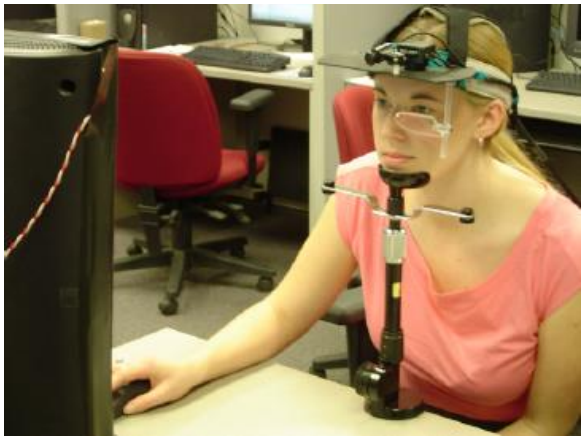
Visual Computing for Big Data

Amitabh Varshney
Institute for Advanced Computer Studies and
Department of Computer Science
University of Maryland at College Park

My Current Visualization Projects

- Visual Attention Management Tools for Big Data
  - Visual Saliency
  - Visual Persuasion

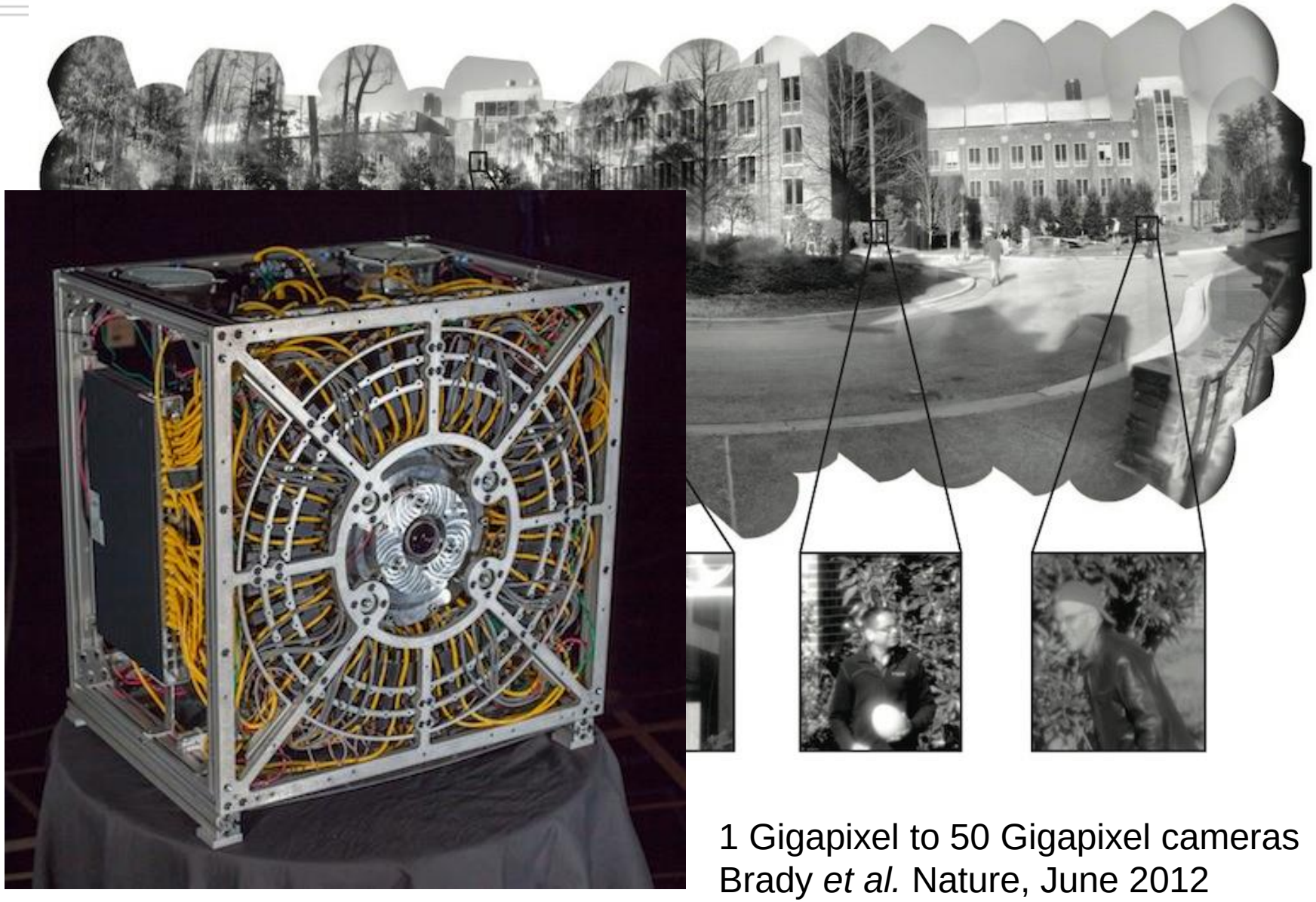


- Driving Application Domains
  - Brain Imaging (DKI and DTI)
  - Live Cell Imaging (with Peter Bajcsy at NIST)
  - Hyperspectral Astronomy Datasets
  - Visual understanding of various disease progressions, such as Parkinson's

Current Challenges

- Modeling of Visual Attention
  - Functional Near-infrared Spectroscopy
- Processing very large datasets
  - tackling the data movement challenge
