مباحث ویژه
(پردازش سیگنال های راداری)

معرفی درس و مقدمه

نیم سال دوم ۰۵-۰۴

معرفی درس

- موضوع درس: آشنایی با الگوریتم های پردازش سیگنال رادار و سونارهای تصویربردار از داده خام تا تصویر نهایی
- تعداد واحد: ۳
- کلاس: روزهای شنبه و دوشنبه ساعت ۱۰ تا ۱۲، کلاس شماره ۱۰۷
- نحوه ارزشیابی:
  - کار مستمر (تمرین و آزمون ها): ۵ نمره
  - پروژه پایانی: ۷ نمره
  - آزمون پایانی: ۸ نمره
- تماس: داخلی ۳۳۲۴، رایانامه s.r.hashemi@gmail.com

معرفی درس

سرفصل ها

- مقدمه
- مروری بر سامانه و سیگنال‌های راداری
- معرفی رادار روزنه مصنوعی
- روش‌های تشکیل تصویر
- جبران‌سازی حرکت و خودمیزانی
- چالش‌ها و کاربردها

مراجع

- Cumming, Ian G., and Frank H. Wong. "Digital processing of synthetic aperture radar data." *Artech house*, 2005.
- Carrara, Walter G, et al. "Spotlight synthetic aperture radar signal processing algorithms." Artech House, 1995.
- Soumekh, Mehrdad. "Synthetic aperture radar signal processing." New York: Wiley, 1999.
- Skolnik, Merrill Ivan. Introduction to radar systems. Vol. 3. New York: McGraw-hill, 1980.

معرفی درس

سنجش از دور

Remote Sensing: Motivation

- Provides unique information to solve societal changelles of global dimension

Climate Change

Environment

Resources

Sustainable Development

Megacities

Mobility

Hazards

Disaster

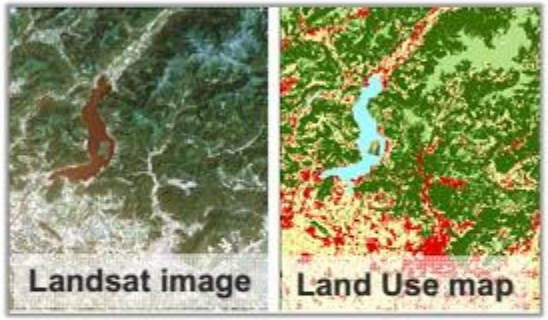
معرفی درس

سنجش از دور

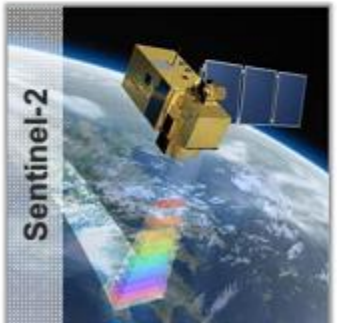
Remote Sensing

- Measuring objects properties from distance with dedicated instruments

- Acquired information
  - spatial (geometric resolution)
  - spectral (frequency resolution)
  - intensity (radiometric resolution)
  - temporal (revisit time)



- Different types of remote sensing sensors:
  - Optical and infrared sensors
    - passive:
      - High-resolution
      - Multispectral, hyperspectral
    - active: Lidar



