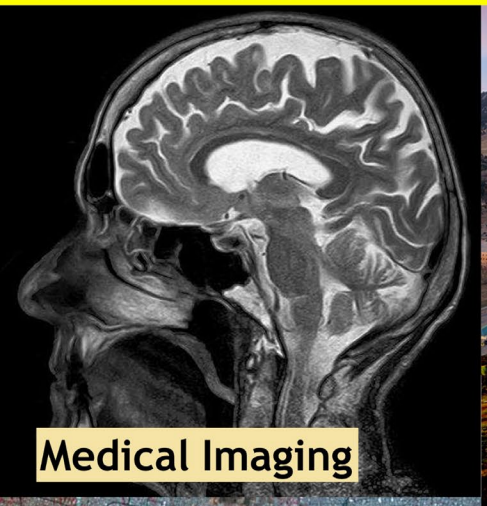
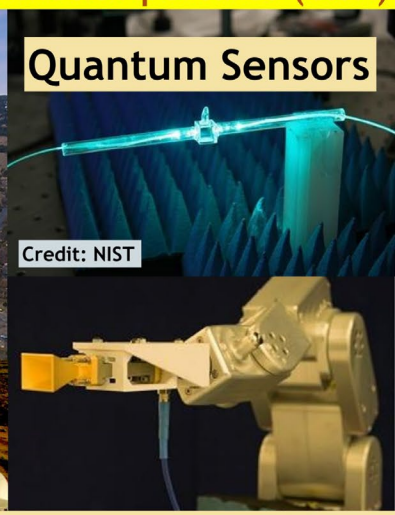
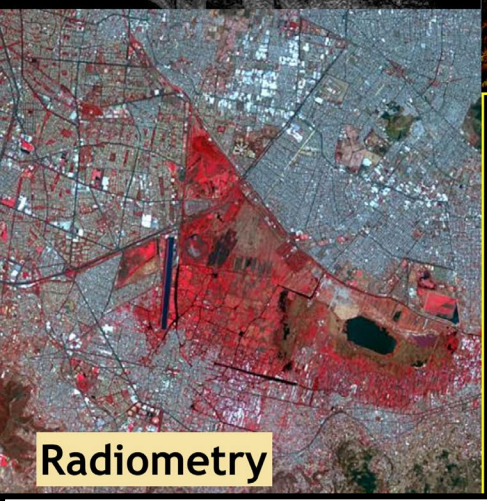
NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

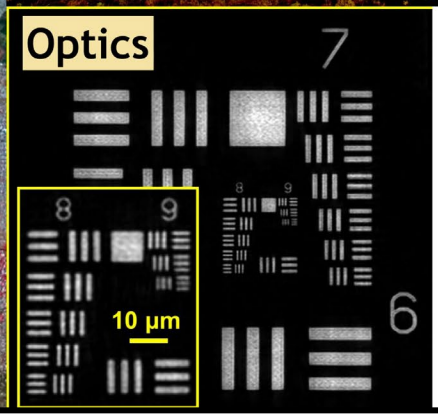
IEEE Signal Processing Society

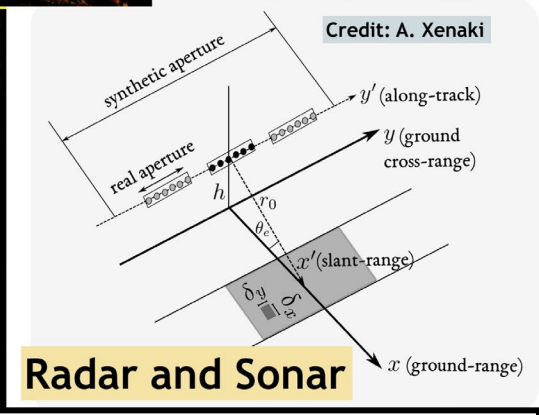
2024 NIST/IEEE Conference on Computational Imaging Using Synthetic Apertures (CISA)











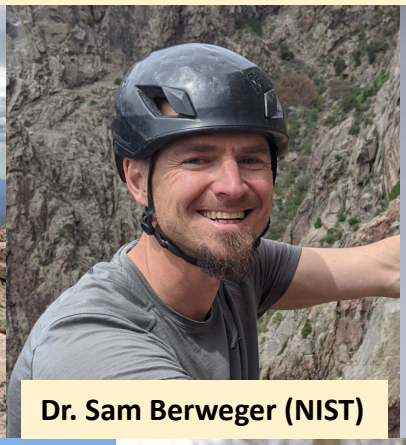
PATRON PROSPECTUS

20-23 May 2024

NIST Boulder, Colorado

Welcome from the Conference Chairs

Dr. Alexandra Artusio-Glimpse (NIST)



Dr. Sam Berweger (NIST)

Dr. Paritosh Manurkar (NIST)

Dr. Kumar Vijay Mishra
(Army Research Laboratory)

Mr. Peter Vouras
(Department of Defense)

It is our pleasure and honor to welcome you to the 2024 NIST/IEEE Conference on Computational Imaging Using Synthetic Apertures (CISA) jointly sponsored by the National Institute of Standards and Technology (NIST) and the IEEE Signal Processing Society (SPS). The conference will be held May 20 – 23 in Boulder, Colorado and will be the flagship destination for researchers in computational imaging and sensing.

