



METASENSING
Radar Solutions

GEO-SOLUTIONS

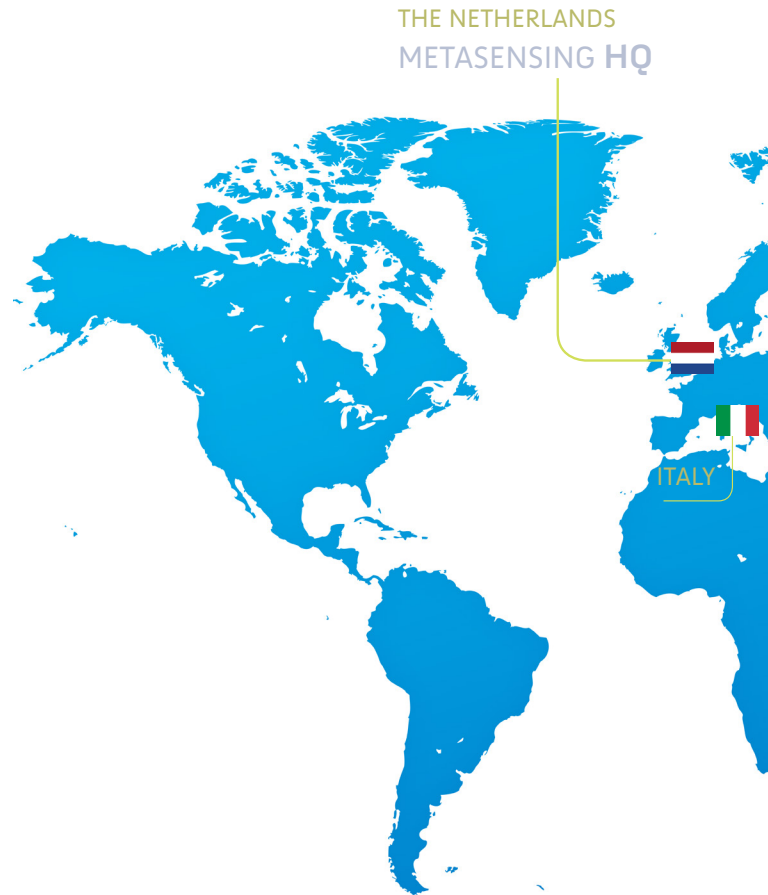
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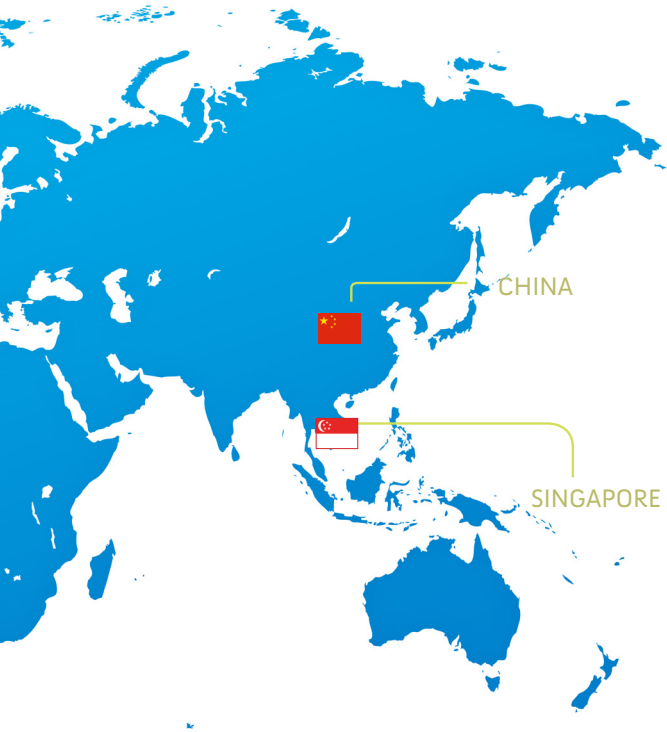
ABOUT METASENSING

MetaSensing is a company based in Noordwijk, the Netherlands that operates in the field of radar remote sensing for airborne, space, and ground applications. By combining innovative radar technology and synthetic aperture radar (SAR) techniques, MetaSensing offers high resolution radar sensors and services for mapping, geo-monitoring, defense, and space applications.

