Main Projects in Radar, Remote Sensing, Image and Signal Processing, Telecommunications, at Università di Napoli Parthenope

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Università degli Studi di Napoli *Parthenope*

National Aviation University - Kiev (Ukraine) – July 05, 2011

Research Group in Radar, Remote Sensing, Image and Signal Processing, Telecommunications

- 4 Professors
- 1 Adjunct Professors
- 6 Assistant professor
- 3 Post Docs
- 3 PhD Students

Active R&D Projects Outline

- Body Scanning
- SAR Tomography
- SAR Urban Edge Detection
- Ground Based - SAR
- Microwave Tomography
- Demining (GPR)
- Magnetic Resonance Imaging
- Oil Spills detection
- …….

- **Body Scanning**
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Body Scanning

Involved in ***Industria 2015*** Project “MELISSA” (Microwave Electronics Imaging Security and Safety Access), financed and supported by the Italian government.

The aim is the development of a innovative body scanner prototype.

Principal investigator is MBDA Italia S.p.a., worldwide leader in defense systems.

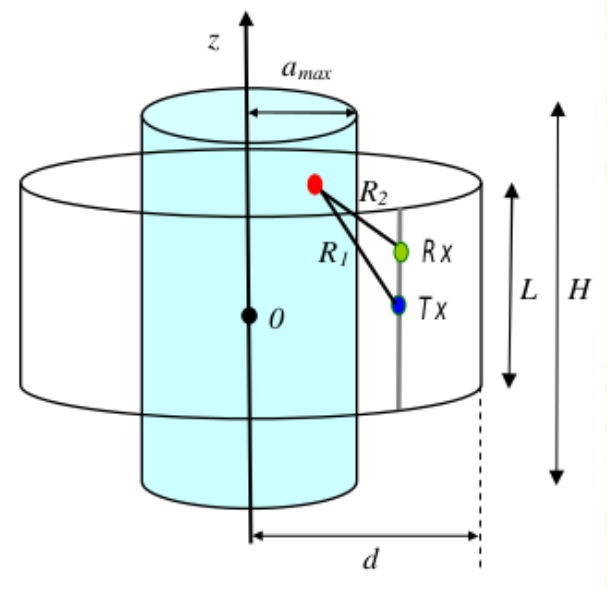
MBDA
MISSILE SYSTEMS

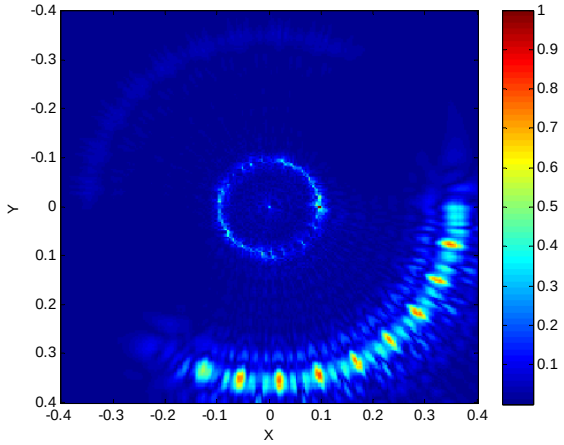
5 research centers and 4 big and medium enterprises are involved in the project.

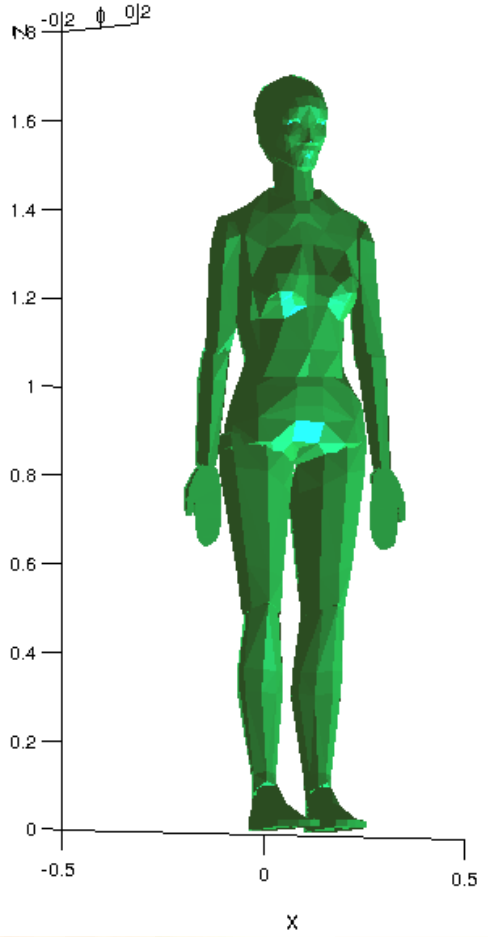
Body Scanning

The system is designed to work with micro waves and in almost real time.

The University Parthenope is involved in the development of the focusing algorithm.







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- Body Scanning
- **SAR Tomography**
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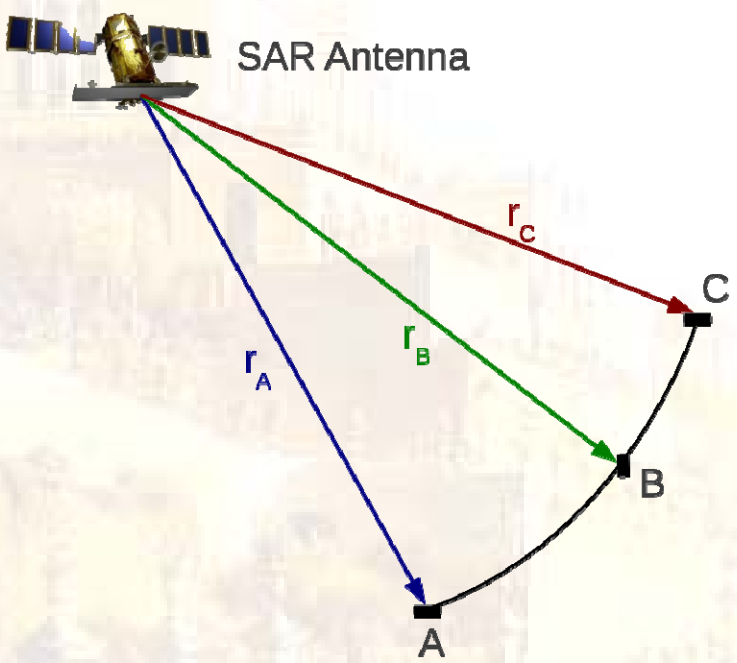
SAR Tomography

