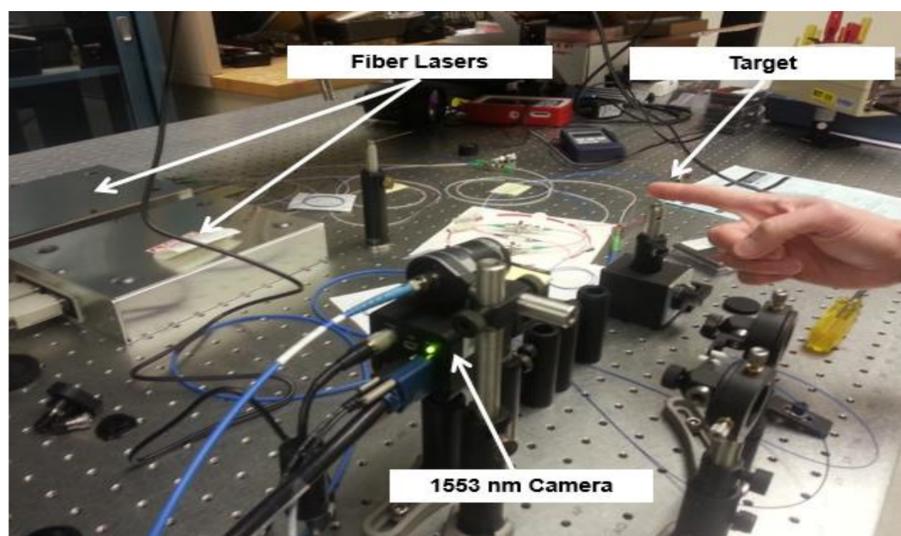


S&T Campaign: Materials Research  
*Photonics*  
*Imaging Sensors & Optics*

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## Research Objective

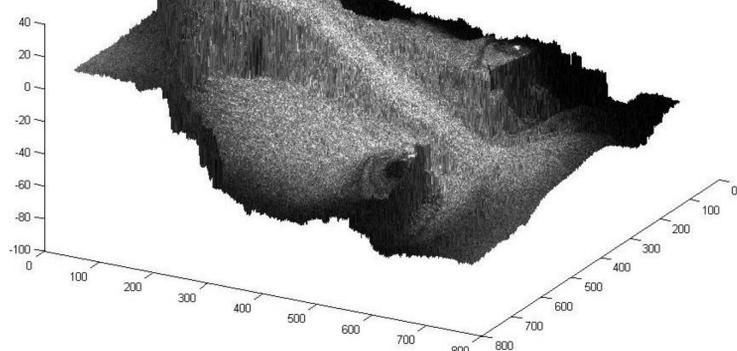
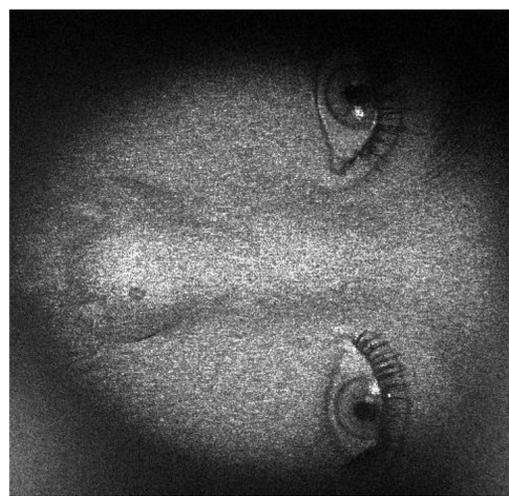
- The objective of this work is to obtain high resolution 3-D images using digital holography.
- Using digital holography:
  1. No image focusing is required
  2. The depth of field is very large, and
  3. Sub-millimeter range resolution is possible.



1550 nm Digital Holography Hardware

## Challenges

- Acquire the image using micro-second exposures to reduce motion to  $\frac{1}{4}$  wavelength of light.
- Align phase image pairs acquired at two different wavelengths.
- Unwrap the 3-D images



Two Poses from a Single Holographic Image

## ARL Facilities and Capabilities Available to Support Collaborative Research

- Collaboration between Quantum, Optics and Photonics and Signal and Image Processing Branches.
- Technical skills among researchers of: electrical engineering, photonics, image processing, interferometry, astronomy and physics aided in project execution
- Early Findings:
  - 680 nm experiments on air table confirmed 3-D imaging technique.
  - 1550 nm fiber experiments reduced exposure to microseconds (due to hardware) and increased eye safety.
  - A 1 microsecond laser pulse measures target motion of about 4-inches per second.
  - 50-100 micron range resolution realized by adjusting wavelength separation.
  - Mathematical pre-processing required prior to unwrapping images.
  - Phase image alignment must be done in phase space and not using image intensity.
  - Observed range resolution is 10-20 better than calculated value.

## Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- High power lasers, telescopes, and high speed computing are sought to advance this research.
- Expertise in placing the reference beam on target (opposed to mixing the reference beam on the sensor) would advance this research.
- Expertise in atmospheric turbulence mitigation required for long range work.