Our presence in the radar community is well-known through several important projects and collaborations.

MetaSensing currently has offices in the Netherlands, Italy, Singapore, and China, and has a commercial and technical network of partners worldwide.





Our main goal is to provide innovative remote sensing solutions based on advanced but cost-effective radar sensors to the world.

MetaSensing products are being used worldwide for deformation monitoring, vibration measurements, and stability assessments of natural slopes and man-made structures. We have successfully performed several airborne SAR radar campaigns at a wide range of frequencies, including Ka-, Ku-, X-, C-, L-, and P-band.

We are currently the only company offering deformation monitoring with millimeter to centimeter accuracy by using airborne data collection. We maintain an exceptional commercial record and possess invaluable operational know-how, allowing the company to become a unique player in the field of SAR mapping.



SOLUTIONS & PLATFORMS

PLATFORMS	GEO-SOLUTIONS	SECURITY & SURVEILLANCE
GROUND-BASED	FastGBSAR, Avalanche Radar, SeaWave, Weather-RADAR	Coastal Surveillance Network, FUAV-Detection
AIRBORNE	Mapping, UAV-DInSAR Deformation monitoring, QX-Avio	MiniSAR, MTI, Guardian
SPACEBORNE	Altimeter, Electronic Corner Reflector (ECR-C)	High-Altitude Radar



OUR GEO-SOLUTIONS

MetaSensing offers a range of ground based and airborne radar sensors for natural and man-made hazard prevention and monitoring.

We use top-level radar technology and signal processing to provide risk assessment and early warnings.

Applications:

- Geo hazards: landslides, glaciers, avalanches
- Mining: pit monitoring
- Structural monitoring: dikes, dams, buildings, bridges, airports
- Land management: subsidence monitoring, change detection (deforestation, desertification)

PRODUCTS

Ground based radars for deformation monitoring:

- FastGBSAR-S
- FastGBSAR-R
- FastGBSAR-C

UAV– based SAR monitoring (UAV-DInSAR)

Avalanche radar

Electronic Corner Reflector (ECR-C)





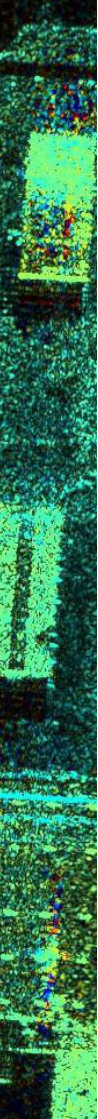
An aerial radar image showing a forested area. The forest is represented by a dense, textured pattern of yellow and green. A road or path runs vertically through the center of the image. To the left of the road, there are several rectangular structures, likely buildings or industrial sites, shown in shades of blue and red. The overall image has a grainy, high-contrast appearance typical of radar data.

WHY DO WE USE RADARS?

Radars are active sensors which generate electromagnetic radio waves through an antenna. Such waves are reflected by the observed scene and received back by the radar, allowing for very accurate measures of distance.

Unlike laser scanners or optical cameras, which use the amplitude of the reflected light to image objects, radars rely on the electromagnetic phase of the backscattered radio waves. This means that radars don't need "visibility" in the normal sense, but can measure deformation with the same accuracy (much higher than any optical or laser-based sensors) and can work in the dark and bad weather conditions.

There is more: depending on the wavelength, radio waves can penetrate through different materials and through the vegetation. Radar data also carry information about the geometry and the dielectric properties of the objects that compose the observed scene.



At MetaSensing we use many different data acquisition and radar processing techniques which allow us to get information about terrain deformations, movements, short or long scale temporal changes in the scene, and to obtain digital surface models.

TECHNIQUES	OBSERVATION GEOMETRY	OUTCOME
Real Aperture Radar - RAR	Fixed point	Range distance and velocity profiles
Synthetic Aperture Radar-SAR	Moving platform	2D images
Interferometry - InSAR & DInSAR	Moving platform performing repeated trajectories, or a single trajectory using slightly separated antennas	2D images of displacement, movements, spatial or temporal changes in the scenario

PLATFORM CHOICE CRITERIA

When using SAR and Interferometric SAR, the radar is installed on a moving platform. Whether the platform is a linear rail on the ground, an aircraft, an UAV or a satellite is up to the user's need.