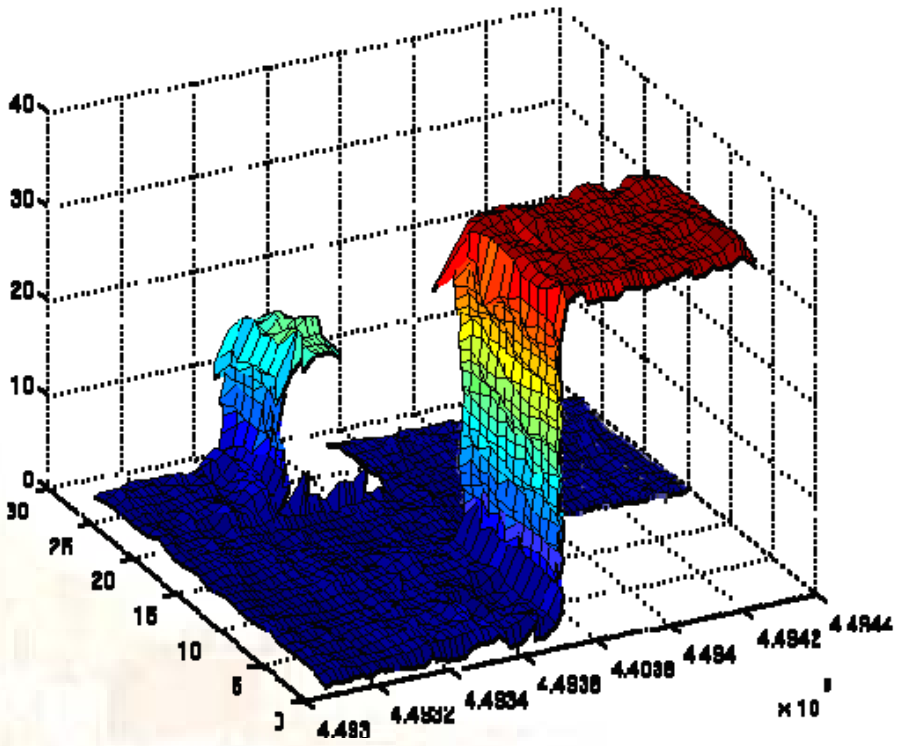
The aim of the SAR Tomography is to reconstruct the observed 3D scene exploiting multi-tempotal and multi-baseline SAR interferometric stacks.

Due to SAR acquisition geometry, geometrical distortion appears, especially in urban areas.

To be able to obtain the 3D reconstruction, a statistical description of the signals scattered from the ground is mandatory.

SAR Tomography





SAR viewing geometry layover distortion

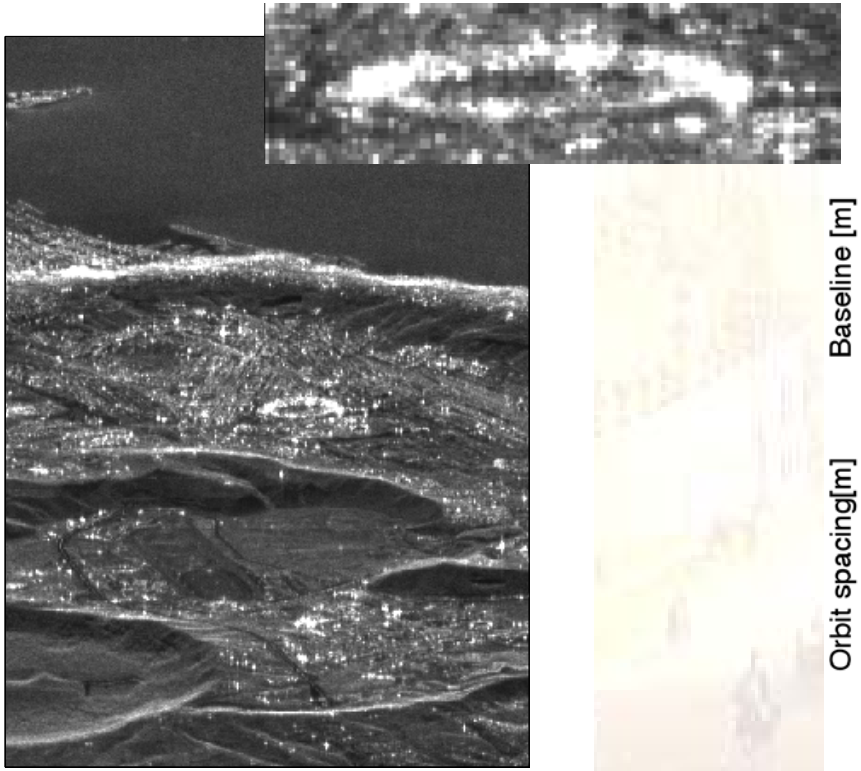
3D tomographic reconstruction of the scene

