![NREL - National Renewable Energy Laboratory - Innovation for Our Energy Future]

The Dawn of Scientific Visualization at NREL: Soliciting Best Practices (& Collaborations)

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Planting some seeds…

- **What visualization technologies have worked well (or poorly)?**
- **What visualization technologies have had the greatest impact on:**
  - **the science?**
  - **the stakeholders?**
  - **research funding?**
- **If you had a clean slate, what you do the same? Differently? Why?**
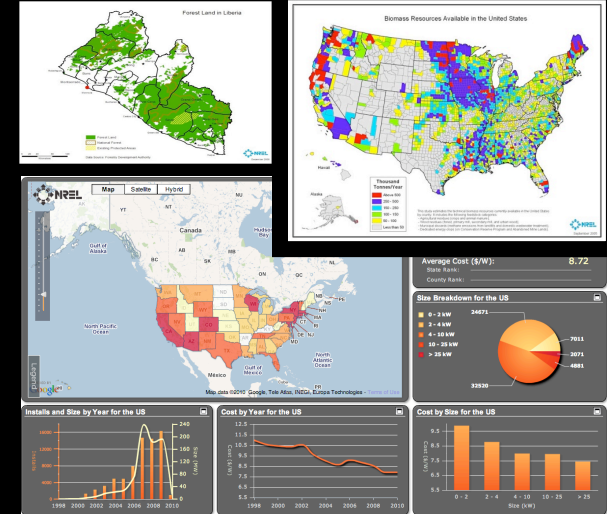
National Renewable Energy Laboratory

Energy Efficiency

- Vehicle Technologies
- Building Technologies
- Industrial Technologies

Renewable Energy

- Wind
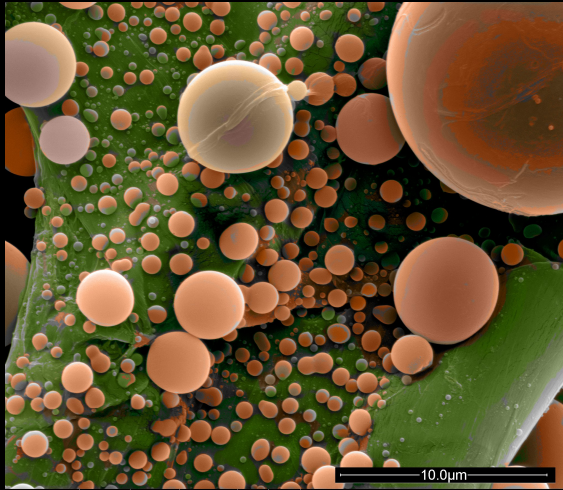- Solar
- Bio-fuels
- Geothermal
- Energy Storage and Delivery

Energy Analysis

- Technology Systems Analysis
- Market Analysis
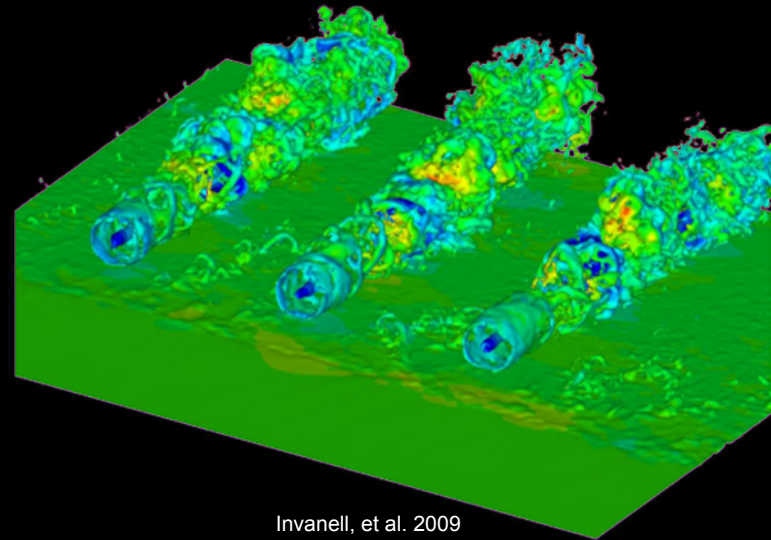- Policy Analysis
- Sustainability Analysis