Four criteria mainly drive the platform choice:

- Spatial coverage
- Time resolution
- Observation geometry
- Deployment flexibility

MetaSensing offers solutions from ground to space, making it possible to overcome the limitations of single carriers by combining different platforms.



SPACEBORNE

- Large area coverage
- Revisit time of few days
- Mainly vertical deformation
- No flexibility with respect to trajectories

MS solution

Satellite InSAR in collaboration with our partners, and combined with calibration using the MetaSensing C-band Electronic Corner Reflector (ECR-C)



AIRBORNE

- Medium area coverage
- Flexible revisit time
- Complete retrieval of all the components of the displacement vector
- Track and flight height can be chosen and optimized

SAR, InSAR, DInSAR with the MetaSAR compact radar mounted on small airplanes. Operational frequencies: VHF, UHF, P, L, C, X, Ku, Ka



- Medium/small area coverage
- Flexible revisit time
- Complete retrieval of all the components of the displacement vector
- Can be deployed anywhere.
- High flexibility on the flight tracks

SAR, InSAR, DInSAR with the MetaSAR compact radar mounted on UAV or helicopters. Operational frequencies: VHF, UHF, P, L, C, X, Ku, Ka



GROUND-BASED

- Small area coverage
- Revisit time of 10 seconds for continuous monitoring and early warning
- Mainly horizontal displacement
- Observation point can be chosen and optimized

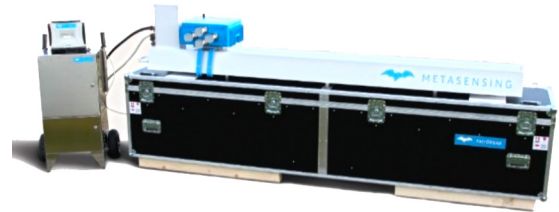
InSAR with the FastGBSAR and rotating SAR mounted on a linear rail or rotating arm. Each system can be mounted on a moving trailer to make installation easier.
Operational frequency: Ku band



METASENSING

FastGBSAR-S

The FastGBSAR-S (Fast Ground-Based Synthetic Aperture Radar) is MetaSensing's solution for continuous monitoring of deformations and displacements in natural and man-made structures, performed at the fastest scanning rate available on the market.



Designed to work in harsh environmental conditions, the FastGBSAR-S generates displacement maps of large areas every 10 seconds with sub-millimeter accuracy, up to a distance of 4 km.

Advantages

- The most accurate real time monitoring of unstable areas or structures
- Earliest detection and warning available on the market
- No reflectors needed
- No stable reference area needed
- Autonomous 24/7 operation in all weather conditions
- Applications
 - Open pit mines
 - Strip mines
 - Landslides
 - Dams
 - Dikes

Key features

- Interferometric ground-based SAR operating at 17.2GHz
- Scan time: 4 seconds
- Time between two scans: 10 seconds
- Spatial resolution: up to 0.5m by 4.8 mrad (0.5 m by 4.8 m at 1 km)
- Accuracy: 0.1 mm
- Maximum range: 4 km
- Proprietary Ranger software for real time processing and early warning
- Trailer solution with hybrid energy system (solar, wind, diesel, backup battery)
- Two hardware version: single and dual polarization
- Configurable: SAR and RAR modes available (-S and -R)