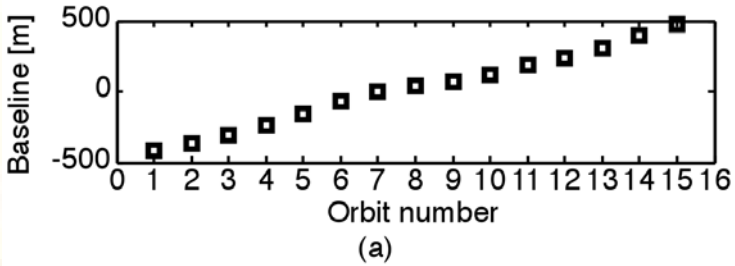
SAR Tomography

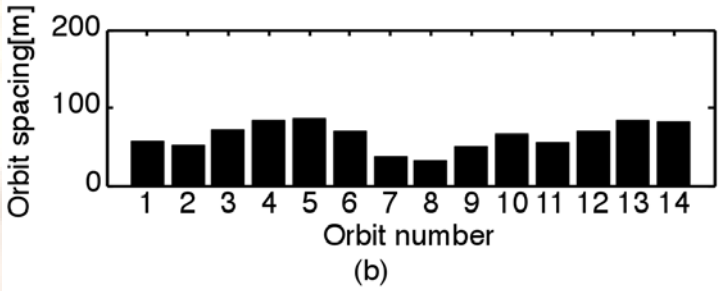
Stadium San Paolo (Naples –Italy)

