CSCI2370, "Interdisciplinary Scientific Visualization," David H Laidlaw, Brown University

Introduction to the CSCI2370 Projects Proposed by Peter Bajcsy, ITL, NIST

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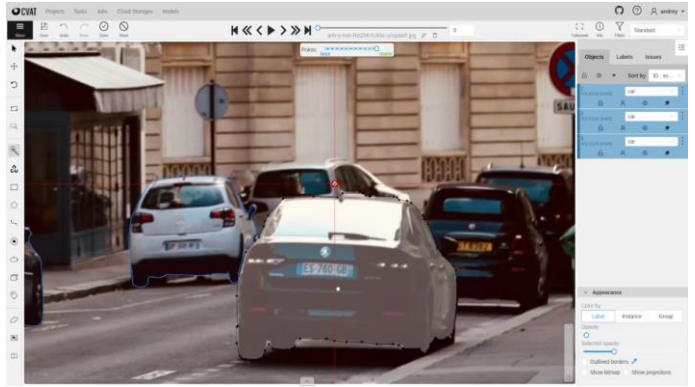
National Institute of Standards and Technology
U.S. Department of Commerce

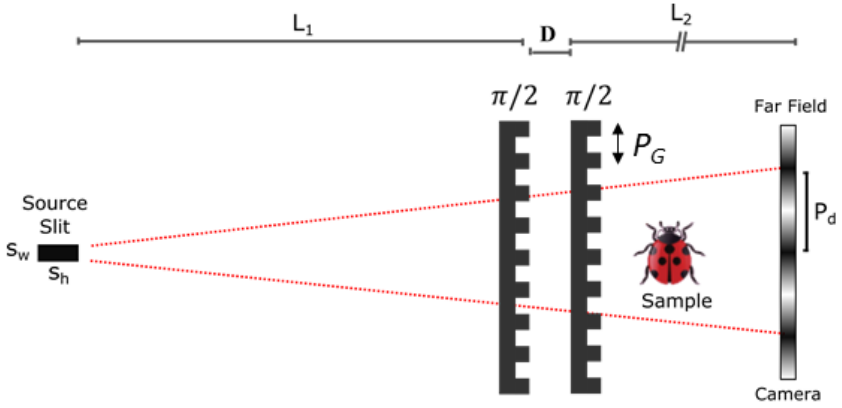
Project 1: Visualization of high-dimensional scientific images

- **General Task:** Visualize high-dimensional images for manual segmentation tasks where the segments are defined by the homogeneity of high-dimensional attributes.
- **Requirement:** CVAT compatible (limited to color 2D images)
- **Dataset source:** INFER neutron imaging data.
  - Neutron interferometric microscopy of small forces and hierarchical structures (INFER)
  - Combines neutron imaging, interferometry, and small-angle scattering



https://www.cvat.ai/

Novel Neutron Imaging Far Field Interferometer



2-Grating Far Field Interferometer

- D = [0.05 to 5 cm]
- $P_D = P_G L / D$
- Sample microstructure reduces visibility
- ***Tunable period probes 1-10^4 nm***

https://www.nist.gov/programs-projects/interferometry-infer-neutron-interferometric-microscopy-small-forces-and