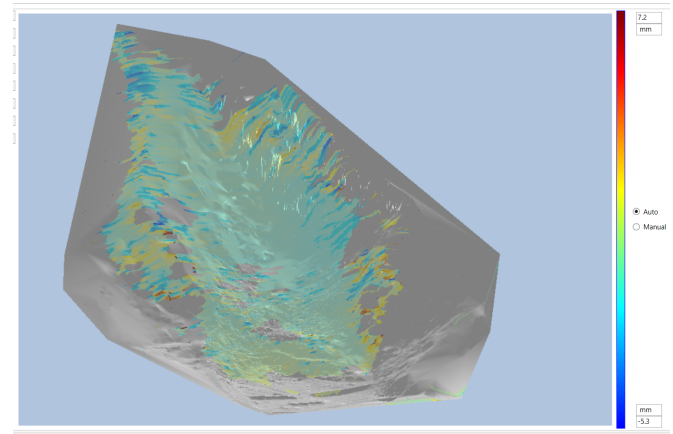
FASTGBSAR-S

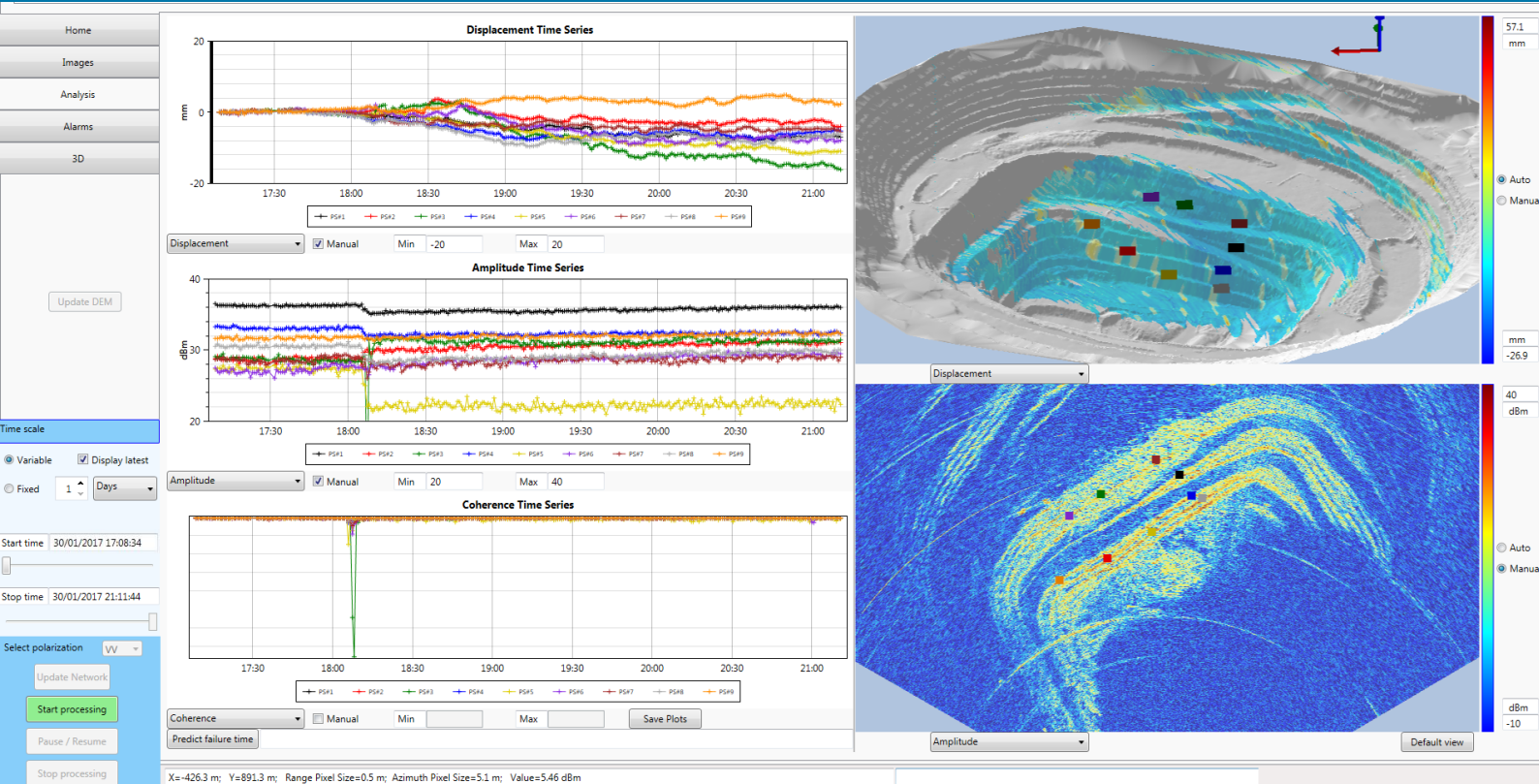
Ranger software

The FastGBSAR Ranger is the software for automatic real-time processing and visualization of the SAR mode FastGBSAR data, developed specifically for the mining environment and for critical structure monitoring. Thanks to its user-friendly interface, the user can obtain a complete picture of critical areas at first glance. Data analysis is simple and fast, allowing for time series analysis, 2D and 3D maps visualization, user defined alarm criteria setup for effective monitoring.