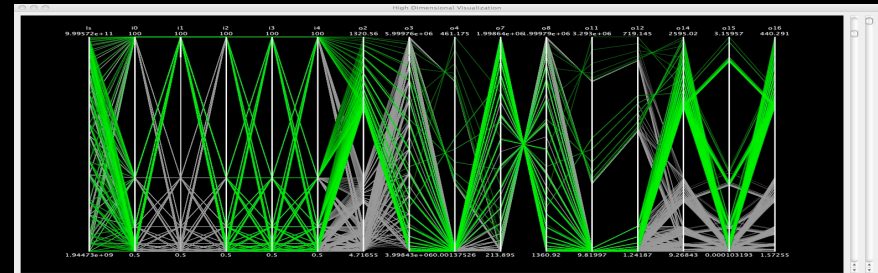# Data Visualization

Wet (Laboratory) Data

Data Courtesy of B. Donohoe

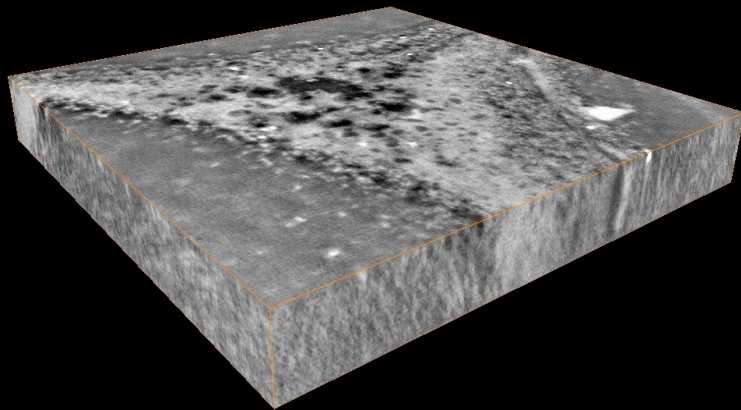## Dry (Computational) Data