- Visual depiction of large spatio-temporal data
- Visualization tools for 10s to 100s of superposed scalar and vector fields
- Leveraging machine-learning techniques to facilitate new visualization techniques

Digital Camera Technology



1 Gigapixel to 50 Gigapixel cameras
Brady *et al.* Nature, June 2012

Personal Drones

Quad, Hexa, and Octocopters

A Multi-Gigapixel Landscape Image

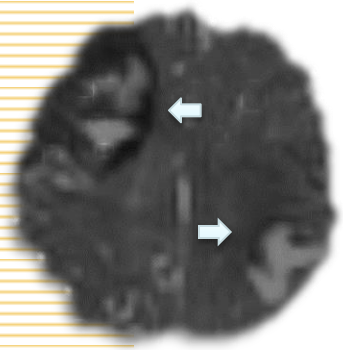
Detailed Panning is Impractical

Cannot afford to miss the salient …

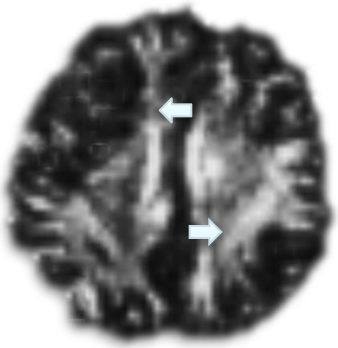
Mount Whitney (5.0 GPix)

Traumatic Brain Injury

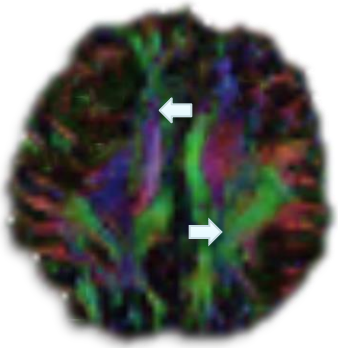
- Traditional diffusion tensor imaging does not exhibit high contrast around injury
- Kurtosis values high around the injury region