Neutron Imaging Dataset

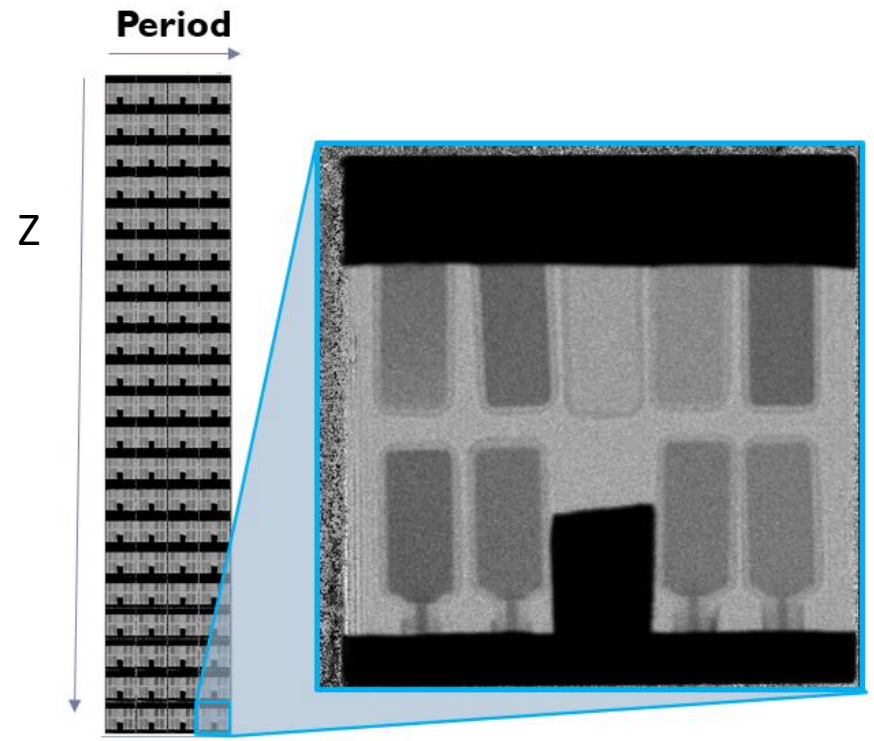
Dimensions: Spatial (x, y), Z, Period (P)

$$\xi = \frac{\lambda Z}{P}$$

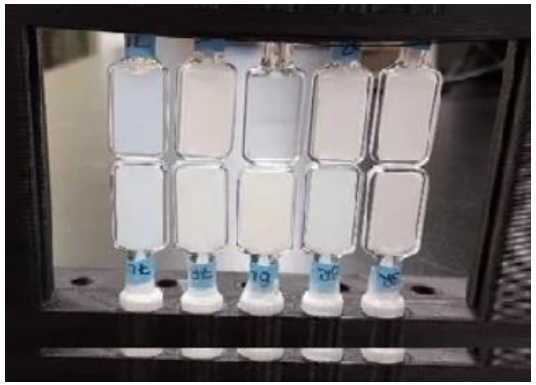
Z: separation of the sample and detector
Period (P): Period of the interference pattern
(x, y, Z, P) = (1942, 1942, 21, 4)

URL: https://isg.nist.gov/deepzoomweb/data/inferSegmentation

- Measured Intensities for 84 autocorrelation values: A sample with polystyrene (PS) beads with varying radii in Deuterium Oxide suspensions acquired at ORNL HFIR) – 1.5GB
- Measured Intensities for 39 autocorrelation values: Amorphous Solid Dispersion (ASD) sample with varying concentrations of Palmitic Acid-d31 in poly(lactic-co-glycolic acid) or PLGA acquired at ORNL HFIR – 650 MB



(TOP) Montage of INFER neutron images arranged by their period and auto-correlation. The inset is a zoom to show one of the images.
(BELOW) Reference Materials.



Project 2: Visualization of the data from frame- and event-based cameras

- **General Task:** Visualize images from frame-based and event-based cameras for manual spatial registration and temporal synchronization
- **Data sources:**