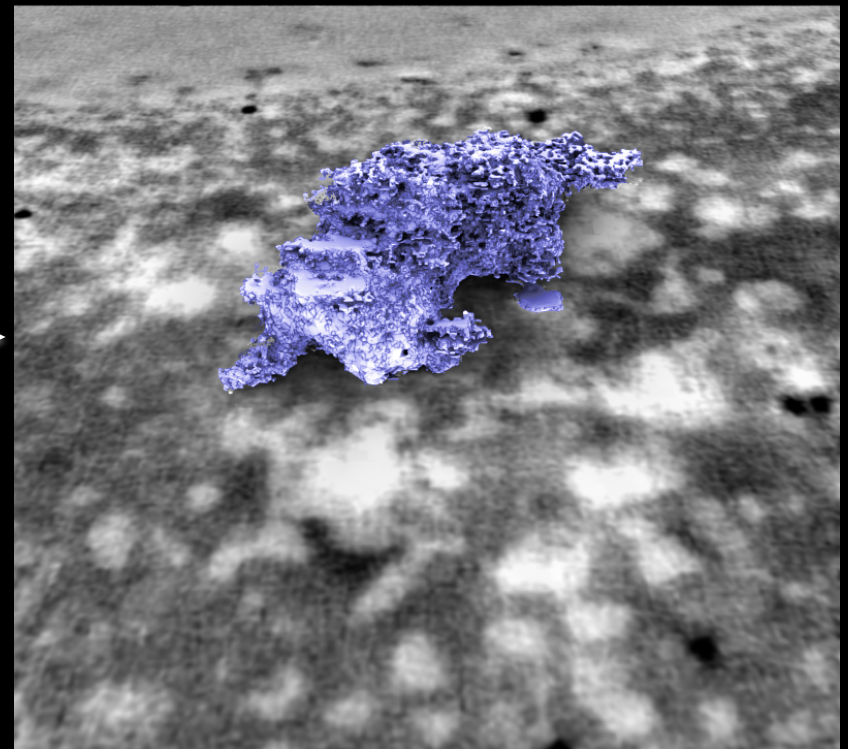Invanell, et al. 2009

Chang, et al. 2010

Data Courtesy of G. Krisnan
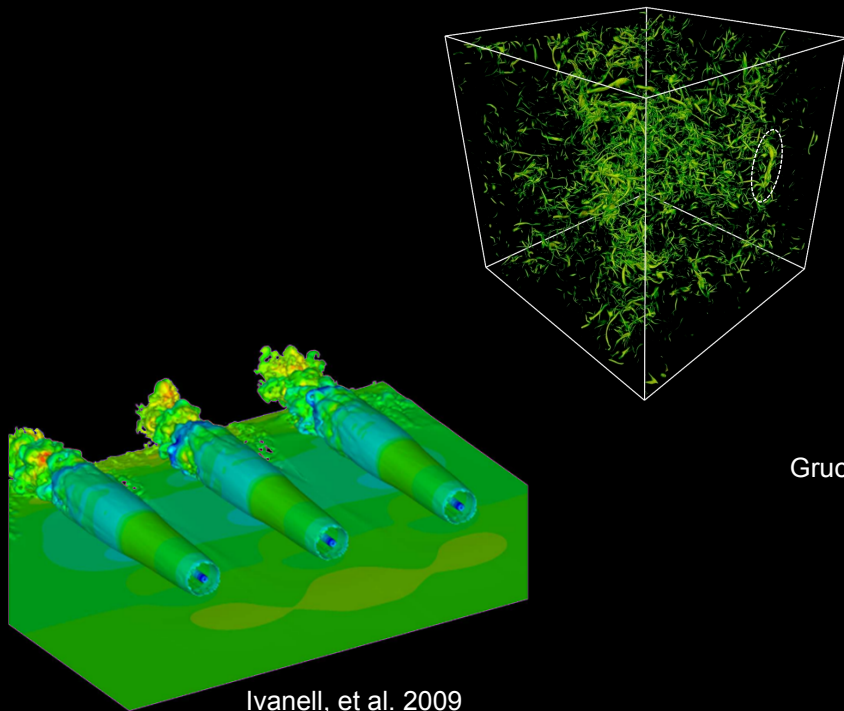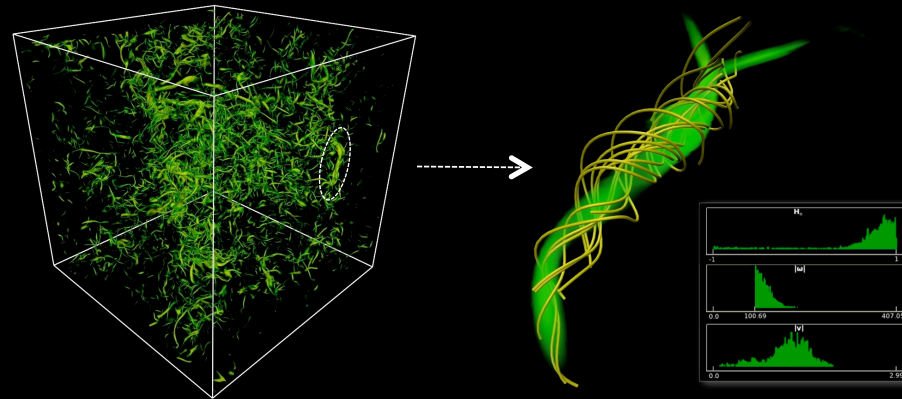
Biomass Segmentation