290 m × 230 m

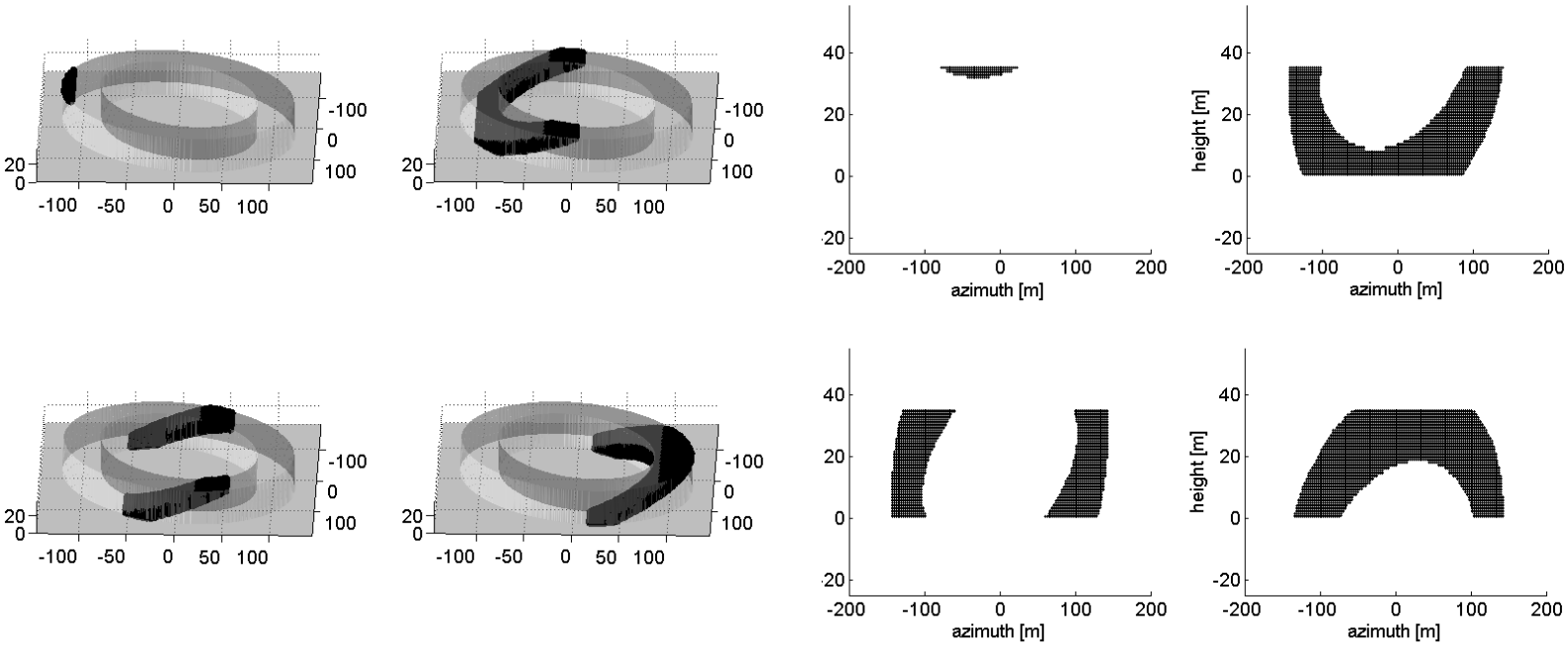
Height 35 m







SAR Tomography



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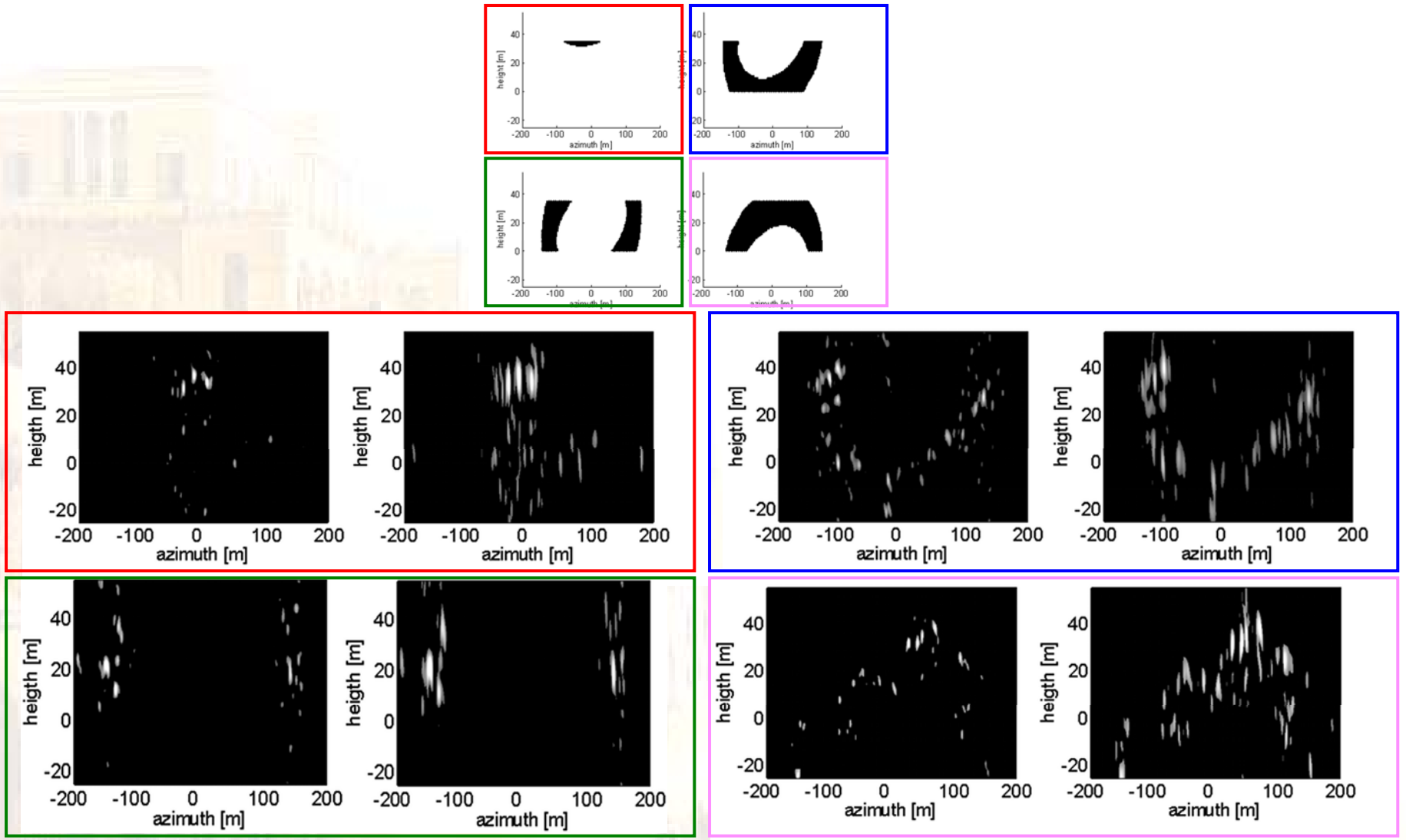
SAR Tomography



SAR Tomography

Principal Investigator of the Italian Space Agency project ”Development of Imaging and Monitoring Methodologies based on the use of COSMO/SkyMED SAR DATA”.

Objectives:

- Multibaseline Interferometry
- Super Resolution
- Differential Interferometry and 3D-4D SAR Tomography
- 3D InSAR data for risk management
- Land Monitoring

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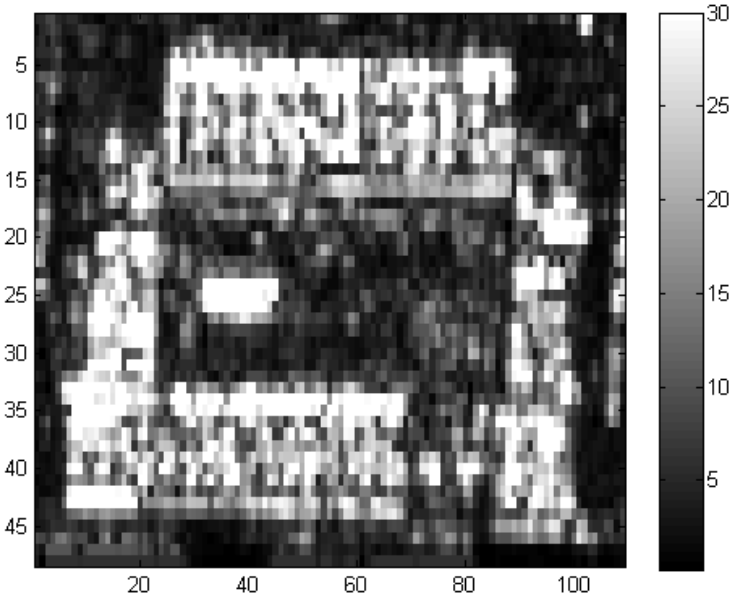
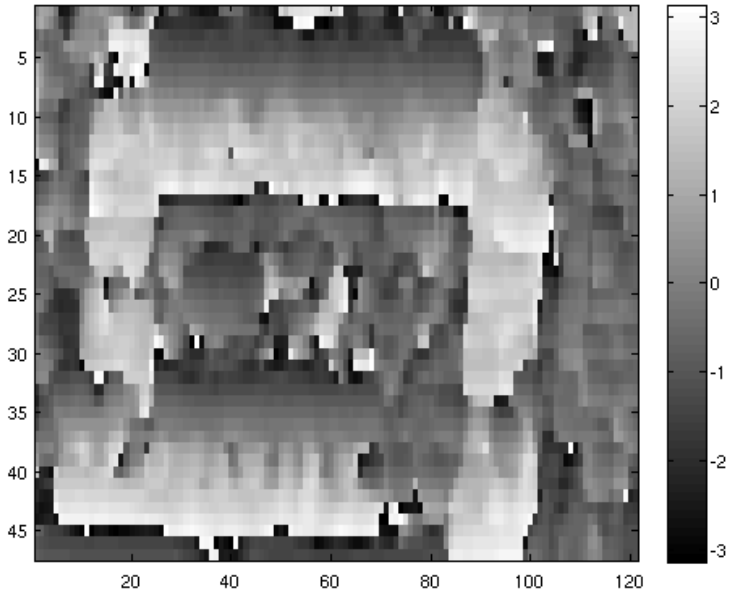
SAR Urban Edge Detection

Statistical Edge detection exploiting SAR complex data in conjunction with Markov Random Field theory.