معرفی درس

سنجش از دور

Remote Sensing

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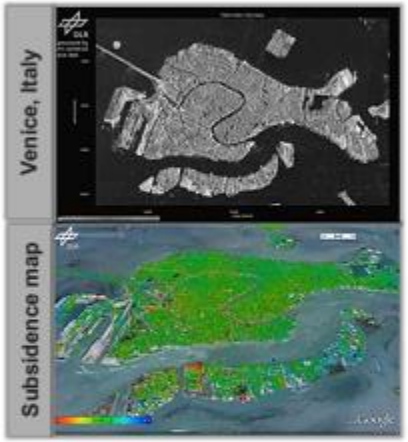
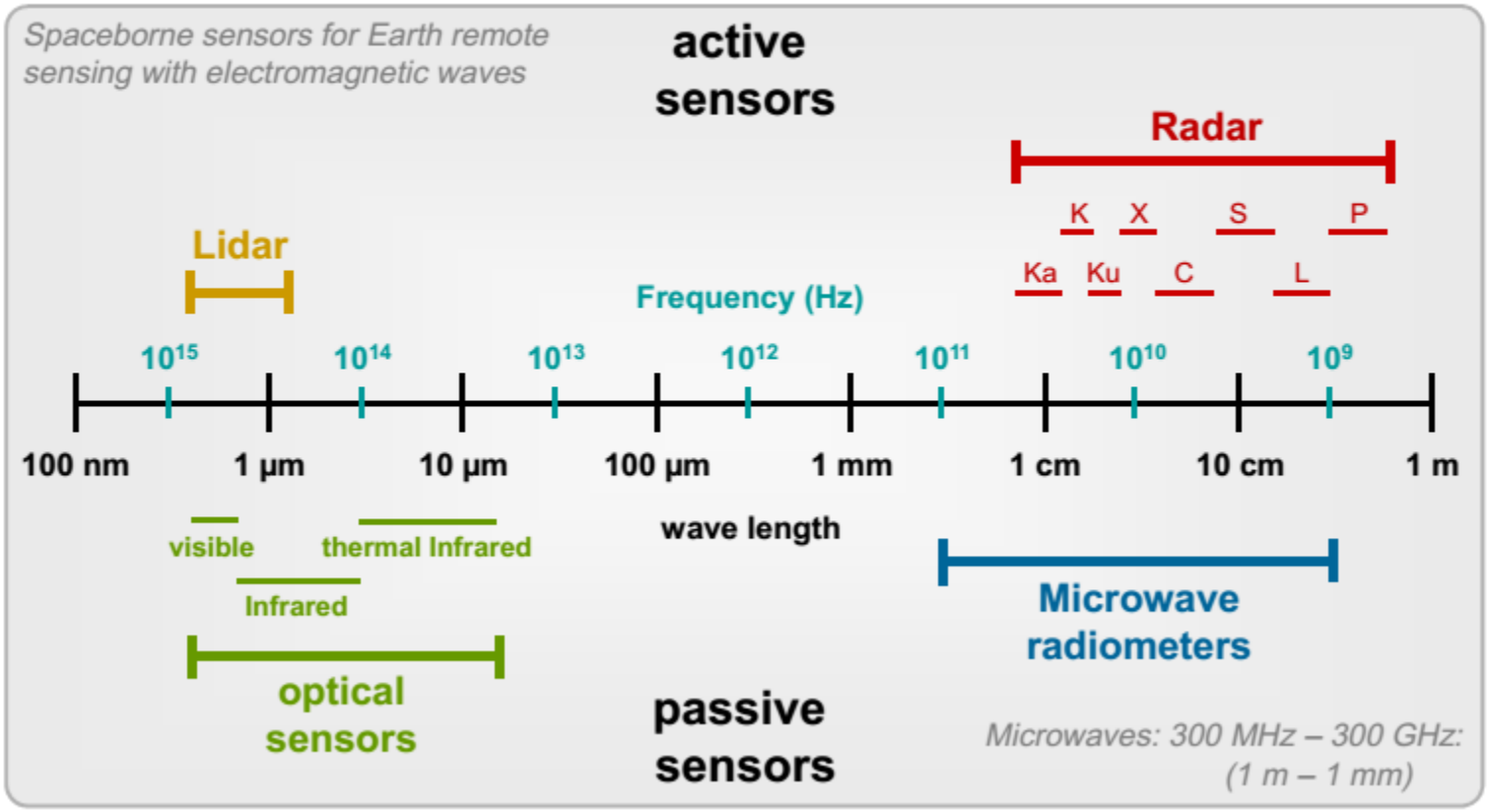


- Different types of remote sensing sensors:
  - Microwave sensors
    - passive (radiometers)
    - active (radars)
      - Scatterometer, Altimeter
      - Synthetic Aperture Radar - SAR

معرفی درس

انواع سنجنده



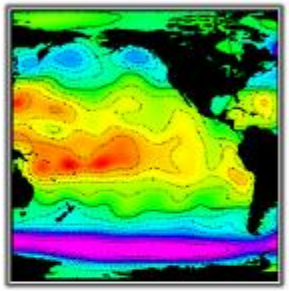
معرفی درس

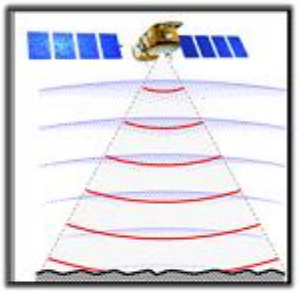
سنجنده های راداری

Spaceborne Radar Remote Sensing

Radar Altimeter

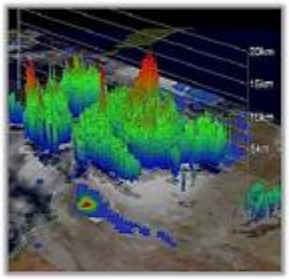
Measures surface topography (surface height)





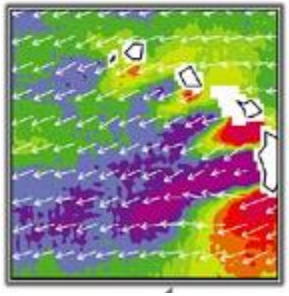
Weather Radar

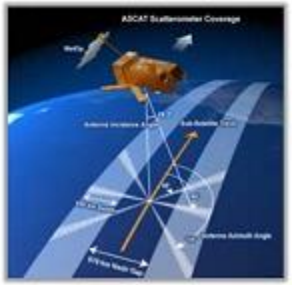
Measures three-dimensional rainfall distribution



Radar Scatterometer

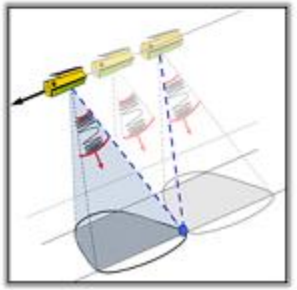
Measures surface backscattering (sea winds)