Biomass Tomogram

Coalesced Lignin
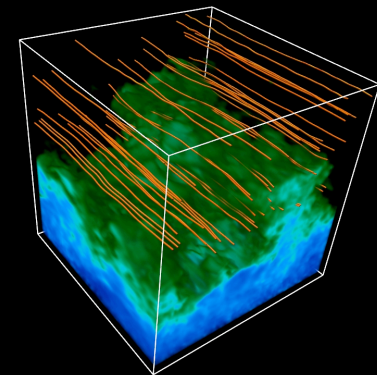

Data Courtesy of B. Donohoe

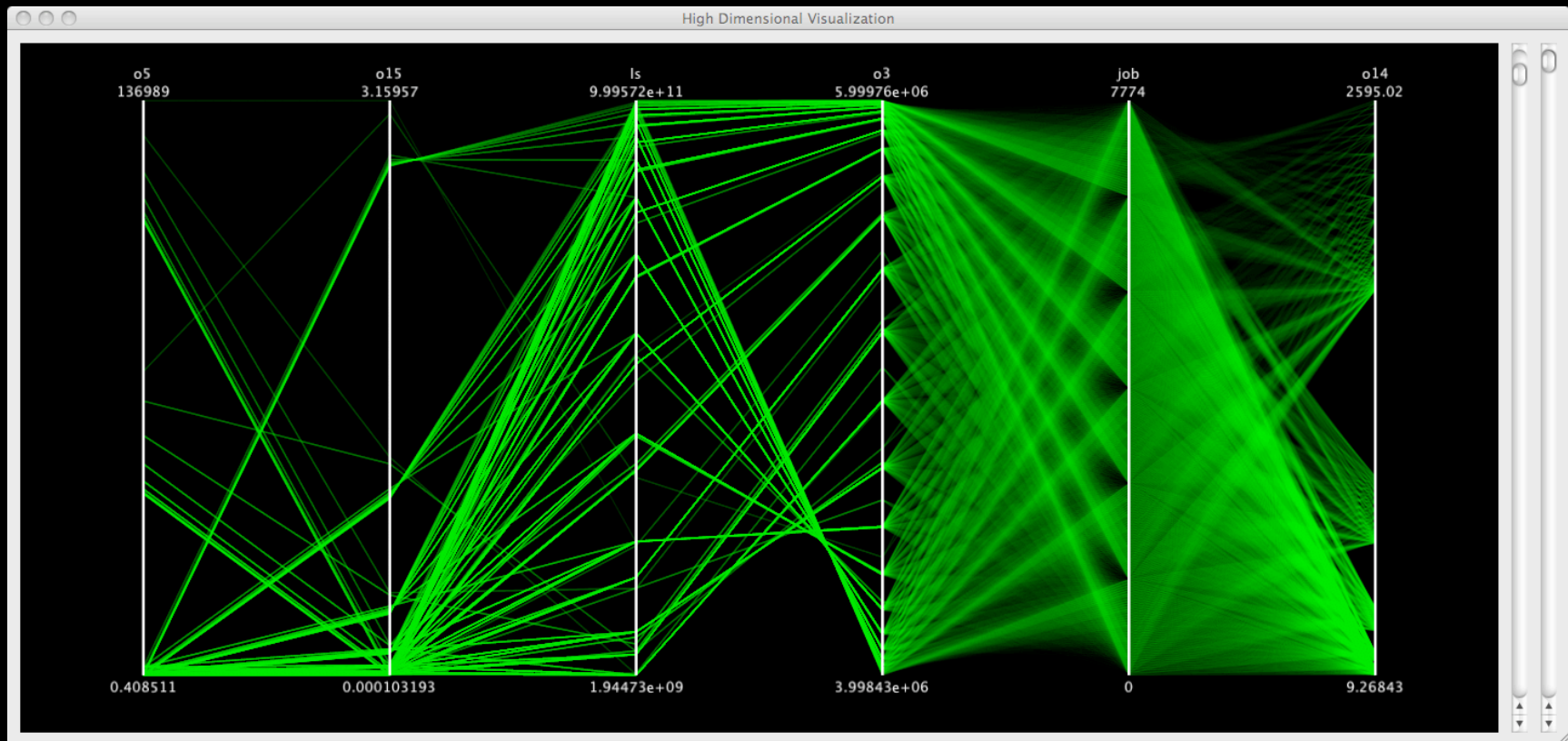# Multivariate Visualization & Feature Extraction

Gruchalla, et al. 2009

Ivanell, et al. 2009

Data Courtesy of M. Chruchfield

- Turbulent wake fields behind wind turbines
- Electric fields in organic photovoltaic morphologies
- Fuel combustion simulations
- Turbulent transport