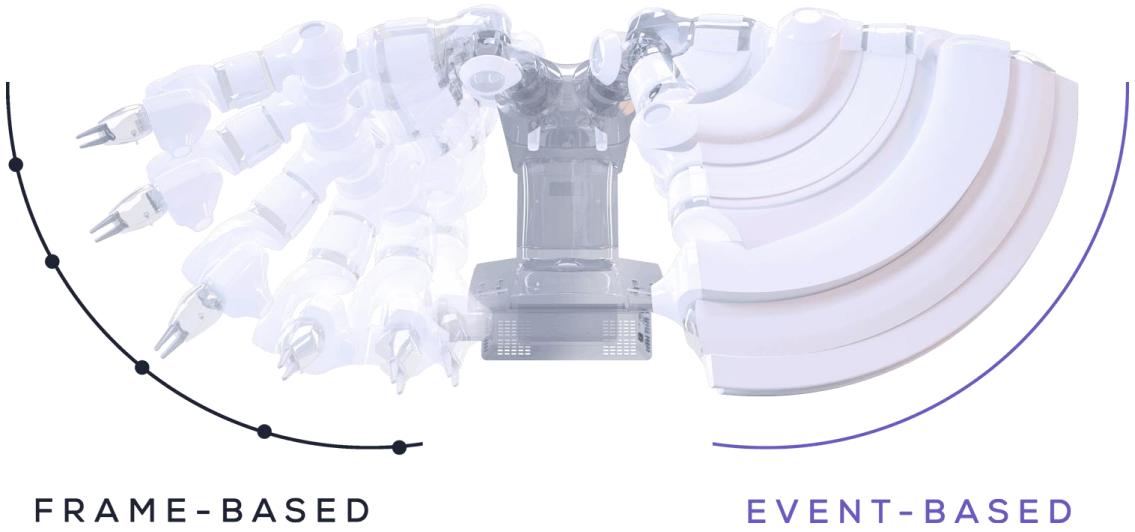
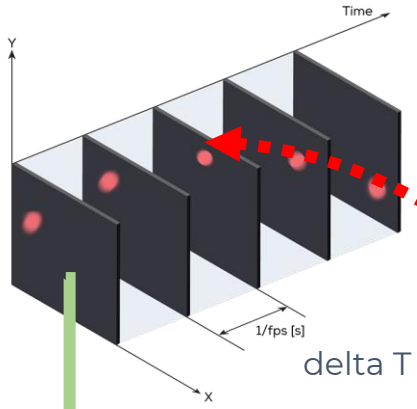


Image courtesy Prophesee S.A

NIST Experimental Setup with Frame-based and Event-based Cameras

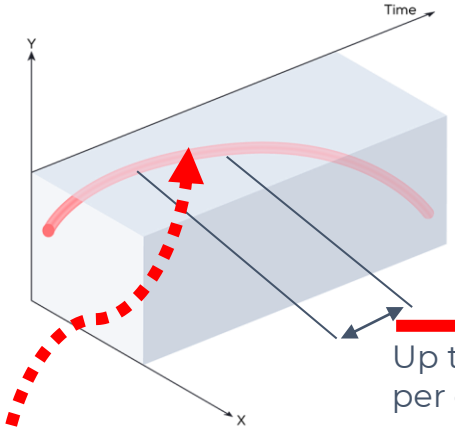
Intensity- and Event-Based Dataset

Frame-based (.tif files)



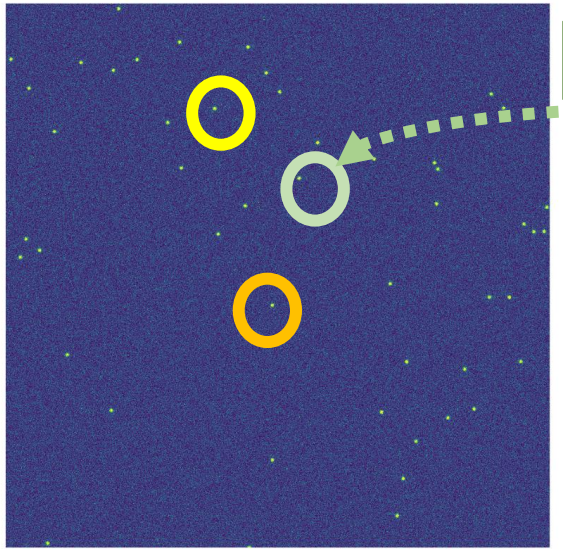
delta T

Event-based (.raw files)