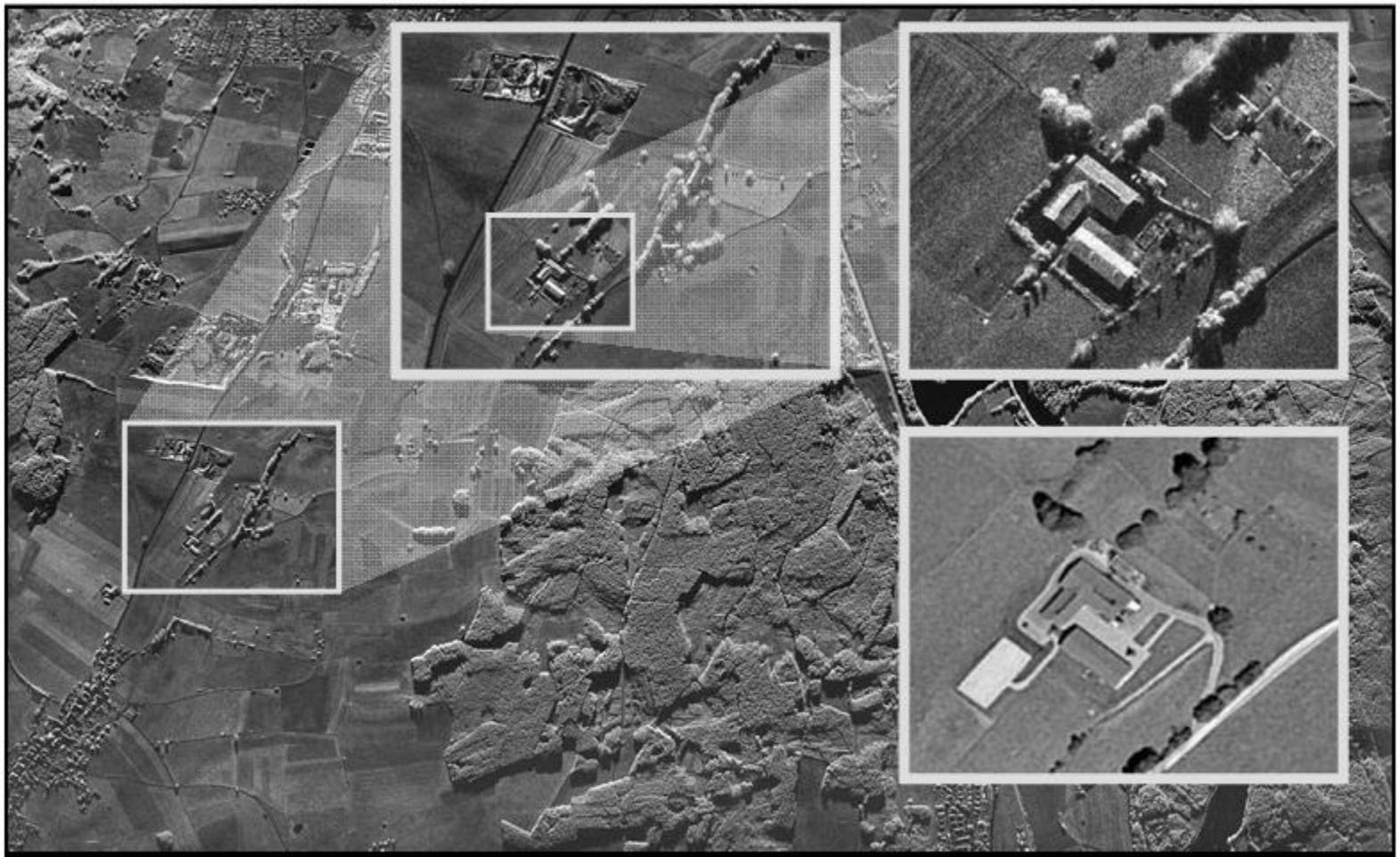
Synthetic Aperture Radar (SAR)