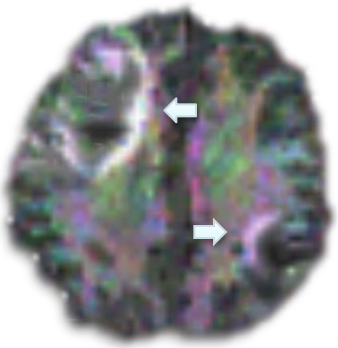
Mean diffusion



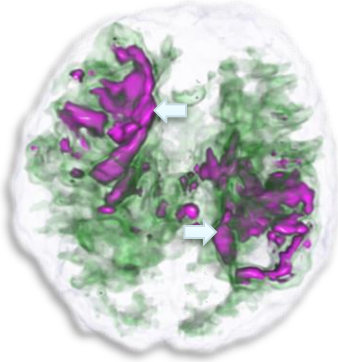
Fractional anisotropy



Principle diffusion direction



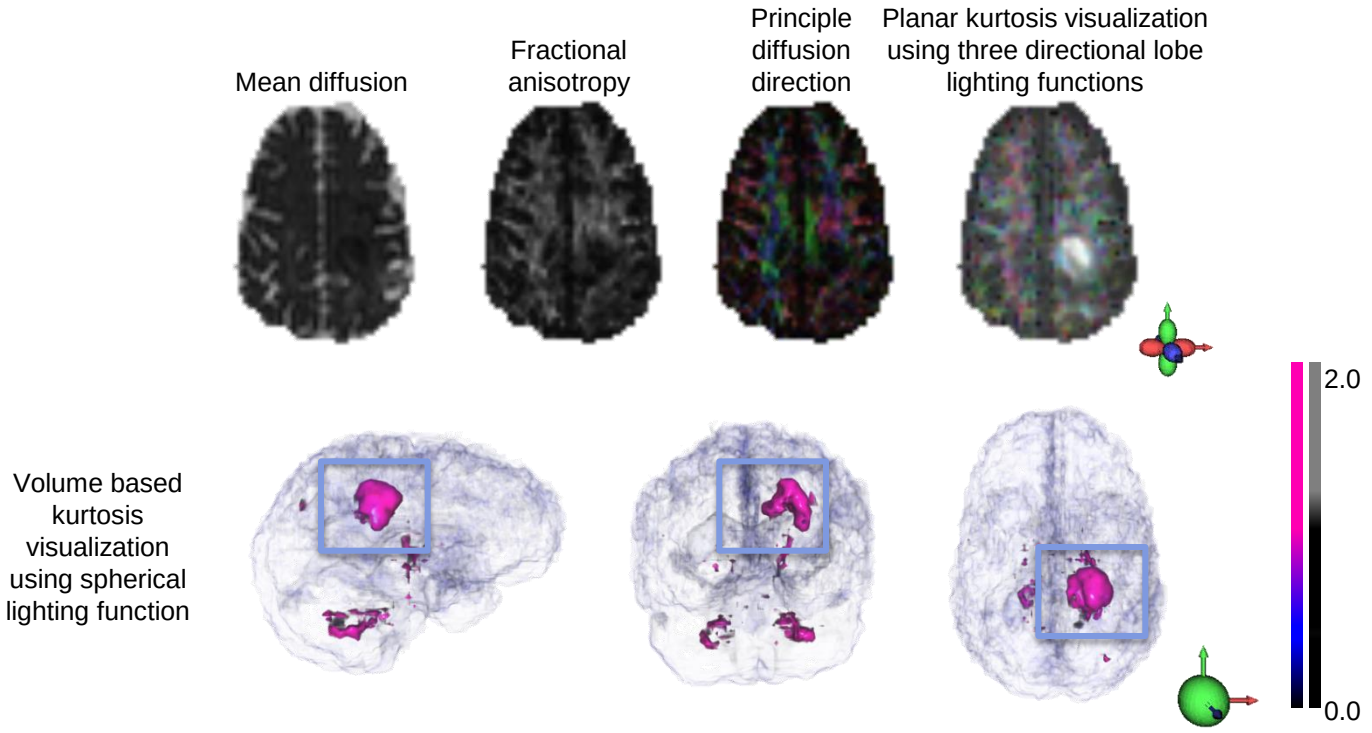
Planar kurtosis visualization using three directional lobe lighting functions