SAR Amplitude



Interferometric Phase

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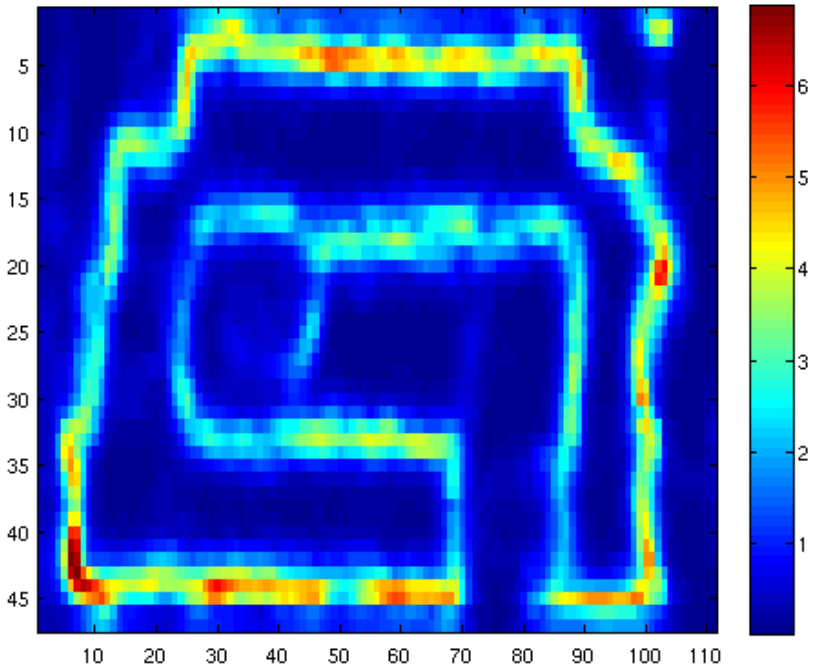
SAR Urban Edge Detection



Edge Estimation

Optical ground truth

SAR Urban Edge Detection

Co-Investigator in two projects of the Germany Space Agency (DLR) project based on the use of terra-SARX SAR DATA.

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Ground Based SAR

Ground Based SAR in the Interferometric cofiguration allows the recosntruction of 3D profiles.

GB-SAR vs SAR: covers much smaller areas, a few square kilometers, but with better resolution and a greater acquisition rate

2 working frequencies:
C band and L band.

5 acquisition positions:
4 baselines

Mean target distance: 180 m

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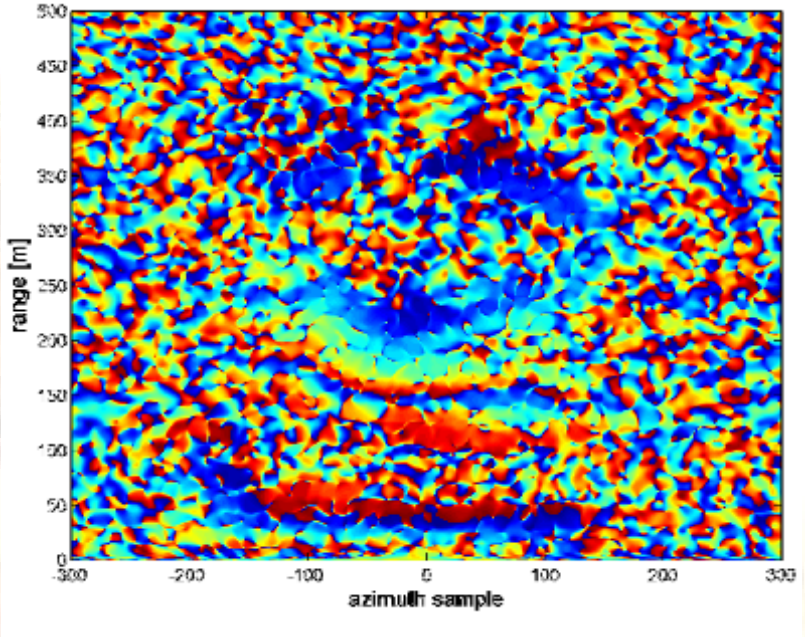
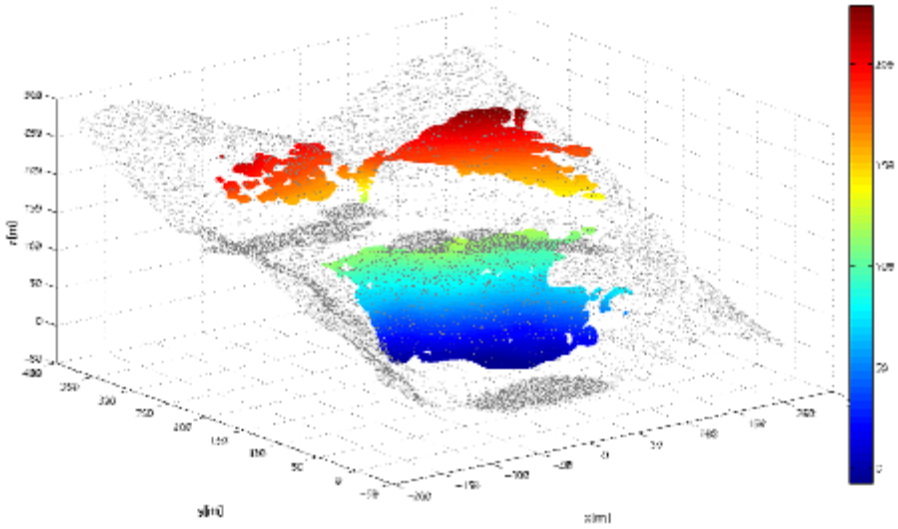
Ground Based SAR