Measures 2D surface backscattering



معرفی درس

رادار روزنه مصنوعی



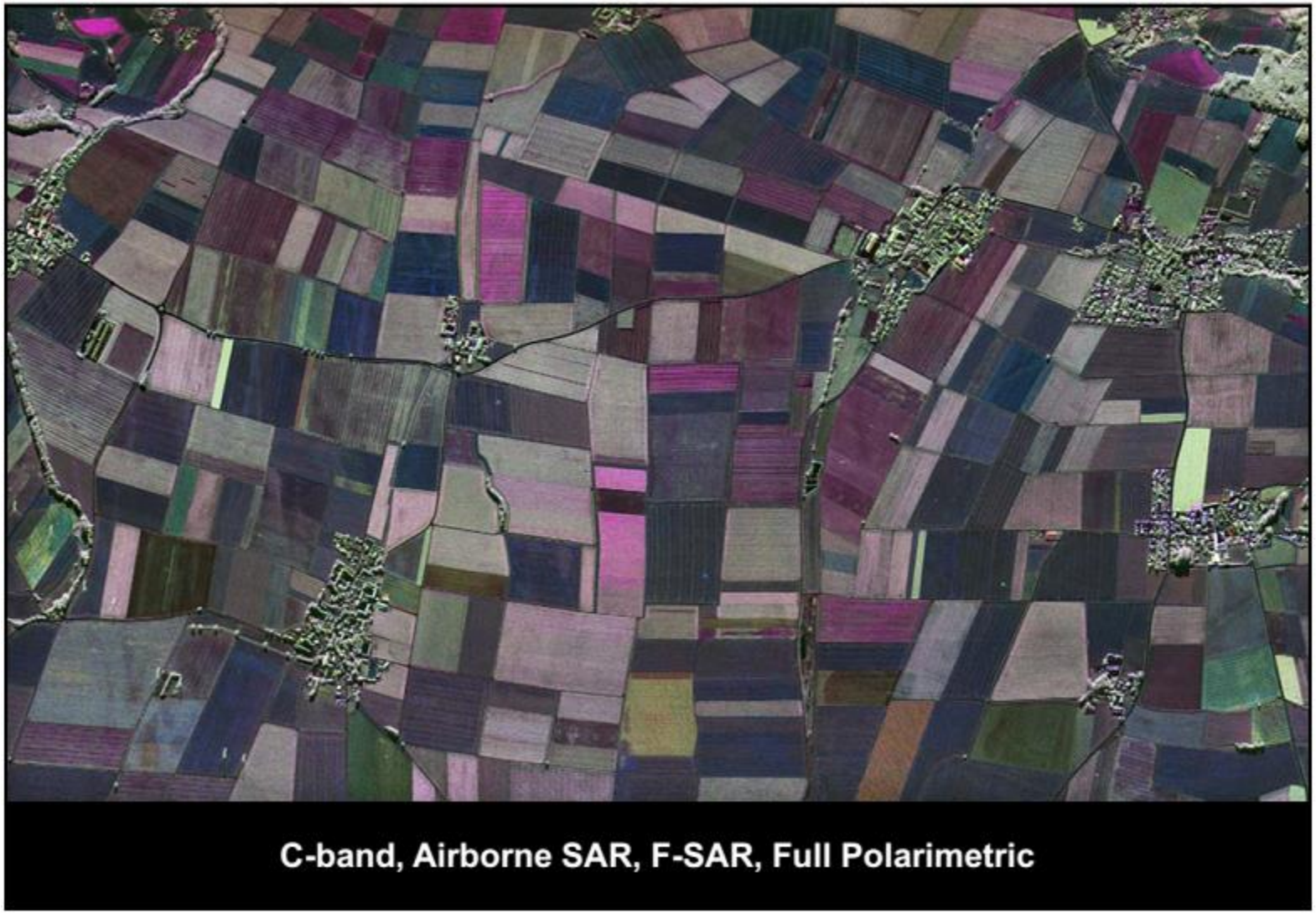
X-band, High Resolution Airborne SAR, F-SAR, Kaufbeuren, Germany