High-Dimensional Data Analysis

Current Visualization Resources
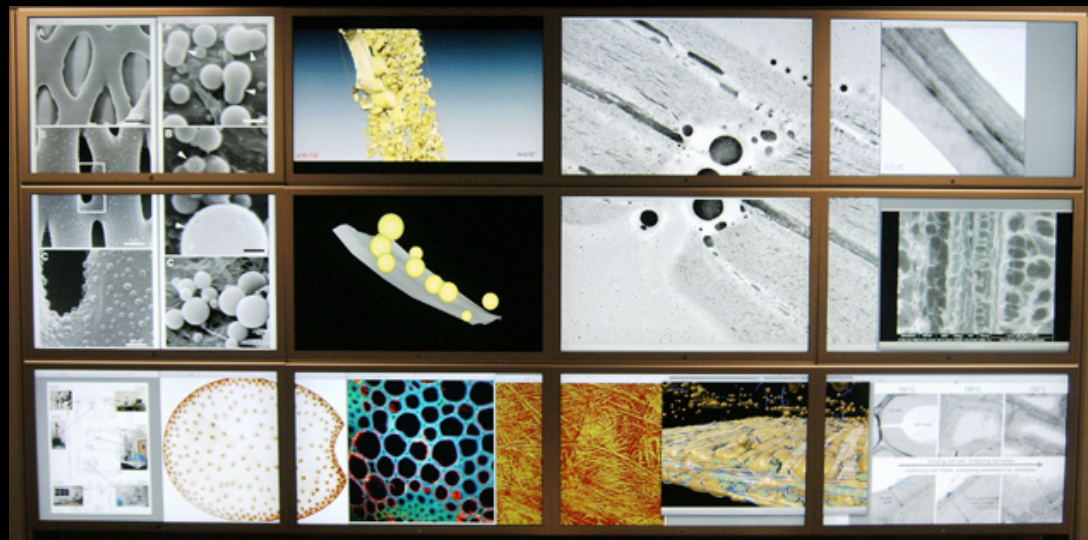
Compute Hardware

- Linux Graphics Workstations
- Mac Pro Graphics Workstations
- Red Rock
    - 15 TFLOP Linux cluster
- Red Mesa
    - 180 TFLOP Linux cluster

Display Hardware

- 3 Large (~27MP) Display Walls
    - Tiled LCDs
- WXGA HD Stereoscopic Projectors
    - Active stereo

Visualization Wetware
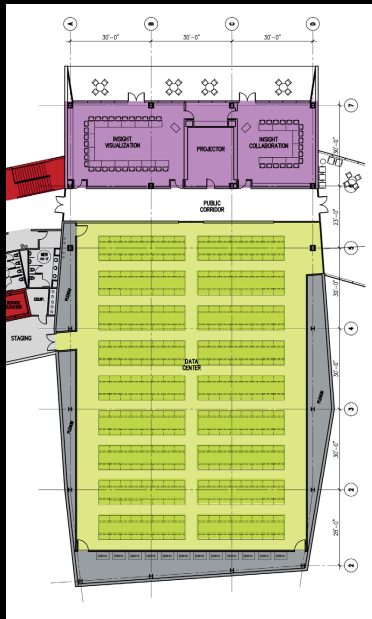
- Kenny Gruchalla
- Pushpak Karnick

