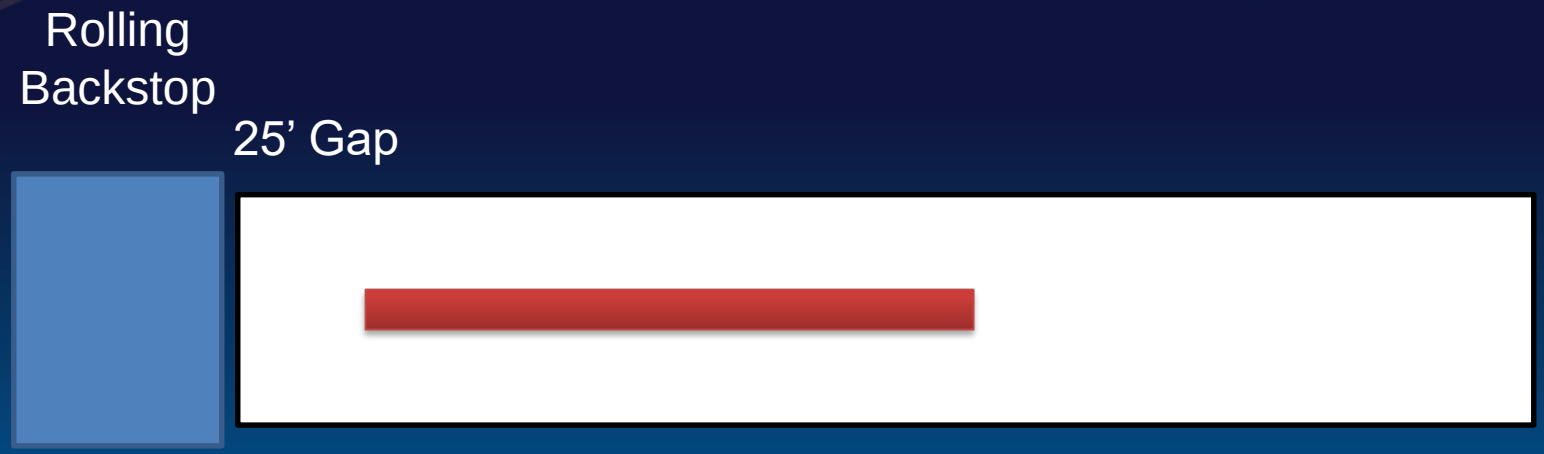
LANL Blast Tube

- Located at Lower Slobbovia with remote bunker operation
- Utilizes existing sled track as foundation
- 8 ft diameter, 2 inch side wall
- 5 – 30 ft long sections for test lengths of 30’, 60’, 90’, 120’, 150’
  - 2 HSLA-100 tube sections to sustain source term detonation
- ARMAGs used for DAQ
- Pressure measured along side and at test end
- Capable of testing objects with live HE