معرفی درس

رادار روزنه مصنوعی

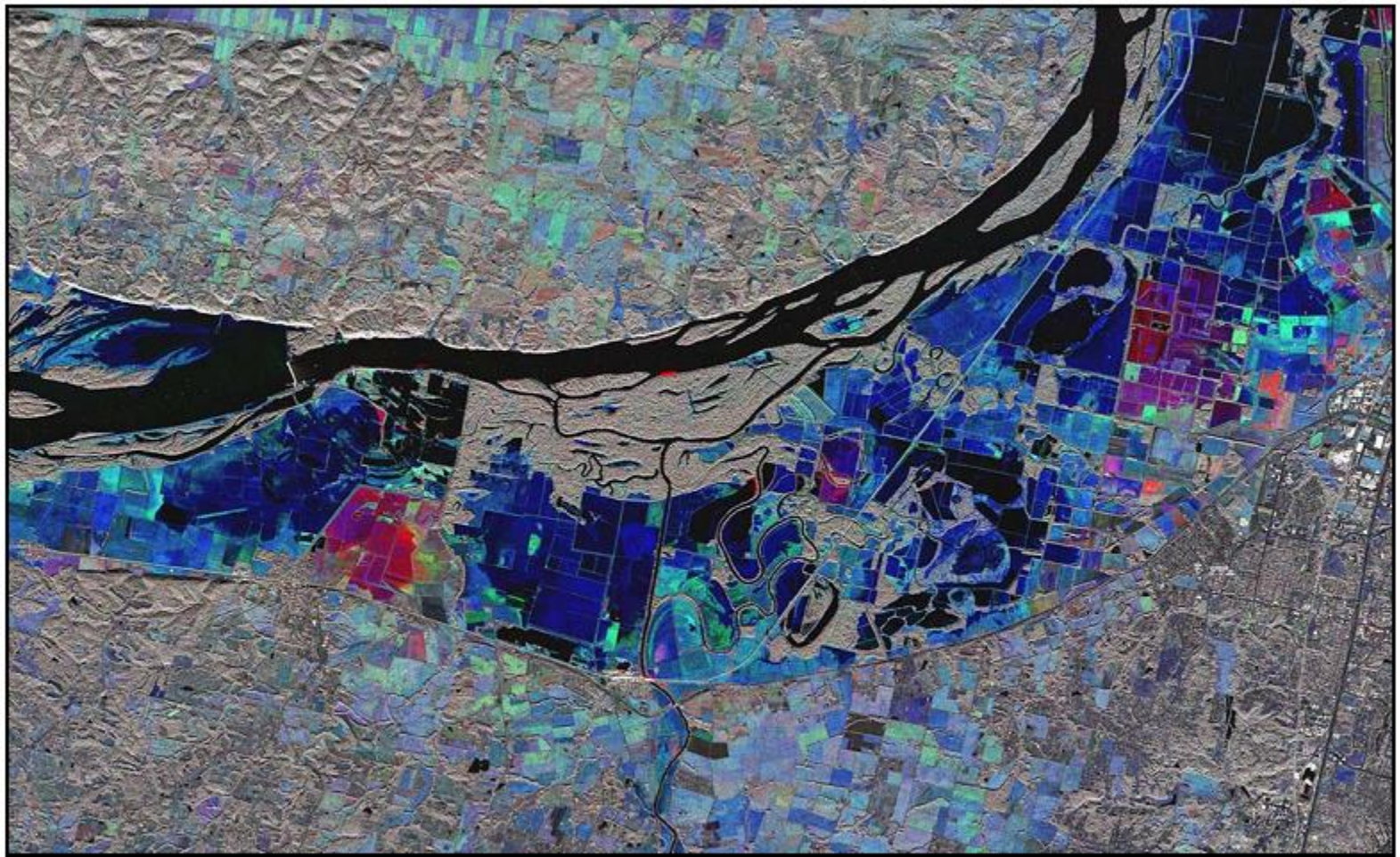
معرفی درس

رادار روزنه مصنوعی



معرفی درس

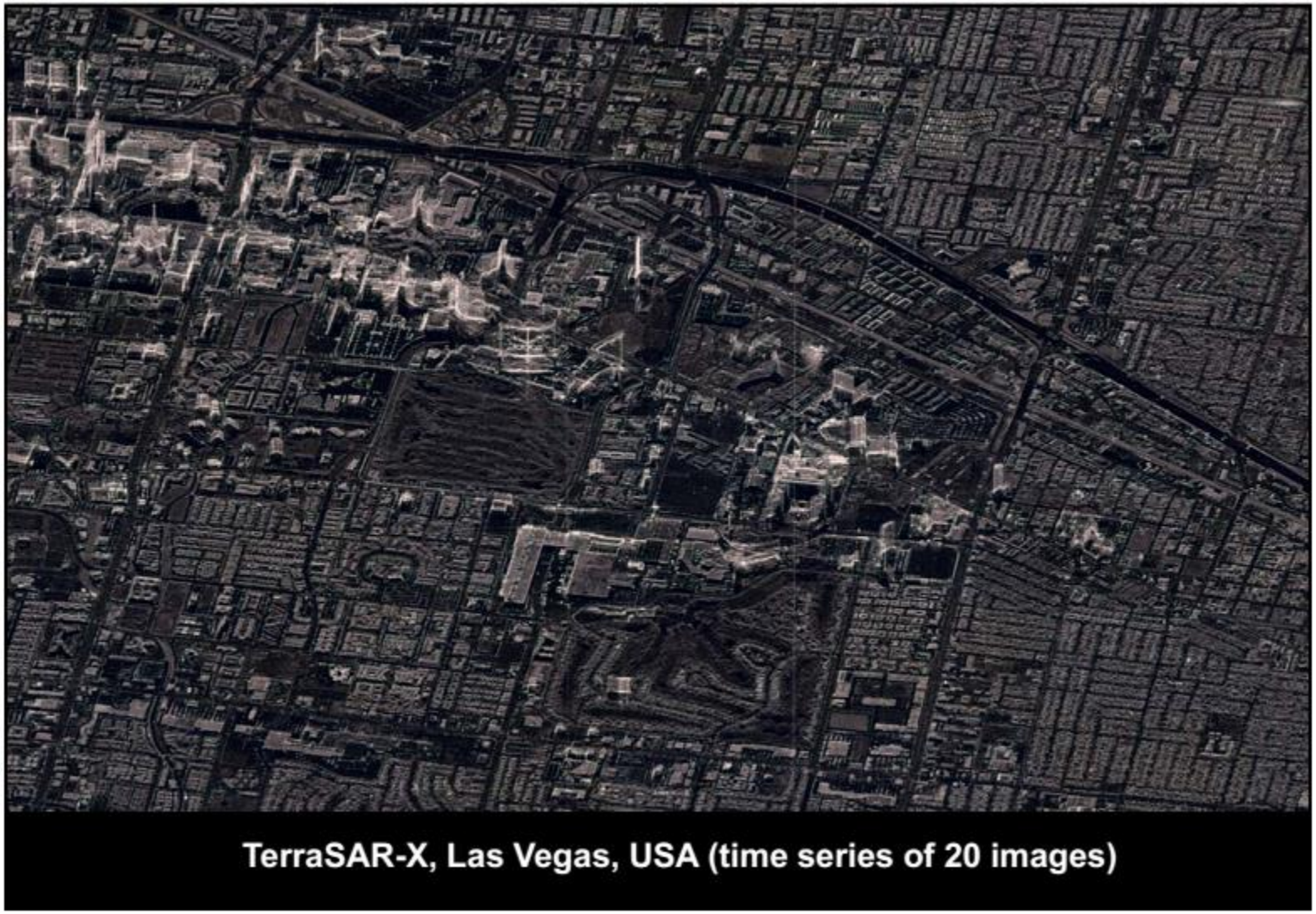
رادار روزنه مصنوعی