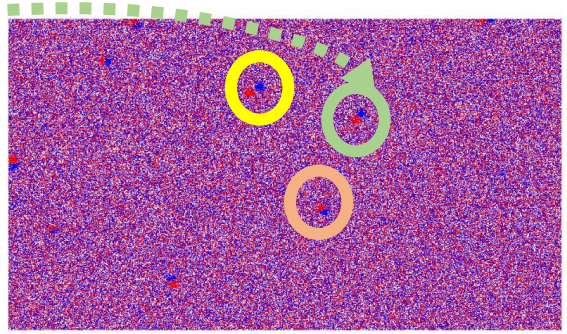


Up to million events
per delta T

Temporal synchronization

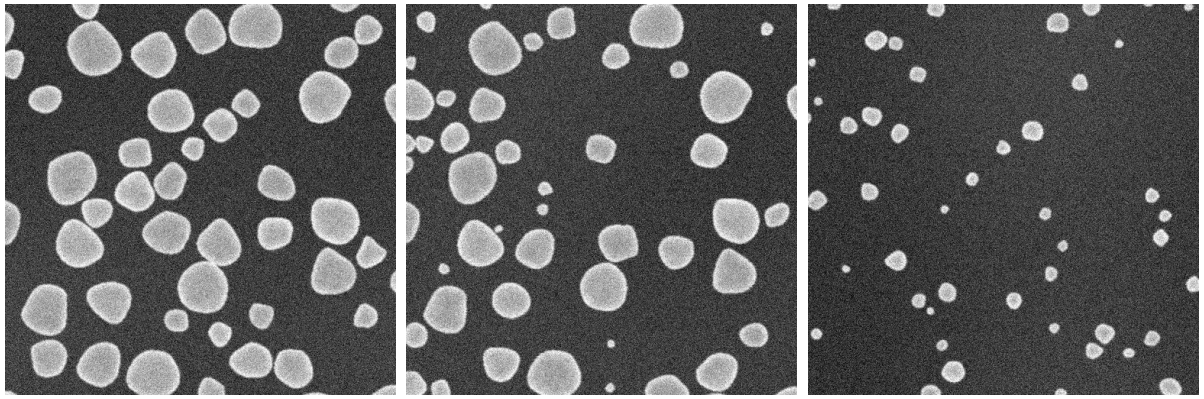


Spatial registration

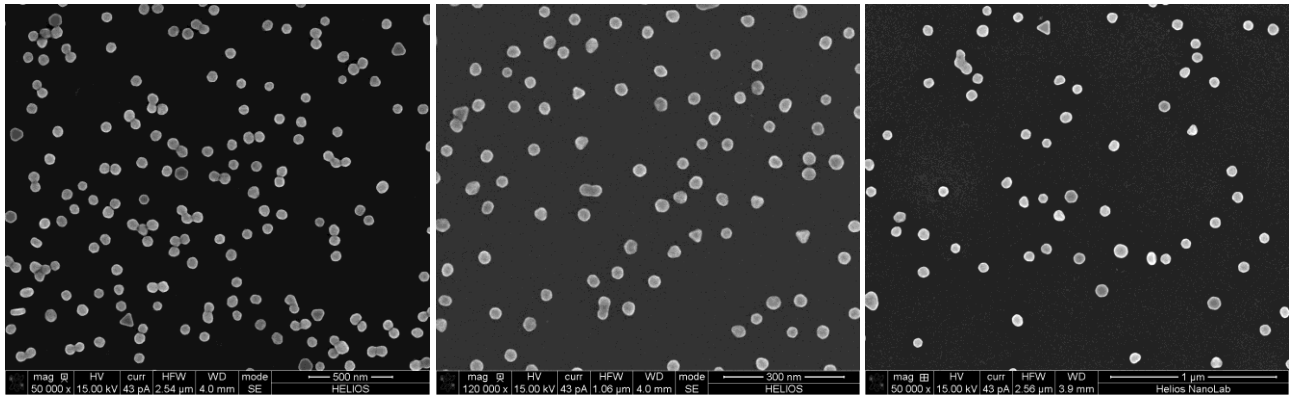


Project 3: Visualization of matching image pairs

- **General Task:** Visualize measured images matched with simulated images in a high-dimensional space of simulations
- **Data sources:**
  - Scanning electron microscope (SEM)