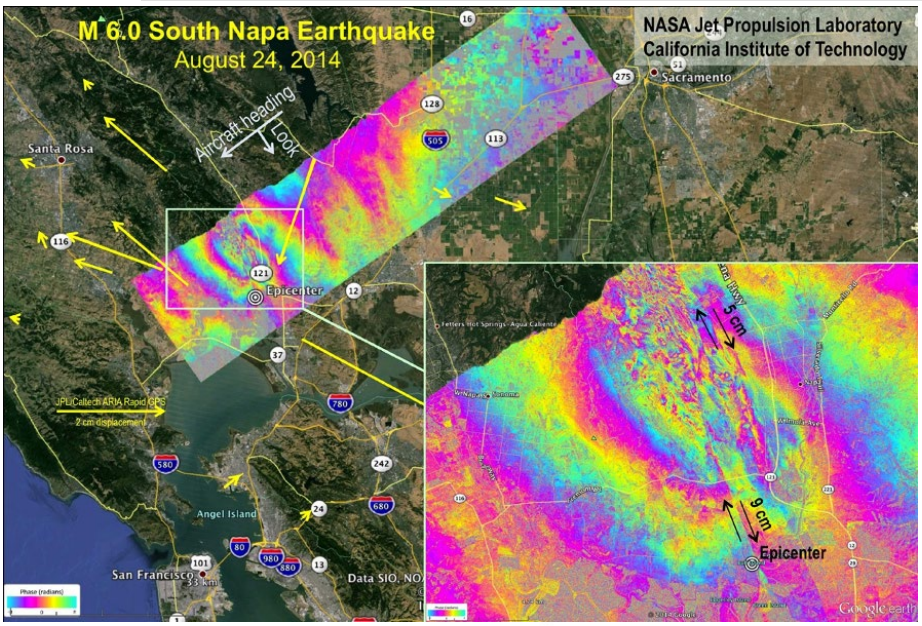
Every researcher knows a picture is worth a thousand words. The 2024 CISA conference will feature modern methods for image formation that have evolved far beyond directly displaying the data captured by a hardware device. New optimization techniques, data-driven processing, deep learning, and physics-based modeling are all tools that have enabled the creation of images with higher resolution, better clarity, wider fields-of-view, and greater signal-to-noise-ratios.

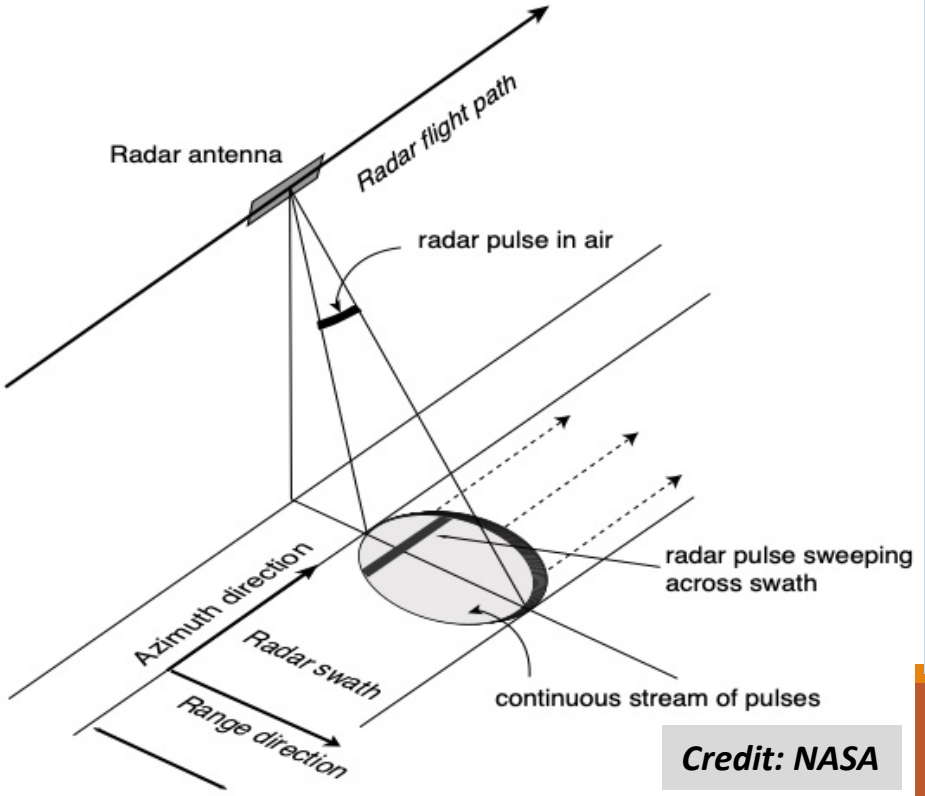
We worked hard to provide impactful sponsor packages that will connect industry with partners in academia and government. We are excited about the 2024 CISA conference and the opportunities highlighted in this prospectus for exhibition booths, panel discussions, publicity, and career networking events engage graduate students, university researchers, innovators from government, and technology leaders from the commercial sector.