One of the available 8 interferograms



Reconstructed profile superimposed to the available DEM

Project developed under a research contract of Campania Region

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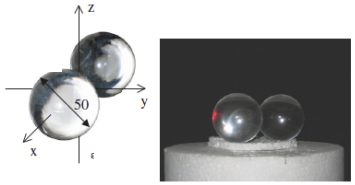
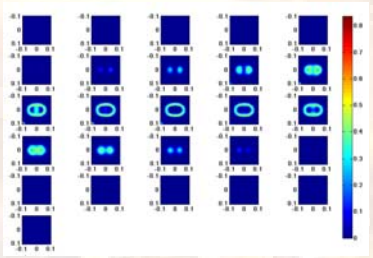
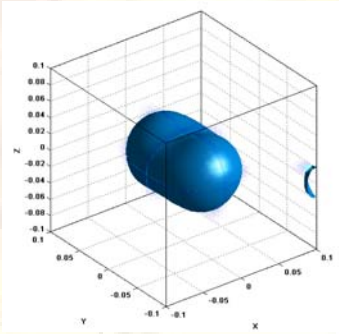
Microwave Tomography

Image reconstruction from 3D real data with Contrast Source – Extended Born (CS-EB) and Markov Random Fields (MRF)

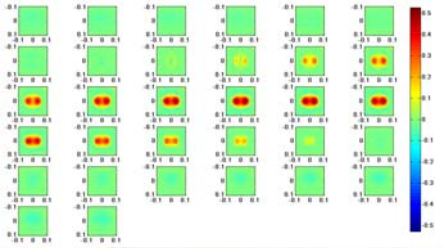


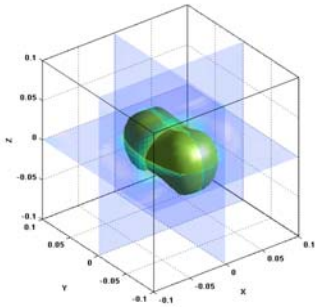
The reference profile





The hyperparameter map with MRF





The reconstructed profile

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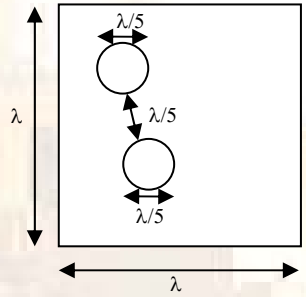
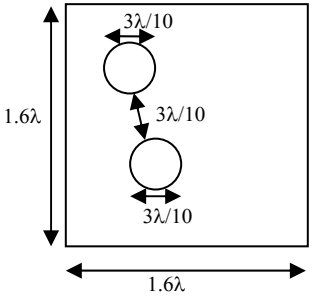
Microwave Tomography

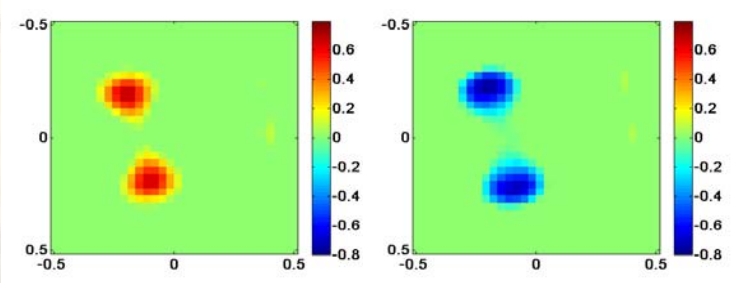
Image reconstruction with Compressive Sampling and Contrast Source – Extended Born (CS-EB)



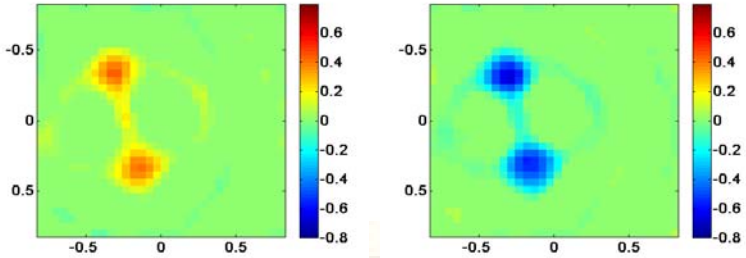
Reference geometry



Reference geometry



- The real and imaginary part of the reconstructed profile



- The real and imaginary part of the reconstructed profile

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Demining (GPR)

- ✓ D-BOX project on Demining financed by EU under FP7.
- ✓ Start: Jan 2012
- ✓ Main Partners:
  Astrium EADS (F-D), SELEX-Integrated Systems (I),
  Telespazio (I), Fraunhofer (D), CNIT (I), …..

