LABORATORY OVERVIEW

Principal Investigator
Dr. Brian Thurow, Department Chair, Aerospace Engineering
Acknowledgments

Tim Fahringer, Cassie Jones, Dominic Hildebrandt, Kyle Johnson  
Elise Hall, Johnathan Bolton, Chris Clifford, Jenna Klemkowsky

Not pictured: Tan Zu, Dustin Kelly, Catherine Saab, Abraham Lee
Mission: To **develop and apply** the next generation of non-intrusive optical diagnostics

Unique Capabilities
- Light field imaging with plenoptic cameras
- 3D imaging
- Ultra-high-speed imaging (1,000,000+ fps) with a MHz rate pulse burst laser system
- Particle Image Velocimetry
- Background Oriented Schlieren
- Laser Induced Fluorescence
- Multi-Spectral/Hyperspectral Imaging

Research Areas
- Optical diagnostics
- 3D imaging techniques
- Ultra-high-speed imaging
- Hypersonic Flows
- Unsteady Fluid Dynamics
- Developing
  - 3D Plume Analysis
  - Combustion & Sprays
  - Rotating Flows
  - Biomedical

Sponsors and Collaborators
- AFOSR, ARO, ONR, NSF
- NASA, Sandia, LANL
- CRAFT Tech, Metro Laser
- Florida State, Ohio St., Texas, Iowa, Notre Dame, Illinois, OleMiss, Texas A&M, Purdue, Georgia Tech
Advanced Flow Diagnostics Laboratory
The Plenoptic Camera

Render of Plenoptic Camera

Photograph of Microlens Array

Assembly in AU Clean Room
Raw Plenoptic Image
Computational Photography

Perspective Shift

Focal Plane Shift
3D PIV – Roughness and Porosity Effects

Single Hemisphere Snapshot

Velocity streamlines and vorticity magnitude isosurface

Porous Interface Snapshot

Velocity streamtraces
3D Flapping Wing

Video from inside water tunnel

Application of Flapping Flight

Experimental Layout
3D Flapping Wing

Pure Pitch

Simultaneous

Pure Roll
3D PIV – Synthetic Heart Valve

Cardiac Cycle

Particle Perspective Image
3D PIV – Synthetic Heart Valve
3D PIV - Shock-Wave Boundary Layer Interaction
Background Oriented Schlieren

**No Flame Image**

**Flame Image**

**Perspective Shift**

**Focal Shift**

**Depth of Field = 1055 mm**

**Focal Plane**

**365 mm**

**542 mm**

**Background Plane**

**Back Flame Plane**

**Front Flame Plane**
3D Particle Size/Velocity
3D Particle Tracking
Plenoptic Spectra Imager (PSI)

In collaboration with NASA Langley (Danehy)
Thanks for Watching!

Any Questions?
Plenoptic Camera Basics

(a) Conventional camera
(b) Single pixel's line of sight
(c) All pixel's line of sight