Scope of CISA Conference

- *The scope of the conference includes all computational techniques applied to data measured using a synthetic aperture to yield an image or to sense the environment*
- *The term synthetic aperture refers generically to the signal measurement scheme that together with an algorithm yields imaging or sensing performance better than what the hardware system is inherently capable of, e.g., wider field-of-view or higher angular resolution*
- *A synthetic aperture may sample propagating wavefields or environmental parameters in the signal domain via linear motion of an antenna or transducer, as in synthetic aperture radar (SAR), sonar (SAS), or channel sounding*
- *Alternatively, a synthetic aperture may sample in the k-space domain via different look angles around an object or scene, as in computed tomography, spotlight SAR, or Fourier ptychography*
- *Lastly, a synthetic aperture may be constructed from a sparse array of sensors as in radiometry, seismology, or radio astronomy*
- *The front end of a synthetic aperture may be a conventional antenna, acoustic transducer, or a quantum sensor, such as a Rydberg atom sensor, in advanced implementations*

Synthetic Aperture Radar (SAR)

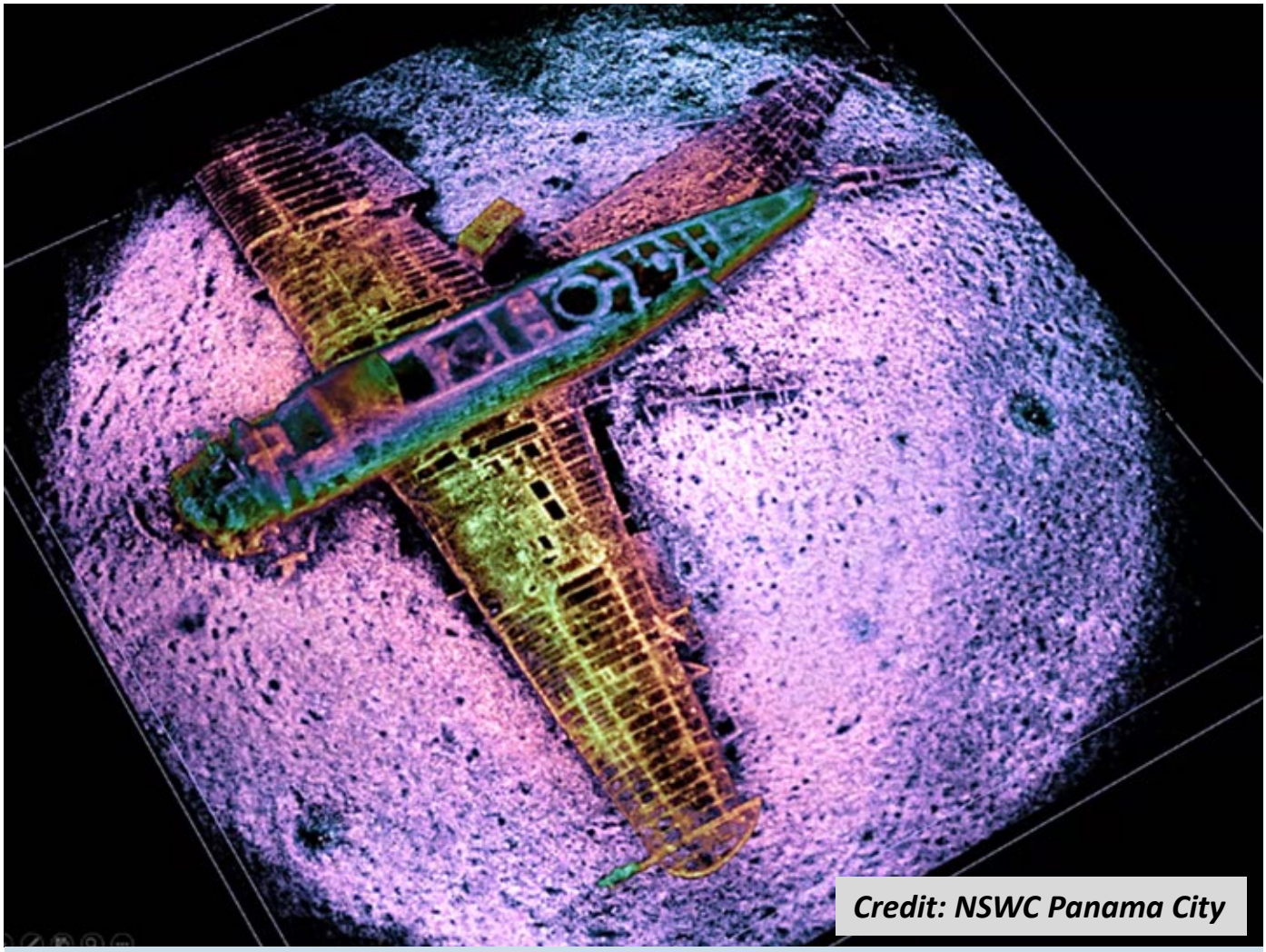




Credit: NASA

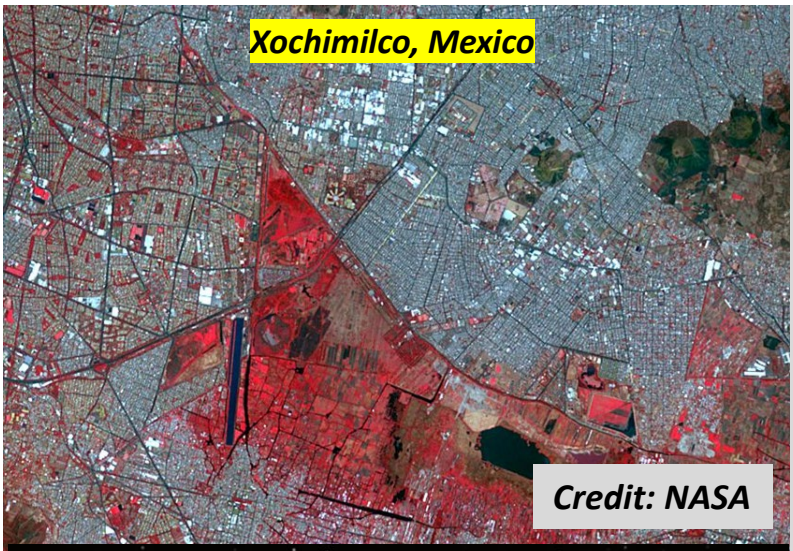
- *SAR is considered the classic example of a synthetic aperture*
- *A long linear array is synthesized by transmitting and receiving chirp pulses along the aircraft's trajectory*
- *There are many modes of SAR including strip map and spotlight where the radar stares at a fixed ground scene*
- *Some modes form an image via a range-doppler map (the doppler shift is aspect angle dependent), time-domain back projection, or frequency-domain focusing (chirp scaling)*
- *The image on left is an example of interferometric SAR and reveals the deformation of the Earth's surface after an earthquake*

Synthetic Aperture Sonar (SAS)



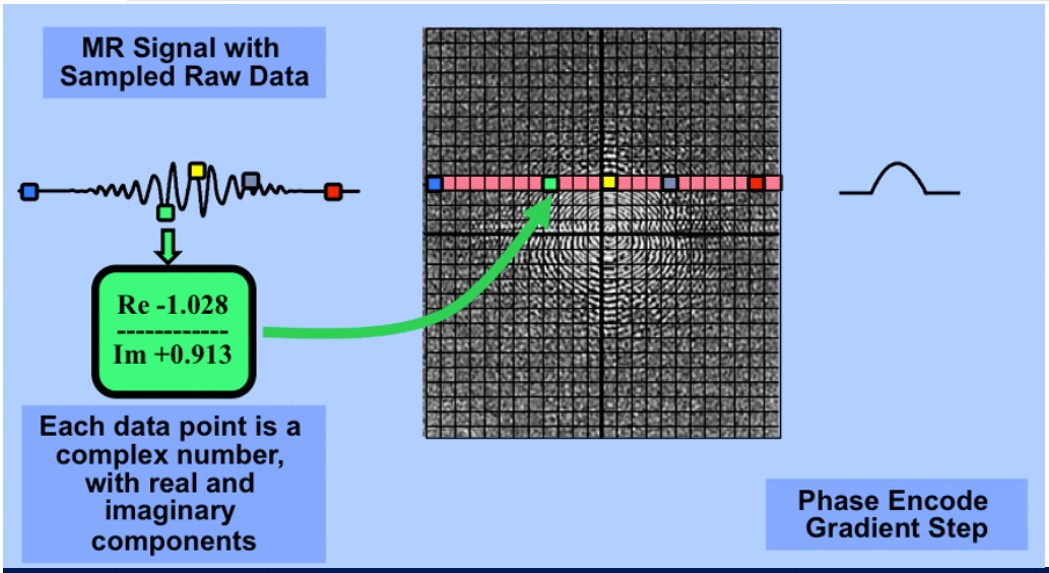
- *SAS also leverages synthetic aperture techniques*
- *The aircraft wreck on the left is known as Buzzard's Bay Helldiver and the image was created using circular SAS, similar to spotlight-mode SAR*