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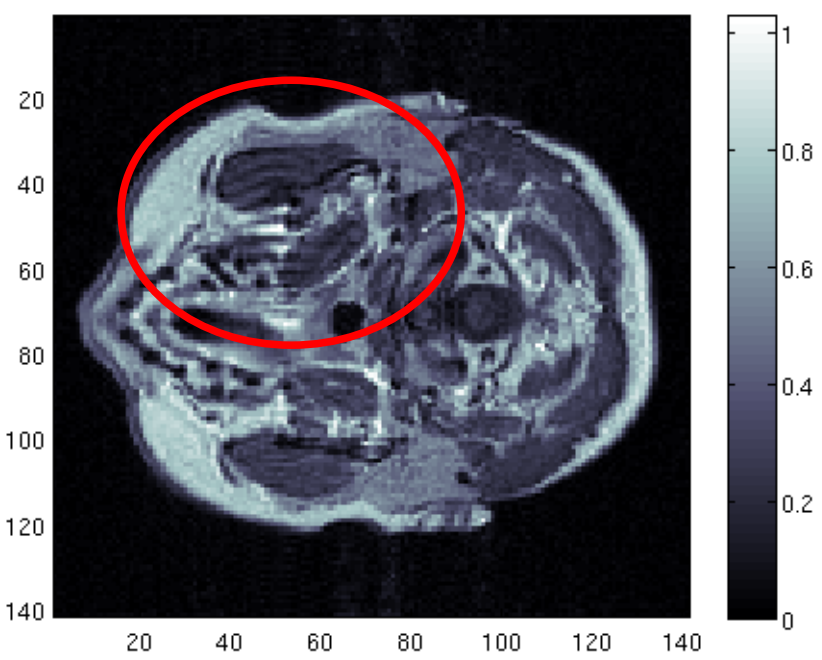
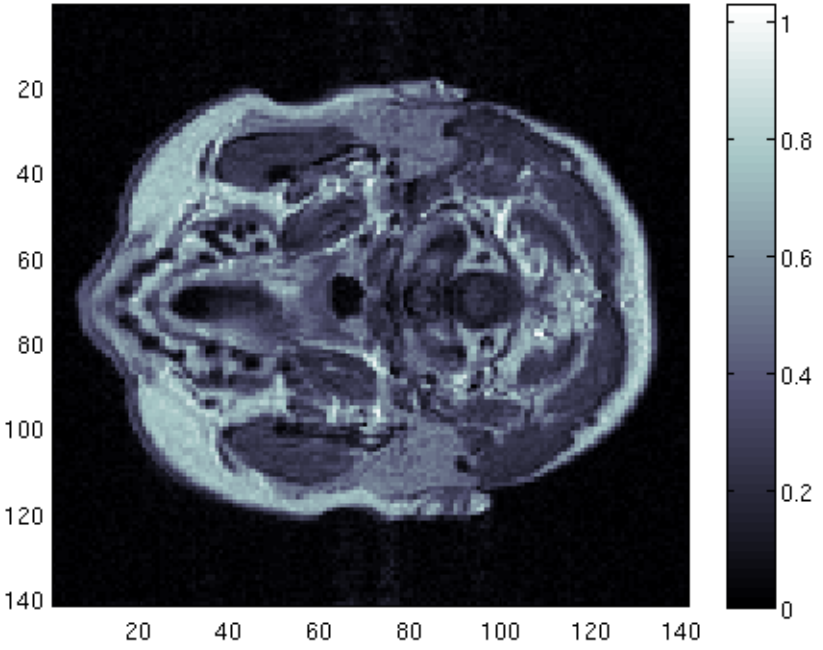
Magnetic Resonance Imaging

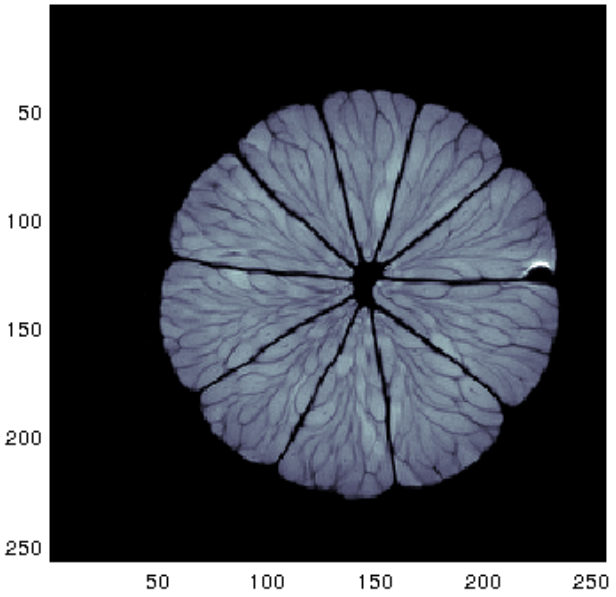
Image reconstruction from *k*-space data with compensation of field inhomogeneities error.

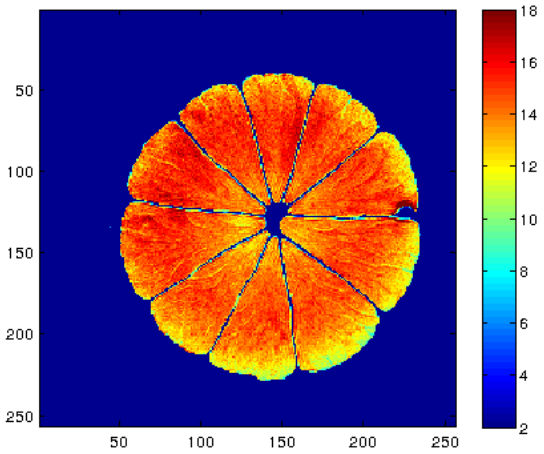




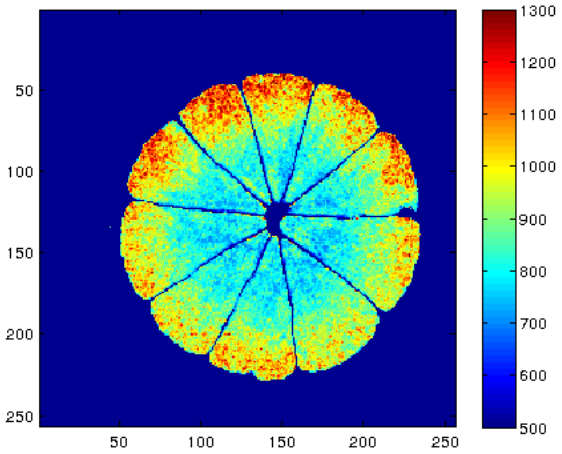
Magnetic Resonance Imaging

Physical tissues parameters (i.e. proton density ρ, spin-spin T_2 and spin-lattice T_1 relaxation times) statistical estimation.