Explosive Configuration



6” Diameter surrounded by C-4

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190lb shot

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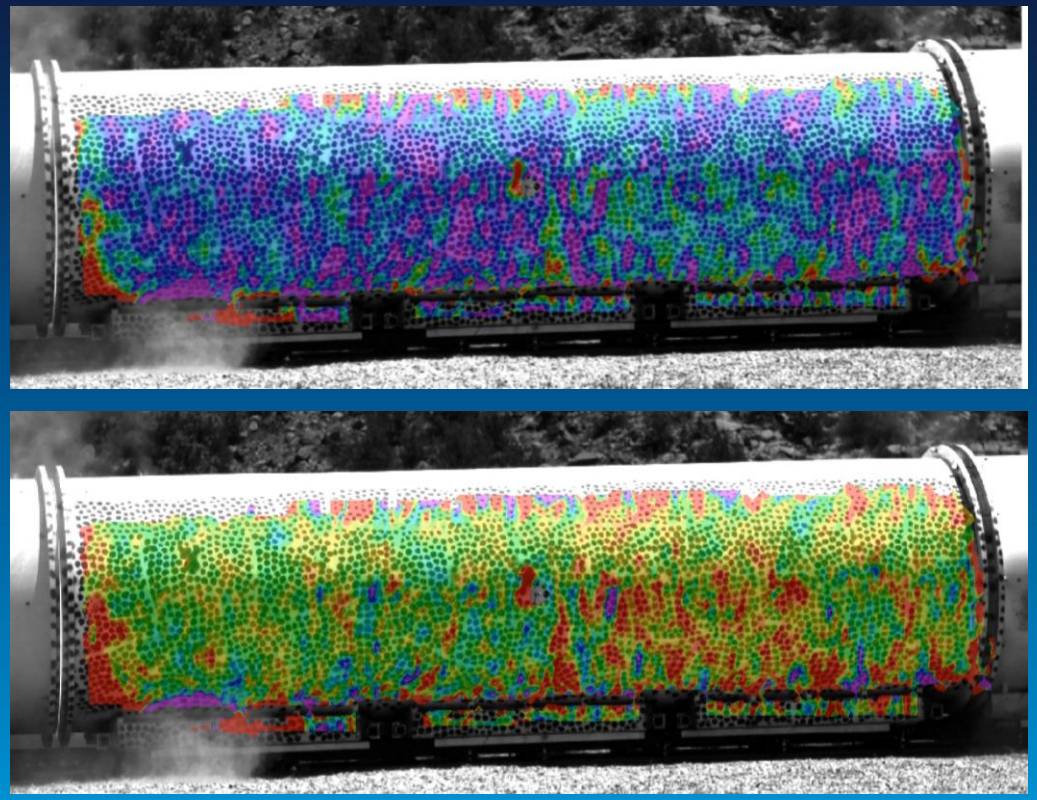
190lb shot



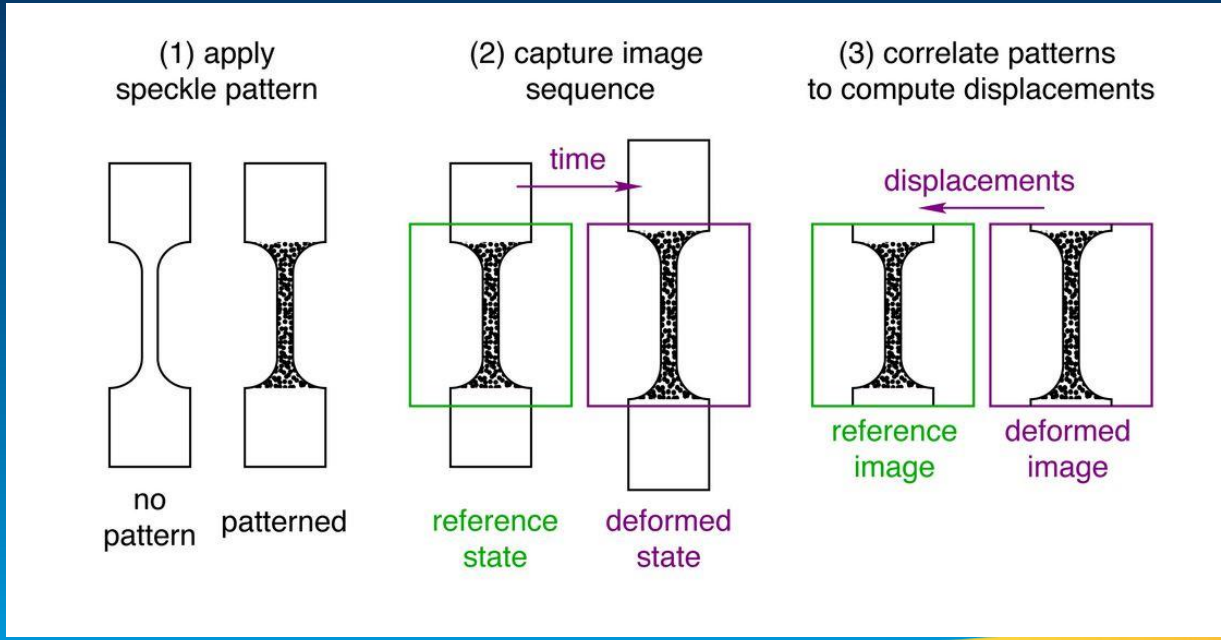
Digital image correlation (DIC) is used to understand tube motion and stress-state during source-term event

Why DIC on the Blast Tube?