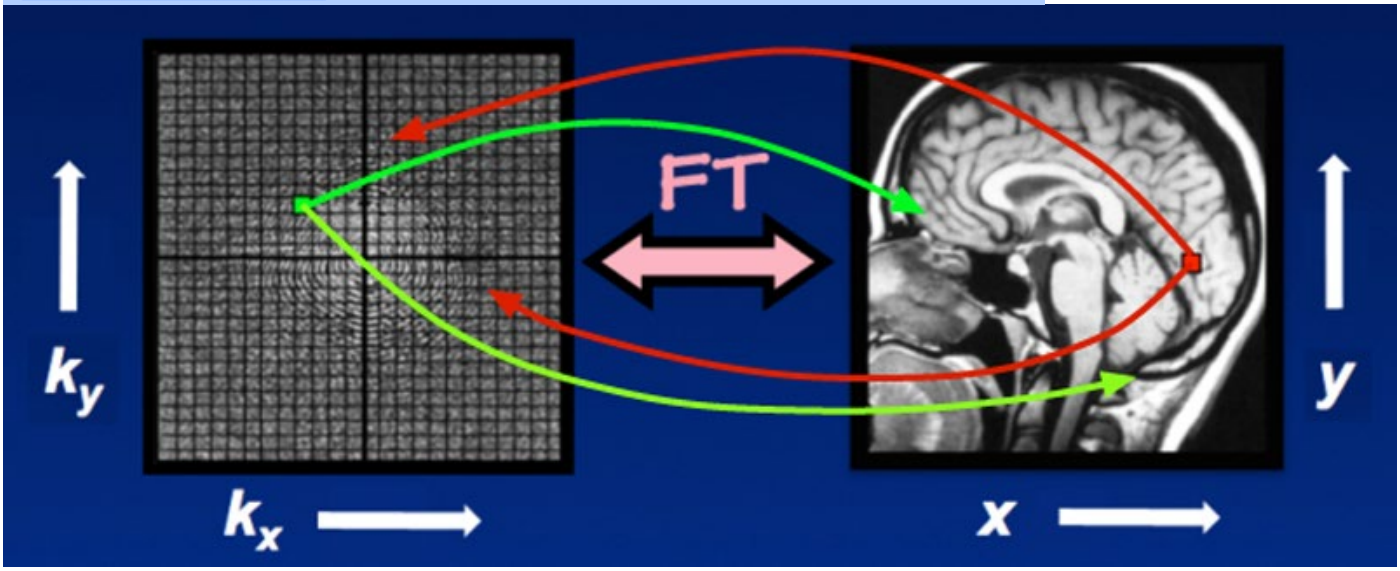
Synthetic Aperture Radiometry



- ***Synthetic aperture radiometers are sparse arrays that measure noise from space***
- ***By cross-correlating all possible pairs of antennas, the measured data populates the frequency-wavenumber domain (k-space)***
- ***An inverse Fourier transform yields the brightness temperature along the Earth's surface***