Future Computational & Visualization Facilities

Energy Systems Integration Facility (ESIF)
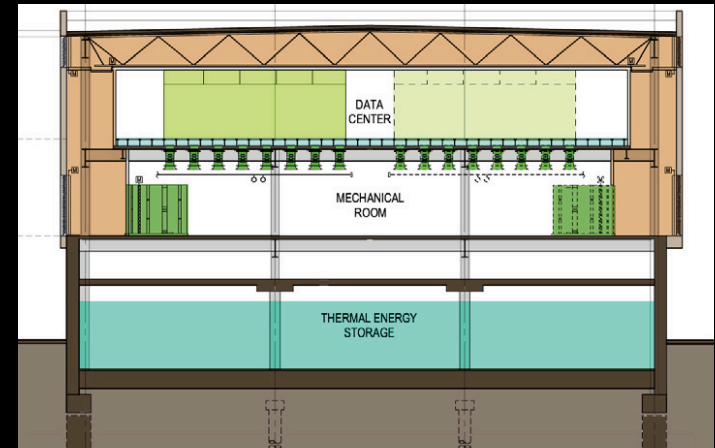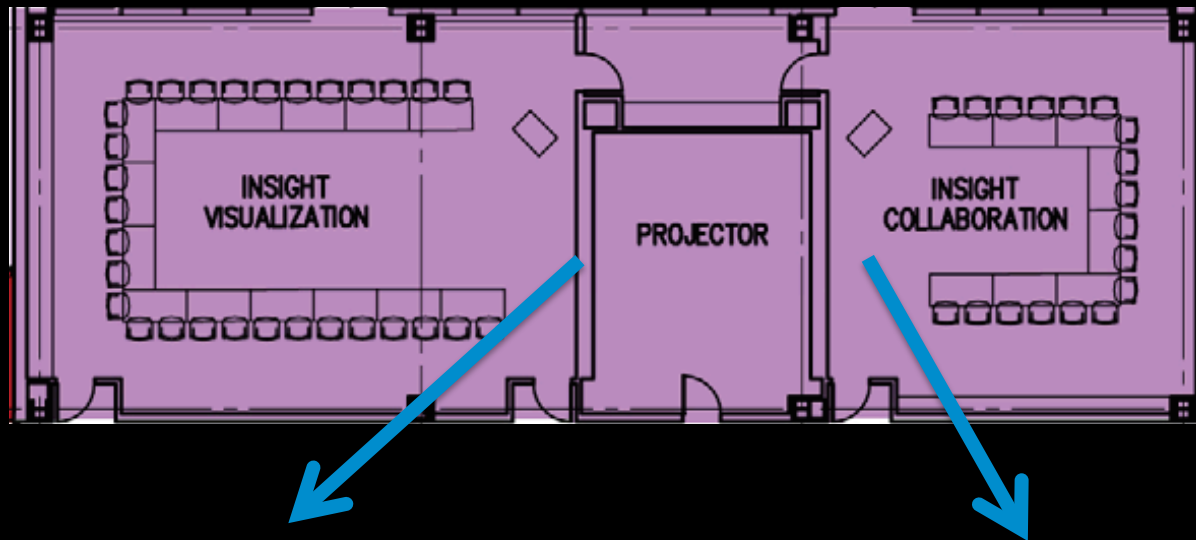

Artist's Conception

Data Center
- 11,000 ft^2 raised floor
- Evaporative cooling
- 200-500 TFLOP Cluster
- Visualization cluster?

Visualization Laboratory
(Insight Center)
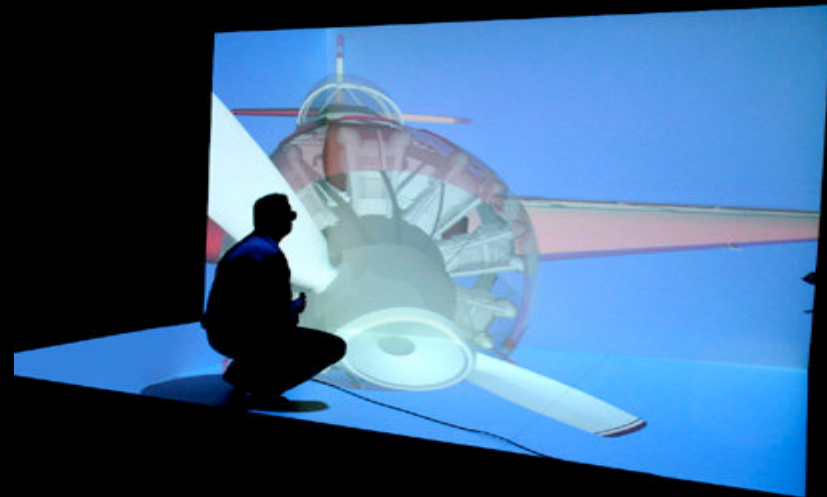- 2700 ft^2
- With ???

ESIF: Insight Center

High-resolution, rear-projected display wall

Immersive & collaborative spaces

Best Practices / Lessons Learned?

High-Resolution Projected Display Walls
- Solutions:
    - Turn-key (Cyviz, Barco, MechDyne, …)
    - Home-grown (with Mersive, Scalable, …)
- Technologies:
    - 4K Projectors, projector arrays, blending, …
- Recurring Problems:
    - Alignment problems, calibration, …

Immersive & Collaborative Spaces
- Trackers
- Stereo (Active vs Infitec vs polarized)
- Tabletop displays
- …

Remote Visualization
- Cluster-based (e.g, Paraview)
- GPU-based (e.g., VirtualGL)
- …

- What has worked well?
- What has worked poorly?
- What has had the greatest impacts?