Key features

- Automatic real-time processing
- Processing results available in a few seconds
- Planar and 3D view for easy data visualization on a Digital Terrain Model
- Simultaneous visualization of displacement maps, quality parameters and time series
- Displacement, velocity, inverse velocity, coherence time series
- Alarm raising based on user defined multiple alarm criteria
- Data download and storage handling
- Data export for integration with mine monitoring software
- Backanalysis







FASTGBSAR-R

The FastGBSAR can be operated in Real Aperture Radar (RAR) mode for remote static and dynamic structural health monitoring of man-made structures. Easily transportable, the FastGBSAR-R can quickly be installed on a tripod. In a few minutes the user can obtain displacement profiles along the complete structure with an accuracy of 0.01 mm.

Applications

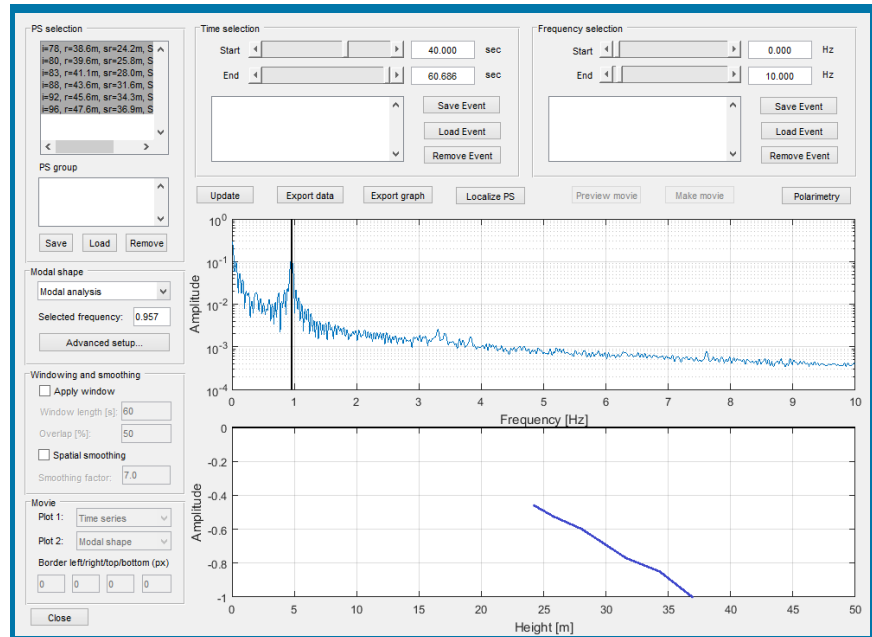
- Bridges
- Towers
- Buildings

Advantages

- The most accurate measure of displacement for static and dynamic structural health monitoring
- Complete frequency and modal analysis of the entire structure in just a few minutes
- Easy and fast setup
- Remote measurements with no need for in situ sensors
- No need to stop traffic when monitoring bridges
- Designed for all weather conditions

Key features

- Interferometric ground-based radar operating at 17.2GHz
- Accuracy: 0.01 mm
- Maximum range: 4 km
- Spatial resolution: up to 0.5m
- Proprietary ViMon software for vibration analysis, including displacement time series, and analysis of the resonant frequencies and modal shapes
- Two hardware version: single and dual polarization







NEW PRODUCT

MetaSensing will soon be releasing a new product within the FastGBSAR family: the rotating SAR (FastGBSAR-C) for continuous deformation monitoring.