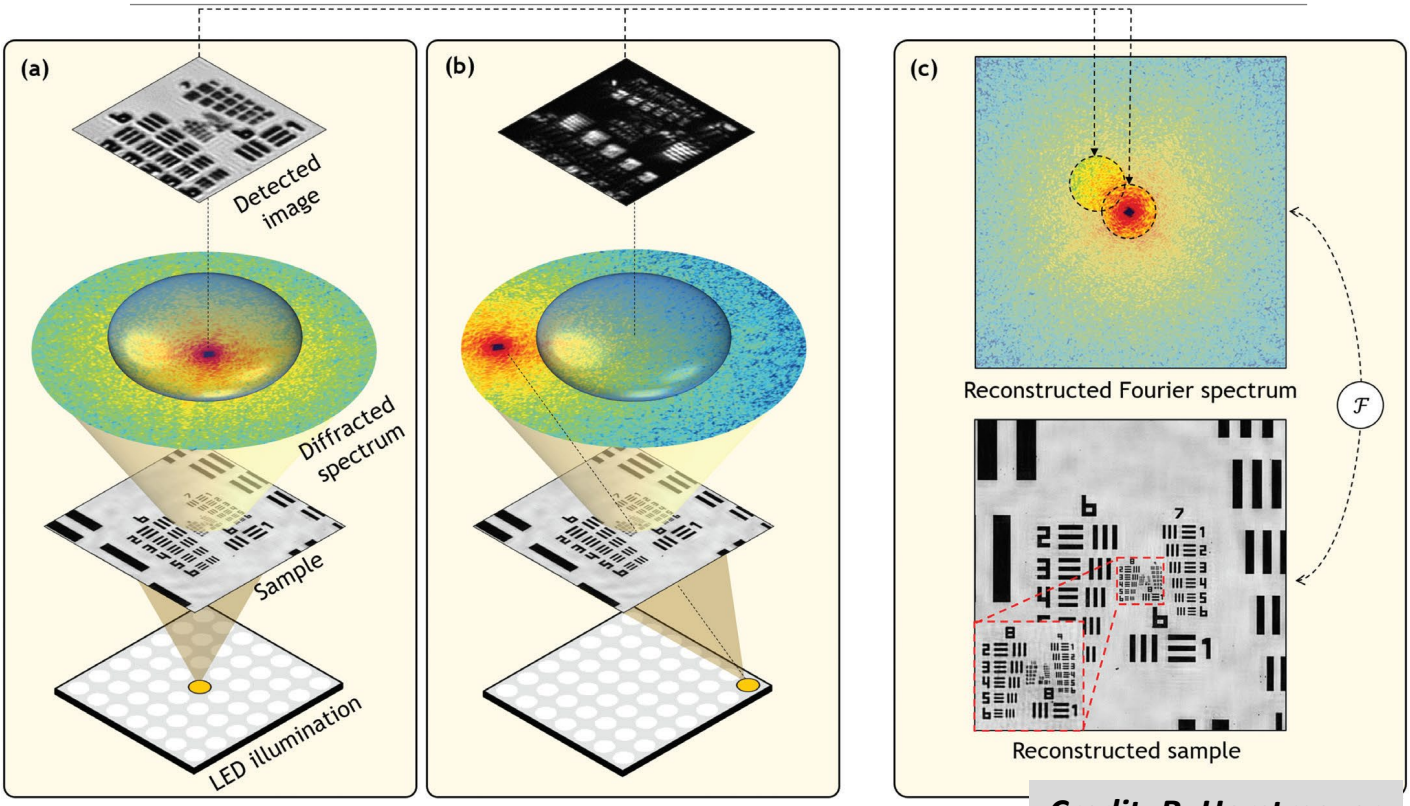
Magnetic Resonance Imaging





- *In the presence of a magnetic gradient, protons at different locations in the body precess at different rates*
- *The result is each point along a received RF signal reflects progressively higher spatial frequencies and can be used to directly populate k-space*
- *An inverse Fourier Transform yields an image of the human body*