- Large area of interest
  - Able to obtain data over a large area vs. points along the blast tube
- Able to obtain data outside of normal range

What is Digital Correlation (DIC)?

- Surface displacement measurement technique used to capture the shape, motion, and/or deformation of a test object by tracking a pattern in a sequence of images

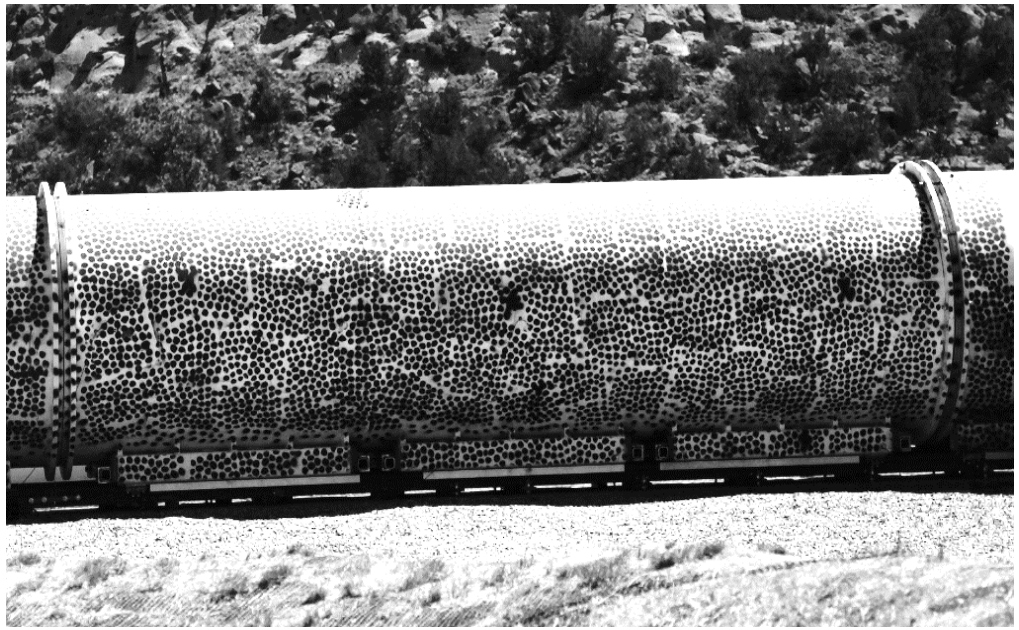


How to Perform DIC on the Blast Tube

- Pre-testing
  - Speckling
  - Calibration
  - Static and Extended Noise Floor
- Testing
- Analysis

Pre-testing: Speckling

- Speckling
  - Size
    - Optimal: 3-5 pixels
  - Variability
    - Random pattern