TerraSAR-X, Mississippi, USA - Flooding

معرفی درس

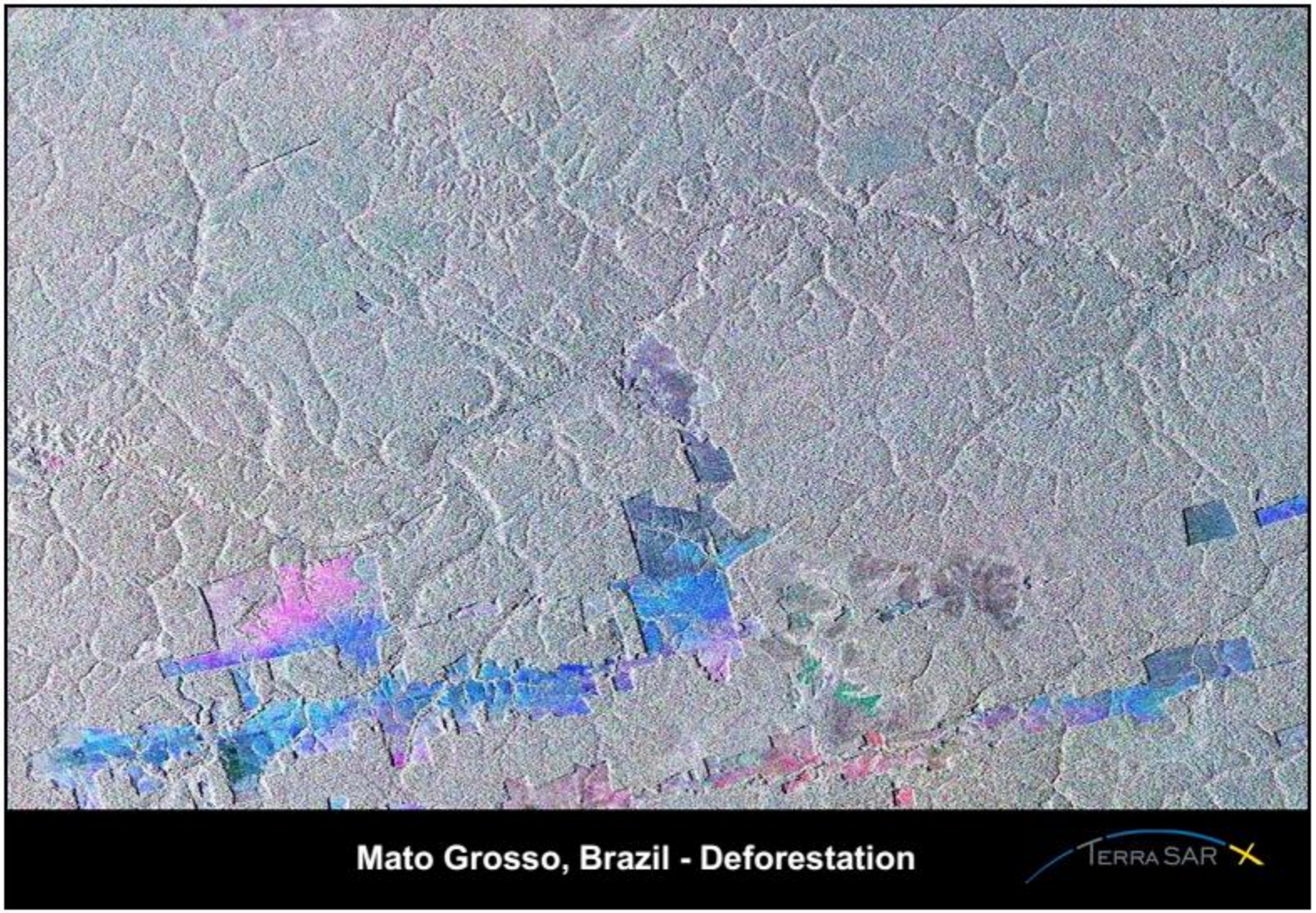
رادار روزنه مصنوعی



TerraSAR-X, Las Vegas, USA (time series of 20 images)