FastGBSAR-C

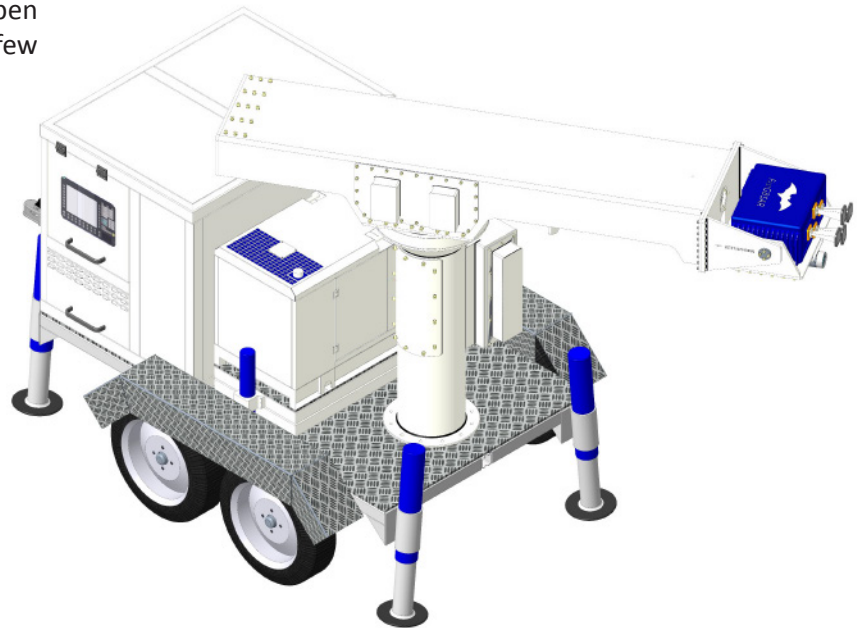
The FastGBSAR-C is the ultimate solution for open pit monitoring. It can cover up to 360° in just a few seconds for a global monitoring of the pit.

Advantages

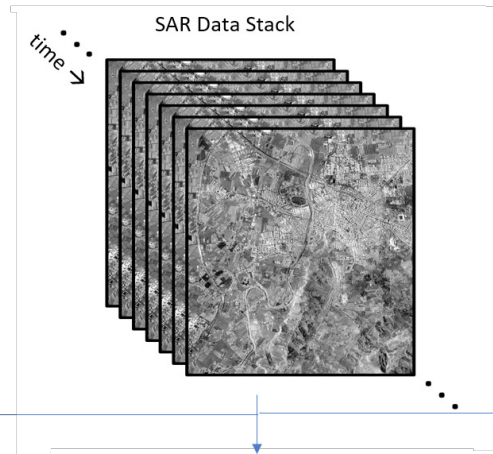
- Built in trailer for easy transport and fast deployment
- High resolution camera
- Built-in hybrid power supply system

Applications

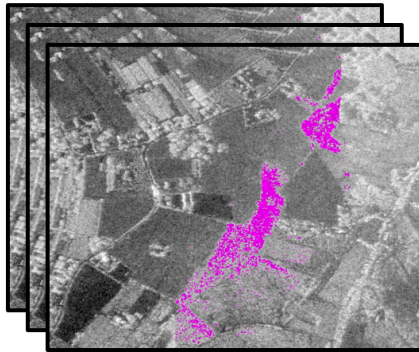
- Open pit mines



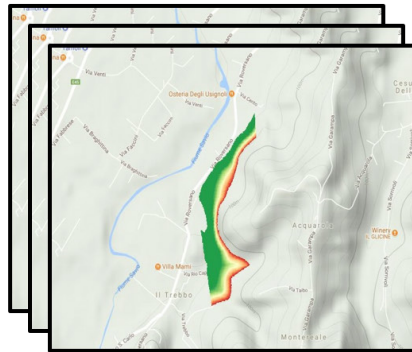
UAV-DINSAR



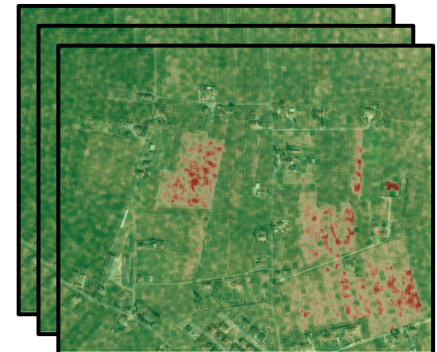
Amplitude Change Detection
Color indicates deforestation




Differential SAR Interferometry
Terrain movements: 3cm (green) to 10cm (red)



Coherent Change Detection
Changes on agricultural fields





The MetaSensing's airborne SAR (MetaSAR) can be integrated into small airplanes, helicopters or UAVs for a customized and cost-effective deformation monitoring over large areas. By using processing techniques such as Differential Interferometry (DInSAR), Amplitude Change Detection (ACD) or Coherent Change Detection, it is possible to retrieve the displacement and velocity of slow terrain movements, from a few mm per year up to several cm per day.