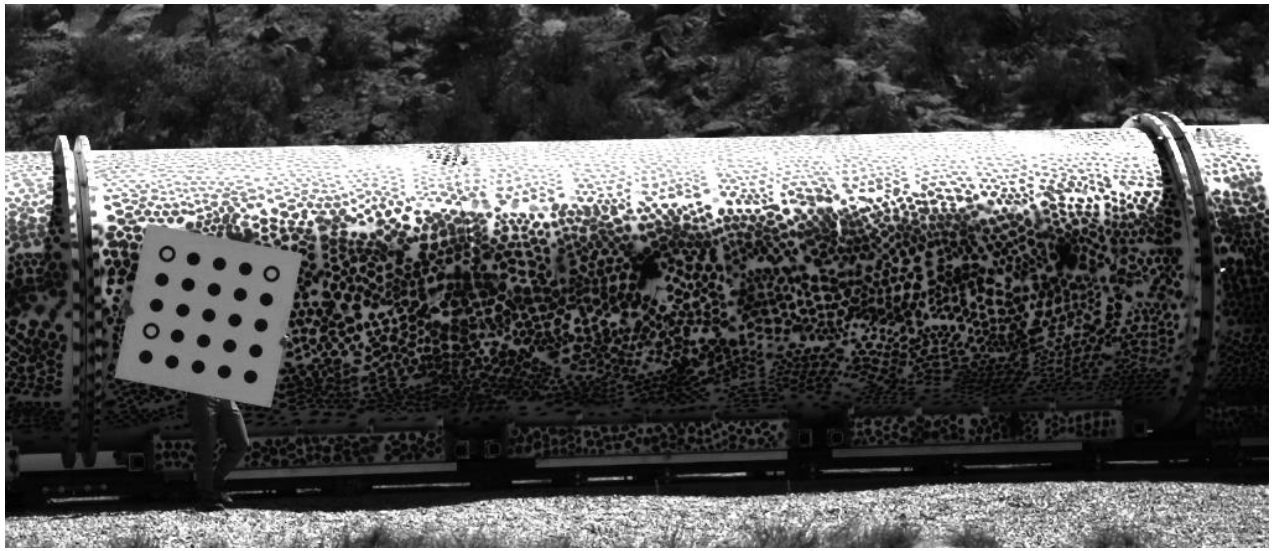


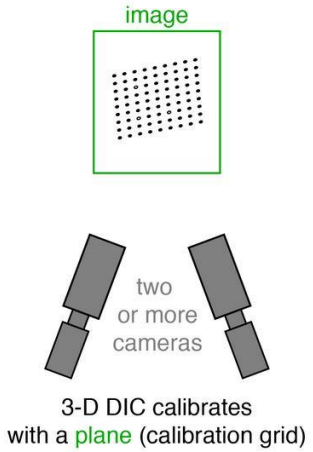
$$\frac{Field\ of\ View}{Chip\ Size} \times Speckle\ Size = Speckle\ Pattern\ Size$$

$$\frac{30\ feet}{1024\ pixels} \times 5\ pixels = \sim 0.2\ feet\ (1.875\ in)$$

Pre-testing: Calibration

- Calibration determines:
  - Intrinsic: image scale, focal length, lens distortions, etc.
  - Extrinsic: stereo-angle, distance between cameras, distance from cameras to object





Pre-testing: Noise Floor Measurements

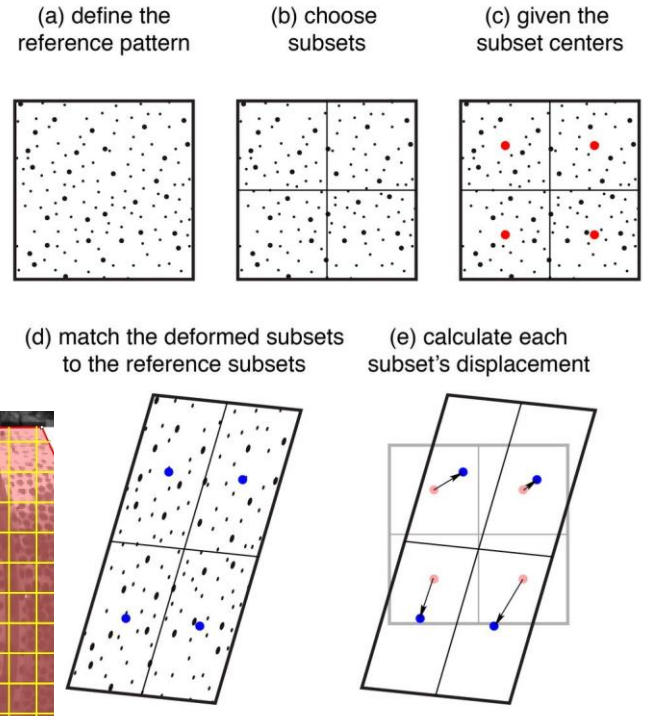
- Static Noise Floor: analyzes several static images of the test object
  - Heat waves, vibrations, etc.
- Extended Noise Floor: analyzes translation of a similarly speckled object
  - Lens distortion