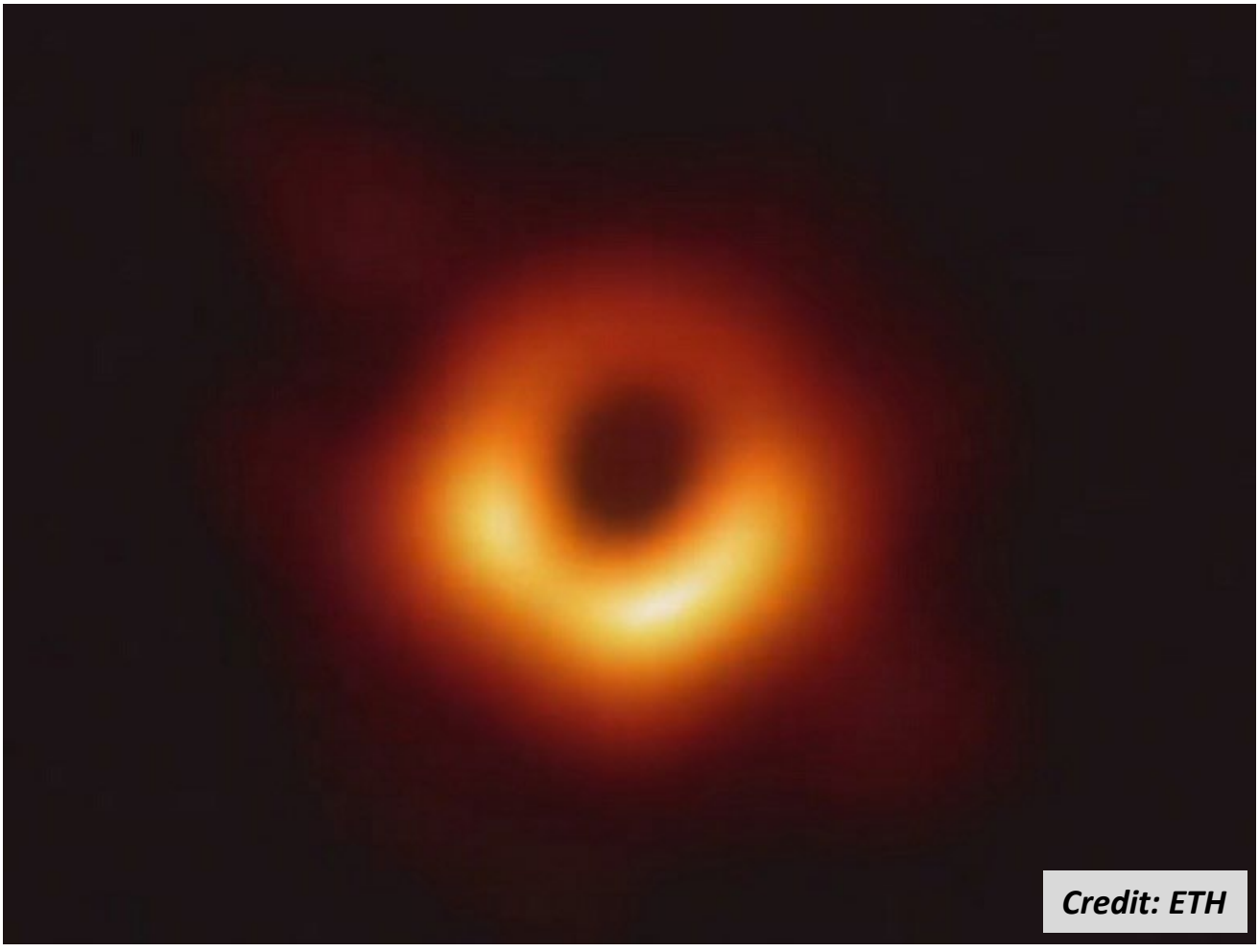
Fourier Ptychography



Credit: R. Horstmeyer

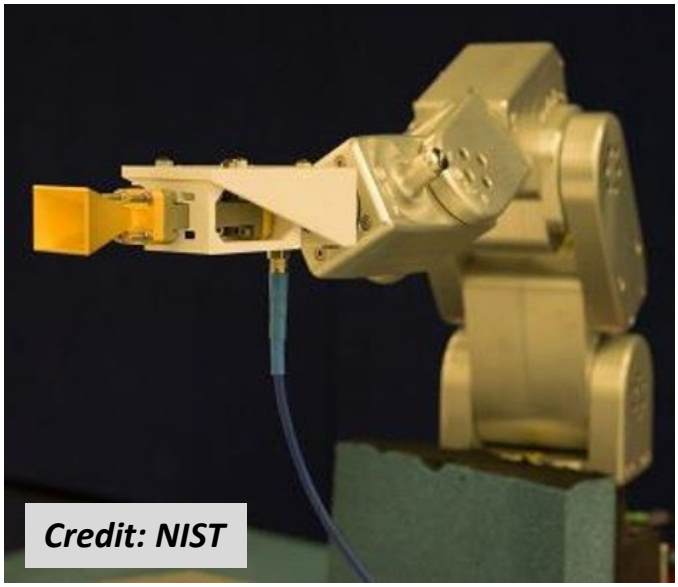
- ***An LED array illuminates a sample from below. Diffracted light from the sample, represented as the sample's Fourier spectrum, does not fully pass through the lens aperture, limiting the detected image's resolution.***
- ***Illuminating the specimen from an angle, using an off-center LED, shifts the sample's spectrum so as to measure a new region of k-space***
- ***Fourier ptychography collects all the images and combines them in the Fourier domain to synthesize a complete k-space spectrum, thereby leading to an image reconstructed with higher resolution.***