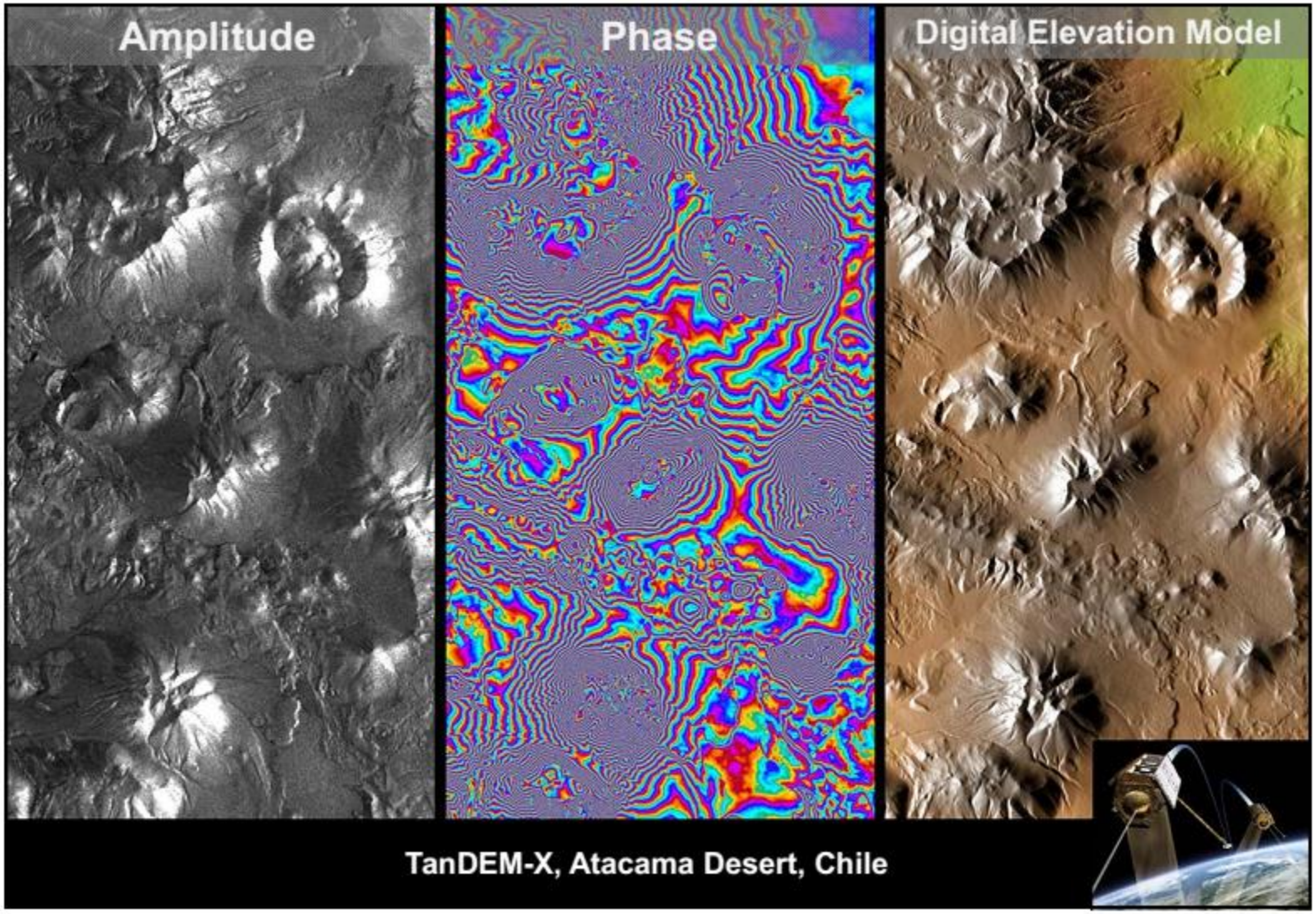
معرفی درس

رادار روزنه مصنوعی



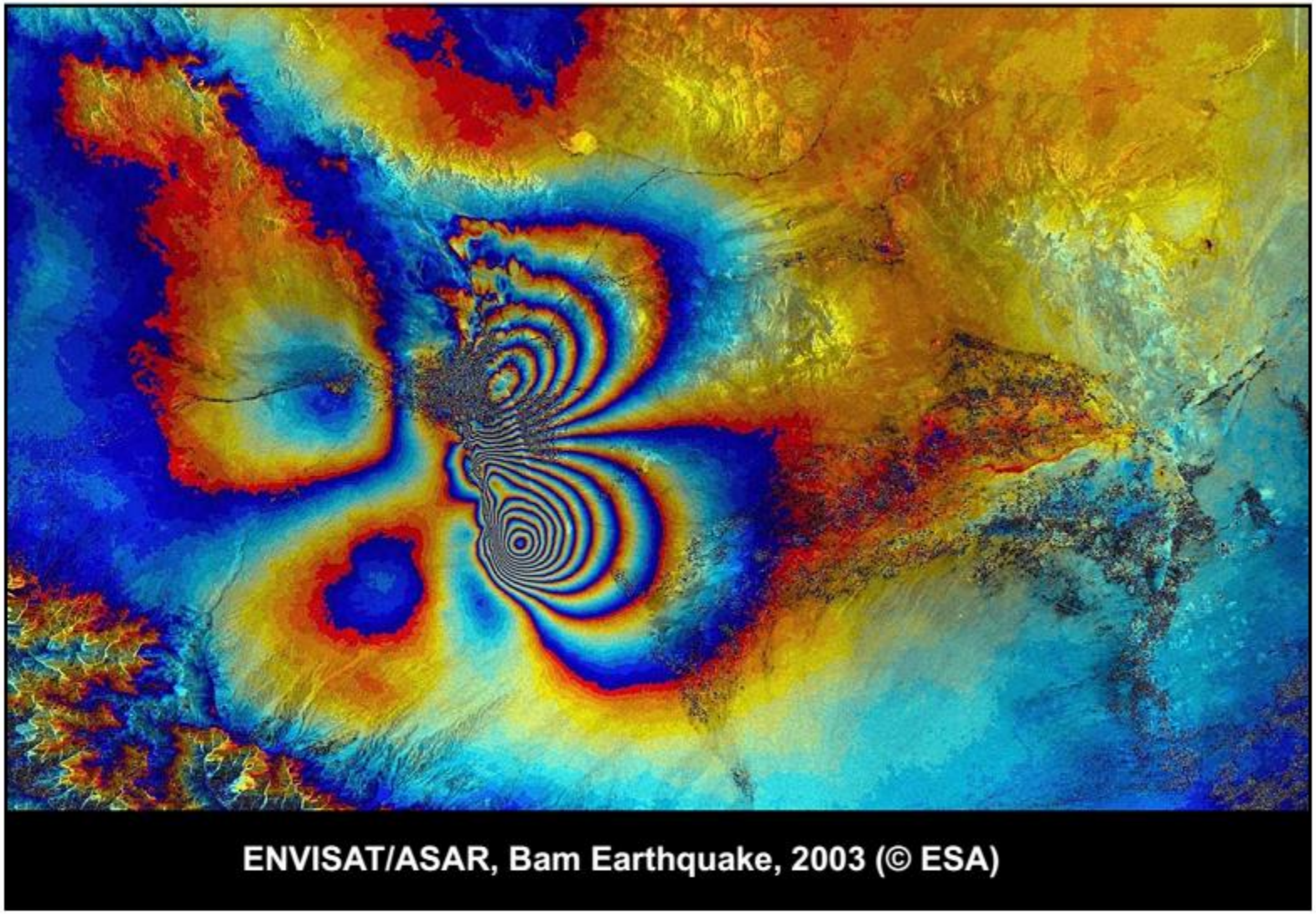
معرفی درس

رادار روزنه مصنوعی



معرفی درس

رادار روزنه مصنوعی



ENVISAT/ASAR, Bam Earthquake, 2003 (© ESA)

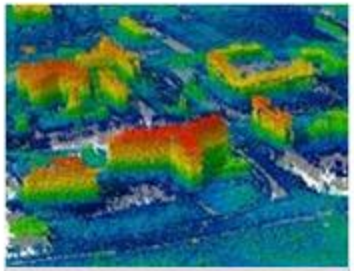
معرفی درس

رادار روزنه مصنوعی

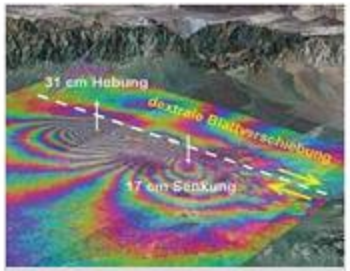
Motivation for Spaceborne SAR

- Complementary information to optical systems
- Penetration of radar waves
- Weather independent
- Day-and-night imaging capability
- Geometric resolution independent of the distance
- New image products by coherent combination of radar images (i.e. using phase information in the radar images)

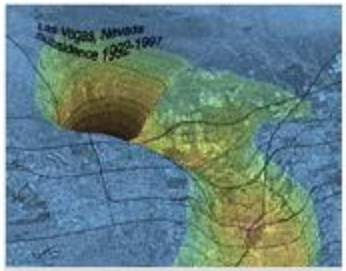
3D Mapping
(Digital Elevation Model)



Tomography
(Urban Mapping)



Differential Interferometry
(Earthquake deformation)



Differential Interferometry
(Subsidence)

معرفی درس

رادار روزنه مصنوعی

SAR Main Properties and Applications

- high resolution capability (independent of flight altitude)
- weather independence by selecting proper frequency range
- day/night imaging capability due to own illumination
- complementary to optical systems
- polarization signature can be exploited (physical structure, dielectric constant)
- innumerous applications areas:

  - Topography (DEM generation with interferometry)
  - Oceanography (wave spectra, wind speed, ocean currents)
  - Glaciology (snow wetness, snow water equivalent, glacier monitoring)
  - Agriculture (crop classification and monitoring, soil moisture)
  - Geology (terrain discrimination, subsurface imaging)
  - Forestry (forest height, biomass, deforestation)
  - Moving Target Indication (MTI)
  - Volcano and earthquake monitoring (differential interferometry)
  - Environment monitoring (oil spills, flooding, urban growth, global change)
  - Military surveillance and reconnaissance (strategic policy, tactical assessment)