Volume based kurtosis visualization using directional lobe lighting function

Case Study : Tumor

- Tumor only visible in kurtosis dataset
- High kurtosis values around tumor

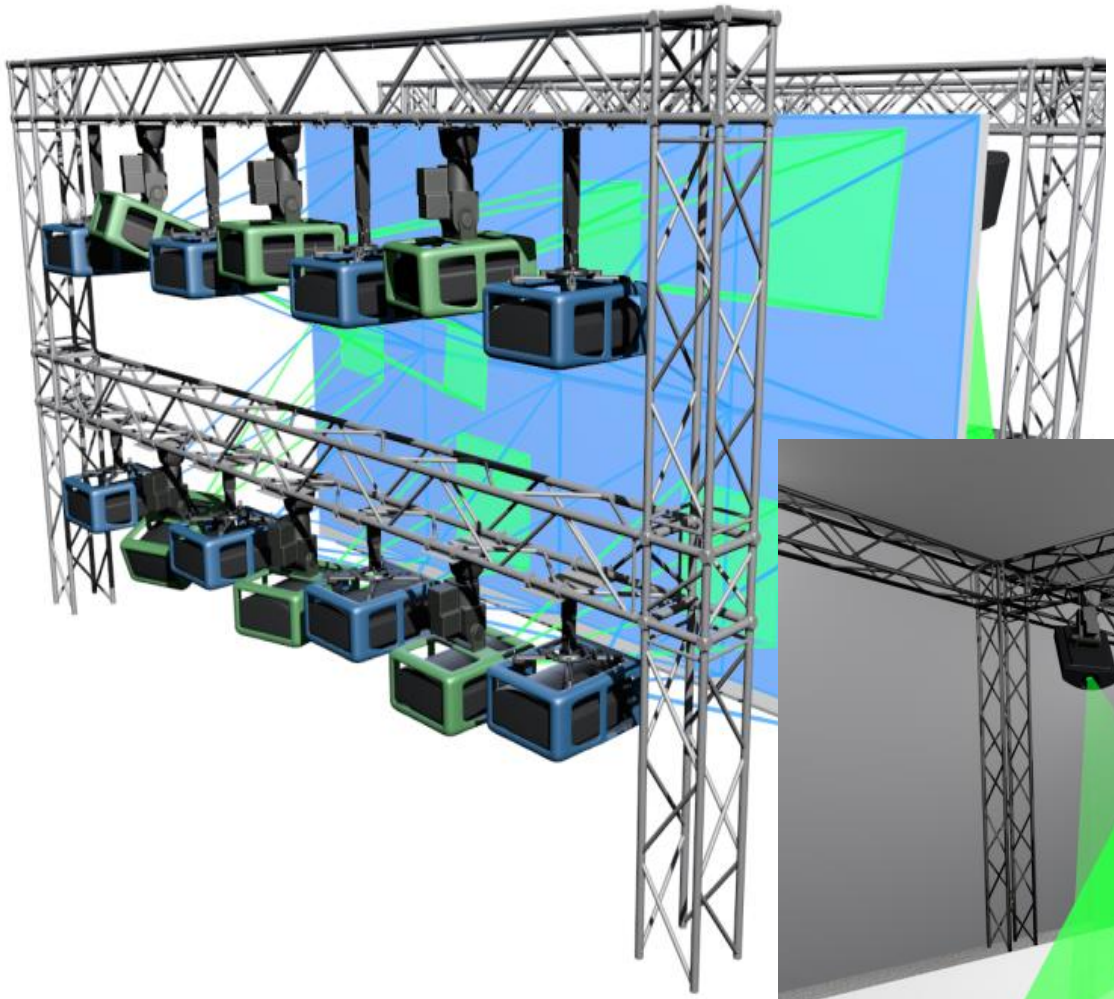


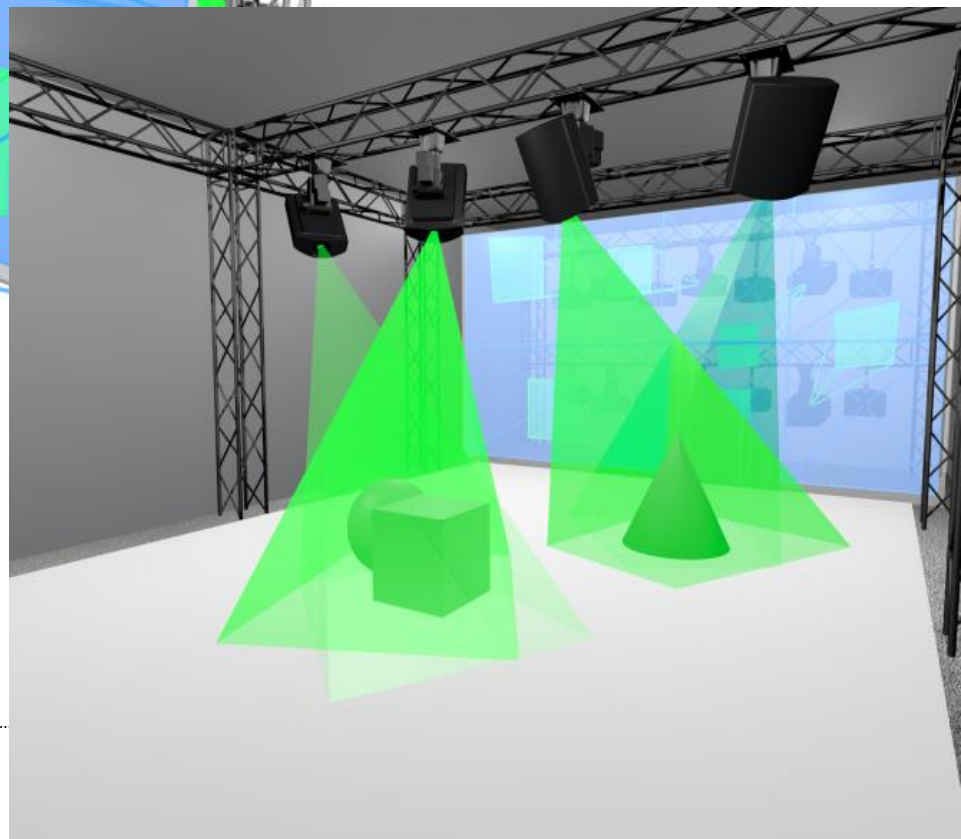
Wish List / Near Future Plans

- Visual Augmentation of Humans