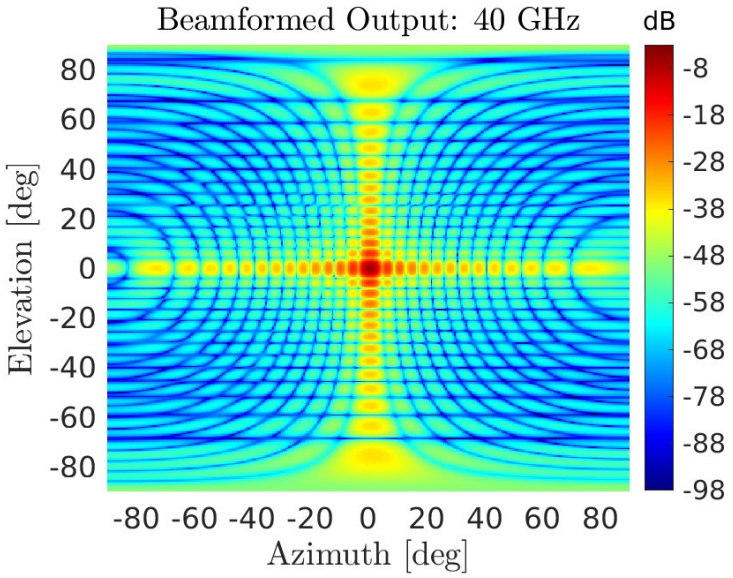
Radio Astronomy

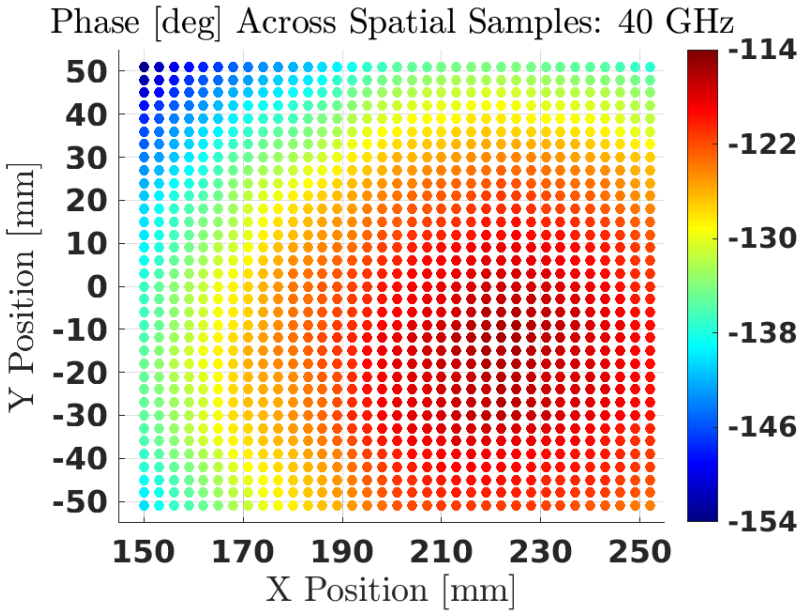


- *The image above shows a black hole and its shadow*
- *This historic image was created using an international network of radio telescopes called the Event Horizon Telescope (EHT)*
- *The EHT combines 8 ground-based telescopes around the world into a synthetic aperture that operates as a single radio telescope the size of Earth*

Channel Sounding







- ***In synthetic aperture channel sounding a robot moves an antenna through space to collect phase coherent samples***
- ***These samples are then combined to form an image of scattered RF energy in the environment***

Conference Venue and Dates

- The conference will be hosted by the National Institute of Standards and Technology (NIST) at the Boulder, Colorado campus
- A portion of the technical program will be devoted to guided tours of NIST laboratory spaces
- Dates for the conference are ***May 20-23, 2024***

Climate Change Standards Initiative

The ***Climate Change Standards Initiative (CCSI)*** at CISA will feature 4 workshops related to monitoring climate change using synthetic aperture radar and synthetic aperture radiometry data. The goal is to initiate a new working group that develops standards for assessing climate change

- ***Workshop on Measurement Technologies for Environmental Sensing*** – this workshop examines the technical challenges inherent in measuring environmental parameters from space or airborne platforms. The focus is on technology, hardware, and the computational algorithms necessary to form images of the Earth's surface.
- ***Workshop on Interpreting Measured Data*** – this workshop will focus on the issues associated with interpreting measured data after images are created of the natural environment. Data analysis techniques that leverage machine learning are germane to this workshop.
- ***Workshop on Uncertainty in the Data*** – even in the best of circumstances the notion of measuring a ground truth parameter is impractical. Instead, careful analysis must be performed to ascertain the uncertainties embedded in measured data. The topics presented during this workshop will be well suited for developing system calibration standards.
- ***Workshop on 5G Interference and Contaminated Data*** – the proliferation of 5G base stations throughout the world has greatly increased the probability that extraneous 5G signals will interfere with spaceborne SAR and synthetic aperture radiometry platforms. This workshop will examine the potential severity of 5G interference and methods for mitigating its impact.
- ***Panel Discussion on Climate Change***
- ***Project Authorization Request (PAR) Draft Writing Session***

Sponsor Packages

	Platinum $12,500	Gold $8,000	Silver $6000	Bronze $4000
Best paper award sponsor	Y			
Name and logo on event signage	Y	Y		
Exhibit booth space	Y	Y		
Career event at local restaurant	Y	Y	Y	
Option to organize conference workshop or panel	Y	Y	Y	
Recognition in conference emailers and announcements	Y	Y	Y	
Promotion in conference website and daily newsletter	Y	Y	Y	Y
Acknowledgement during opening reception and banquet	Y	Y	Y	Y