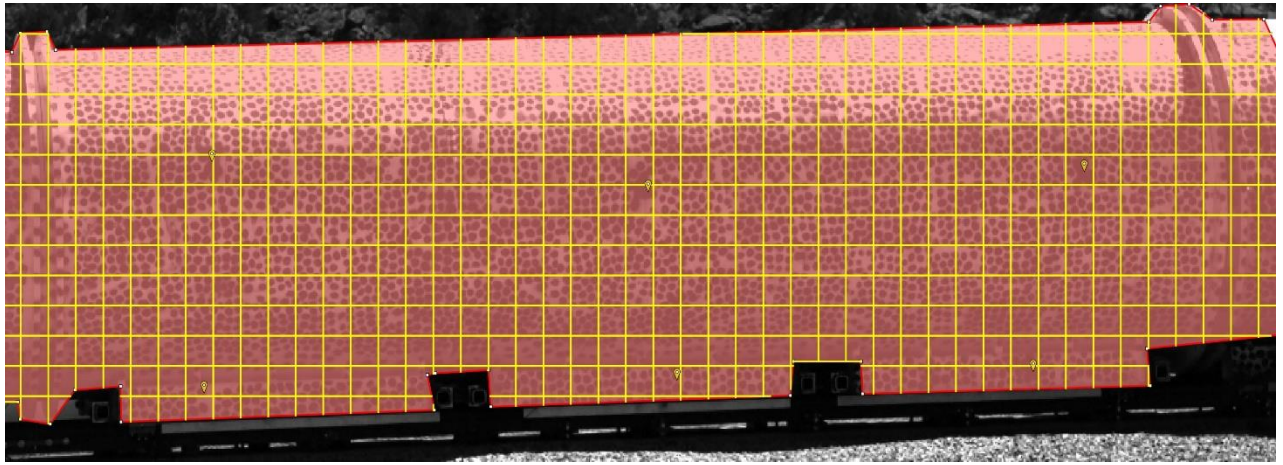
Testing

- Triggering
- Double check
  - Exposure
  - Focus

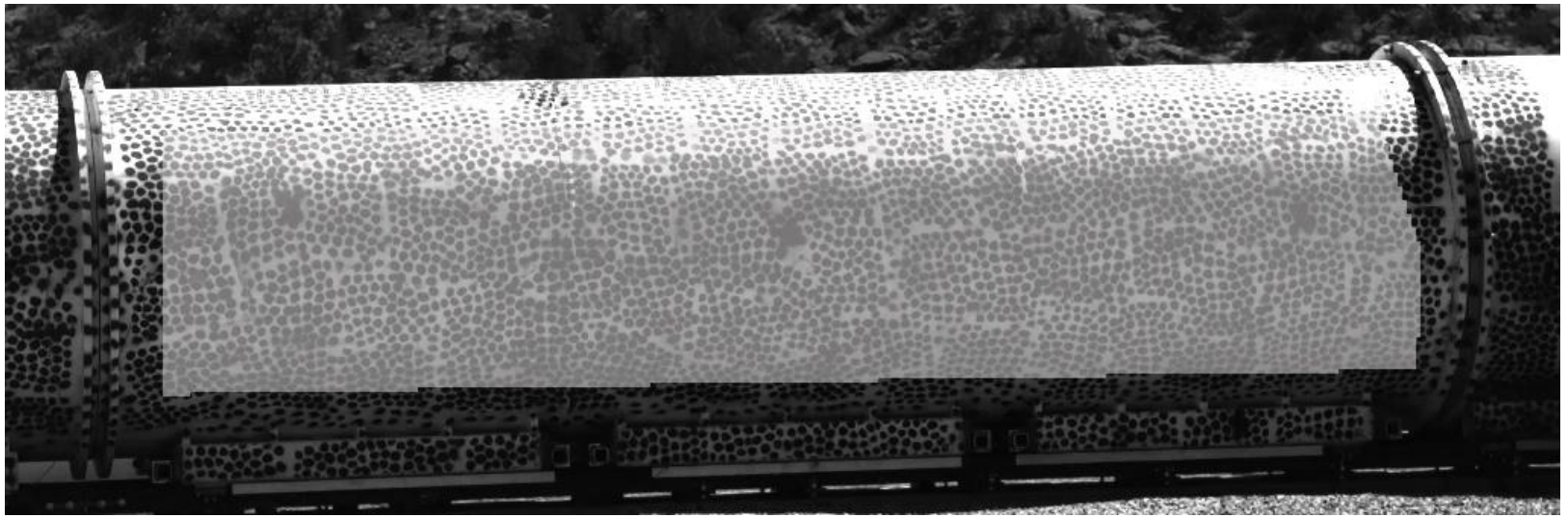
Analysis

- Subset
  - 4-5 points of interest (speckles)