  - Proceed from Spatial AR to Personal AR

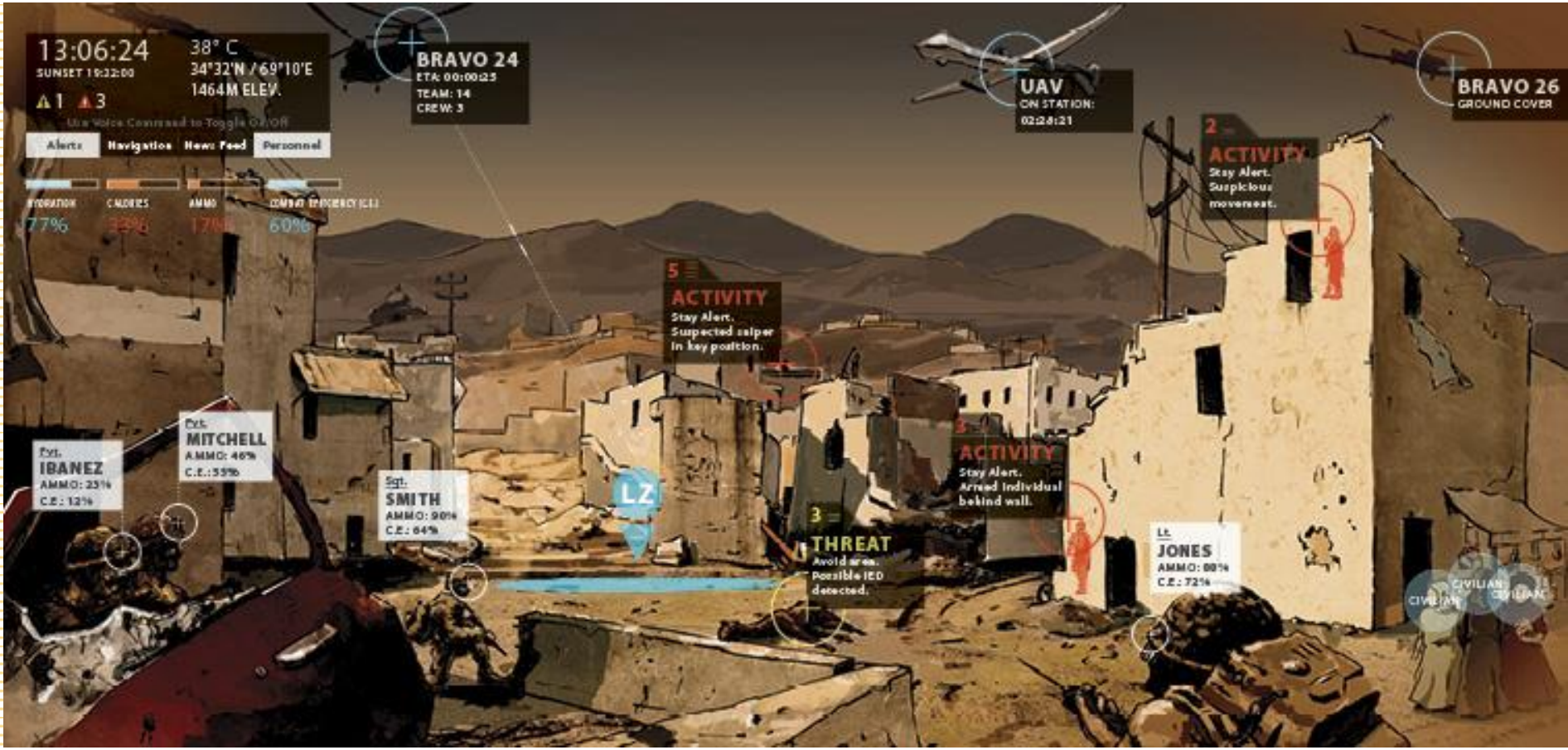
- Spatial AR: leverage advances in
  - Programmable robotic mounts
  - Projector-Camera Pairs
  - GPU-based visual display

Augmentarium





Mixing Real and Virtual Environments



Mixing Real and Virtual Environments