  - Simulations of SEM images

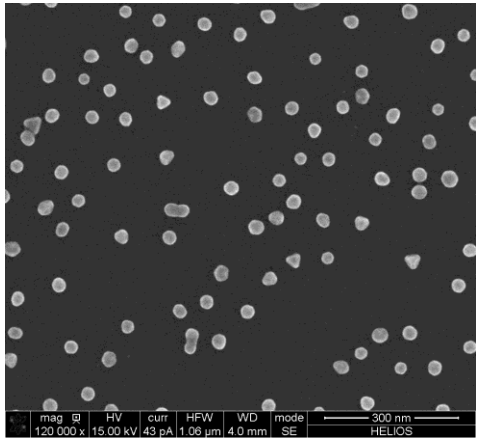


Simulated



Measured

Simulated and Measured Datasets



Measured

Similarity Metrics

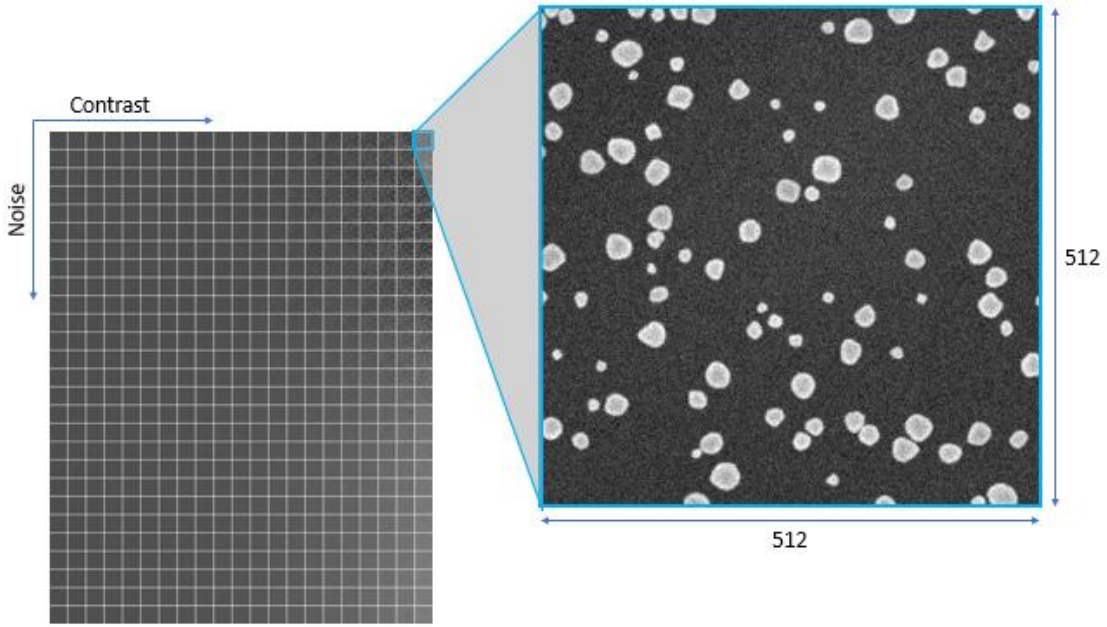


Fig. Montage of the set1 simulated SEM images arranged by their noise and contrast levels. The inset is a zoom to show one of the simulated images.

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