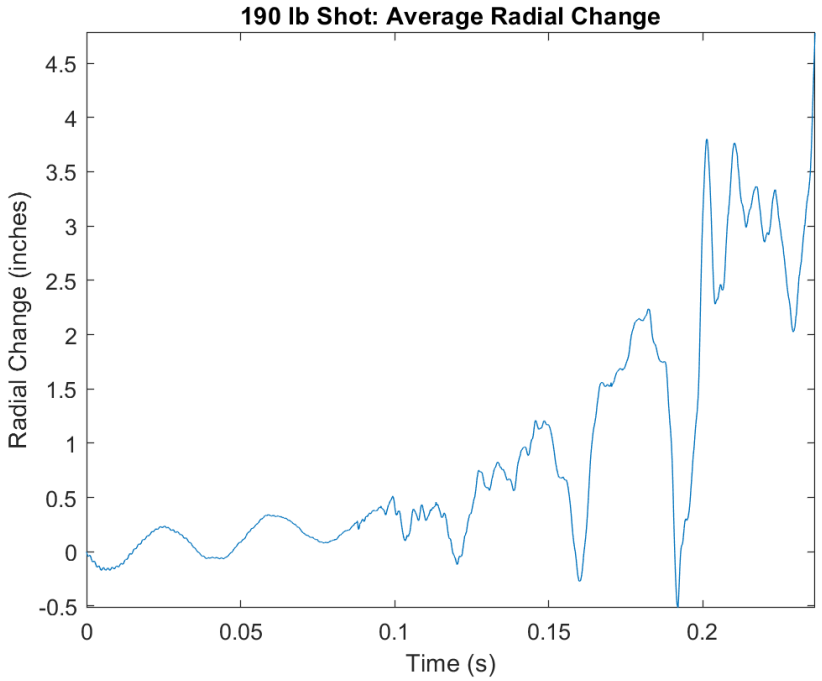


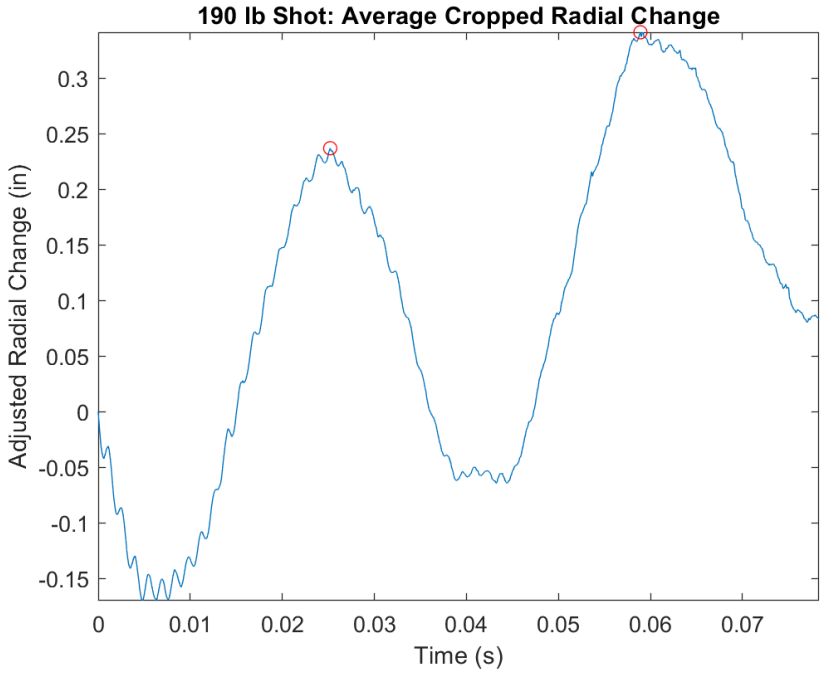


Test Results

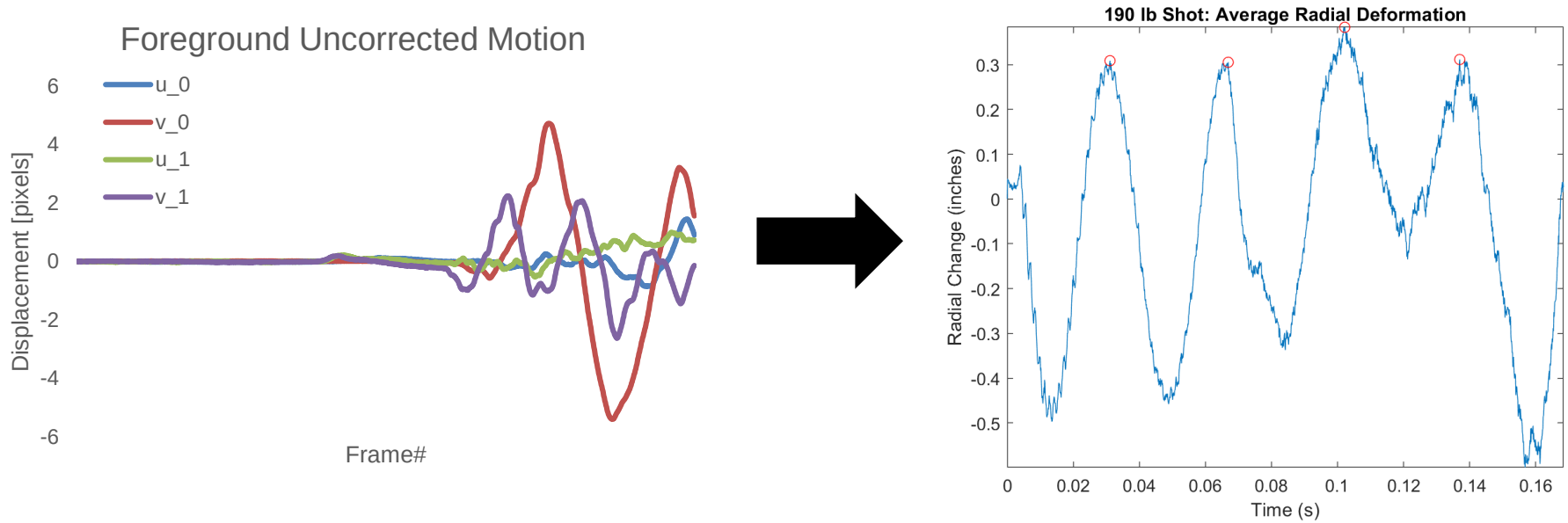


Initial Results





Updates


Foreground Uncorrected Motion
u_0
v_0
u_1
v_1
Displacement [pixels]
6
4
2
0
-2
-4
-6
Frame#
190 lb Shot: Average Radial Deformation
Radial Change (inches)
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
Time (s)

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Questions?

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