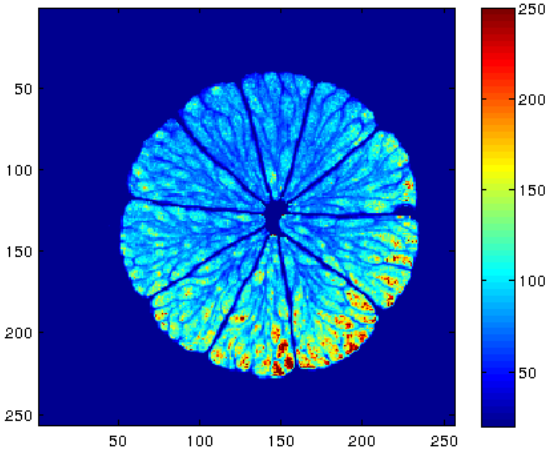




ρ



T_1



T_2

- Body Scanning
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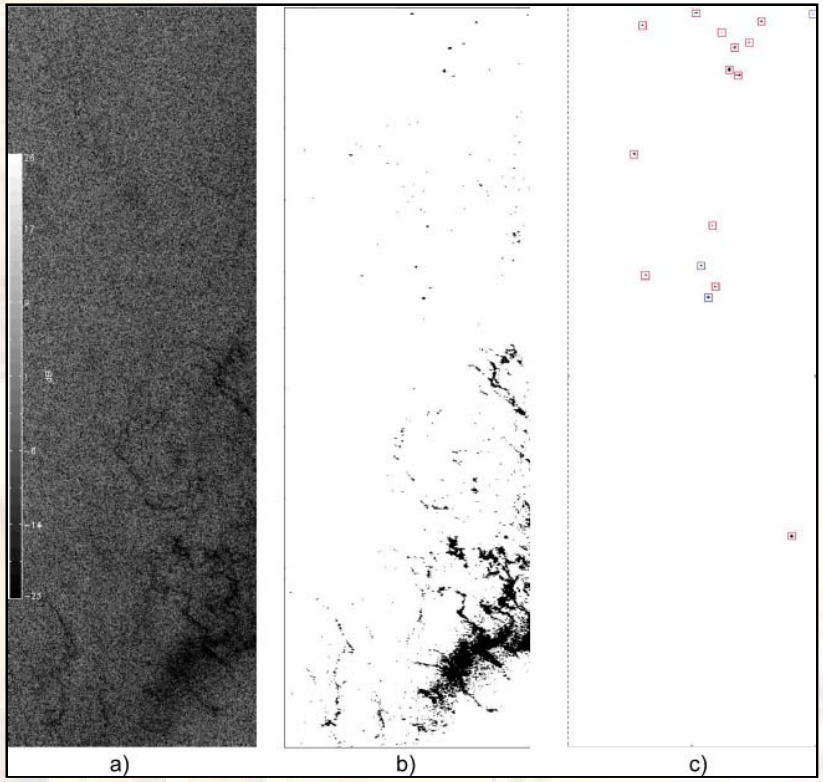
- **Oil Spills detection**
- ……

Oil Spills Detection



Together with the National Oceanografic and Atmospheric Administration (NOAA) a physically-based polarimetric processing chain has been dveloped to both observe oil spills and metallic targets, i.e. oil rigs and ships, in quad-polarimetric SAR measurements.
The processing chain constists of two steps:
1)Both oils and targets are detected.
2)Targets and oils are unambigously distinguished

L- and C-band quad-pol SAR data can be processed.
a)HH-pol SAR data. b)1° step: Oil and targets map. c)2° step: Target map

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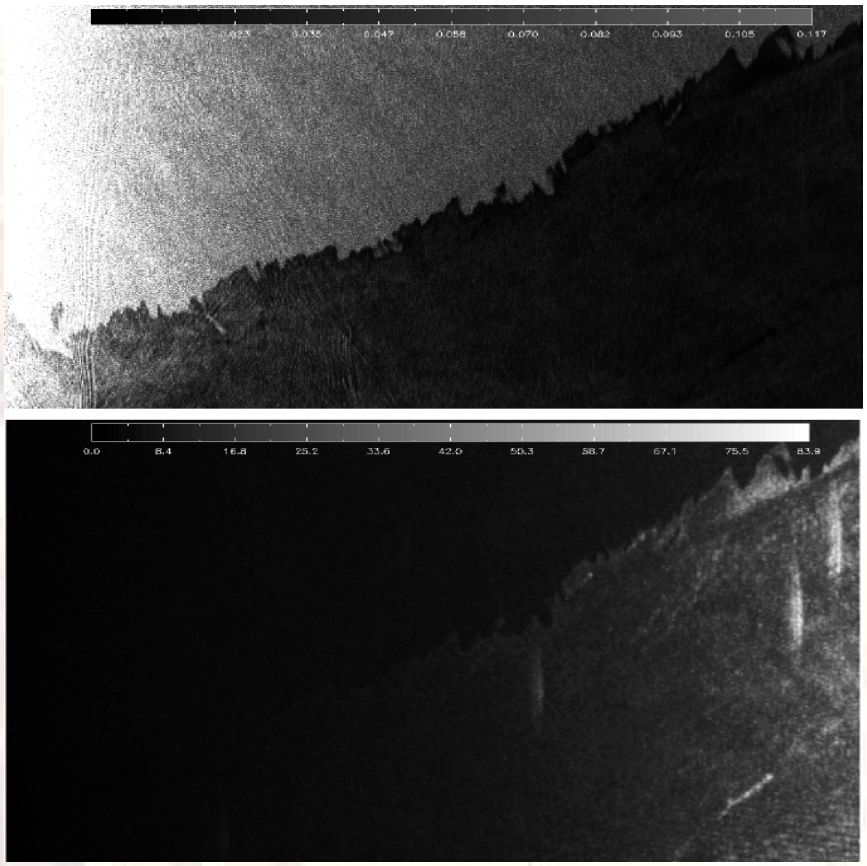
Oil Spills Detection



Together with the NASA Jet Propulsion Laboratory a polarimetric technique has been developed to exploit polarimetric data gathered by the NASA UAVSAR mission over the polluted area of Gulf of Mexico.

A model is first proposed which allows relating the damping properties of the oil slick (dark area top image) to the polarimetric scattering.

Although the dark area in the top image is uniformly dark, this does not happen in the processed image (bottom). Brighter areas are due to thicker oils

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Other Projects

- SIS-TEMA (Industria 2015 project)
  on Boat Navigation and Services in Harbour
- HABITAT (PON Project)
  on Boat Navigation and Services in Harbour
- ……