Advantages

- Flexible revisit time: the periodicity of data acquisition can be chosen according to the dynamics of the changes or of the terrain movements
- The operational frequency can be selected to maximize the return on a specific terrain type
- Track and flight height can be suited to avoid shadowed regions, and to optimize the Line-of-Sight with respect to the direction of the movement of interest

Key features

- Platform: UAVs, aircrafts, helicopters
- Operational frequency: from P to X band
- Flight altitude: Up to 7000m
- Swath: Up to 15 km
- Resolution: Up to 1m
- Size [cm]: 40 (L) x 30 (W)x 25 (H), customizable
- Weight: 15kg
- Power consumption: 200 W



AVALANCHE RADAR

The avalanche radar is a C-band doppler radar designed for early detection of avalanches and landslides. It can detect the first movements during avalanche initiation and trigger alarms within 1.5 seconds, so that roads in the area can be closed immediately for the safety of the drivers.

Advantages

- Reliable monitoring of spontaneous and controlled triggered avalanches
- Long range
- Easy deployment
- Autonomous operation in all weather conditions
- Provides an estimate of the avalanche's peak velocity and extension



Key features

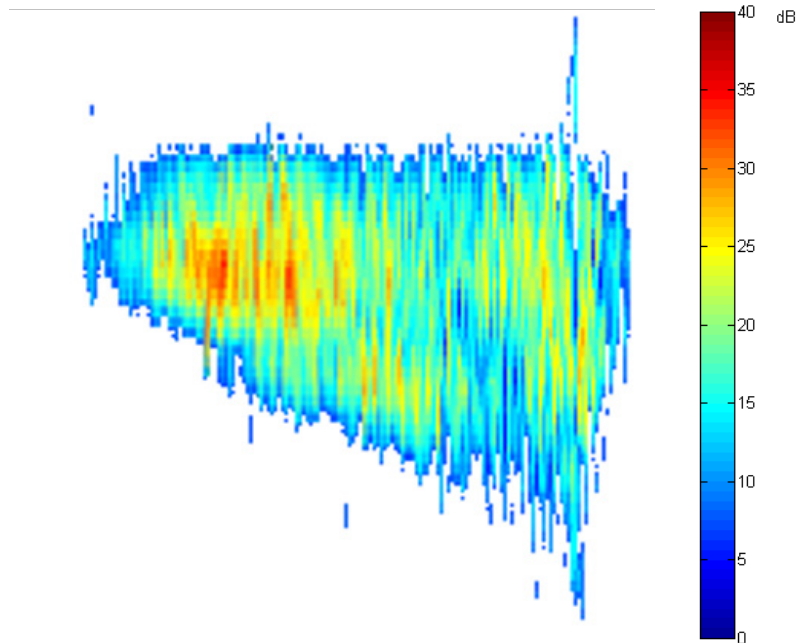
- Operational frequency: C-band (5.4 GHz)
- Maximum range: 2 to 4 km
- Early warning system with different levels of warning and alarms
- With Different levels of warning and alarms
- Detections based on dedicated thresholds providing low false alarm rate
- Output: Avalanche map in the range-Doppler domain, range and velocity profiles



The radar is part of Cautus Geo monitoring system, which uses the alarms generated by the radar to trigger light, sound, or dynamic signs on location, as well as send SMS and email alerts.

The alerts can be used to control the traffic on the roads which can be affected by the snow, thus protecting the drivers from potentially severe accidents.

Upon detection of a slide, an integrated optical camera starts recording. All videos, as well as the radar measurements, such as velocity profiles and avalanche range doppler maps, are available on the web in near real time via the Cautus Web system.



Intensity map of an avalanche occurred in Norway in May 2017

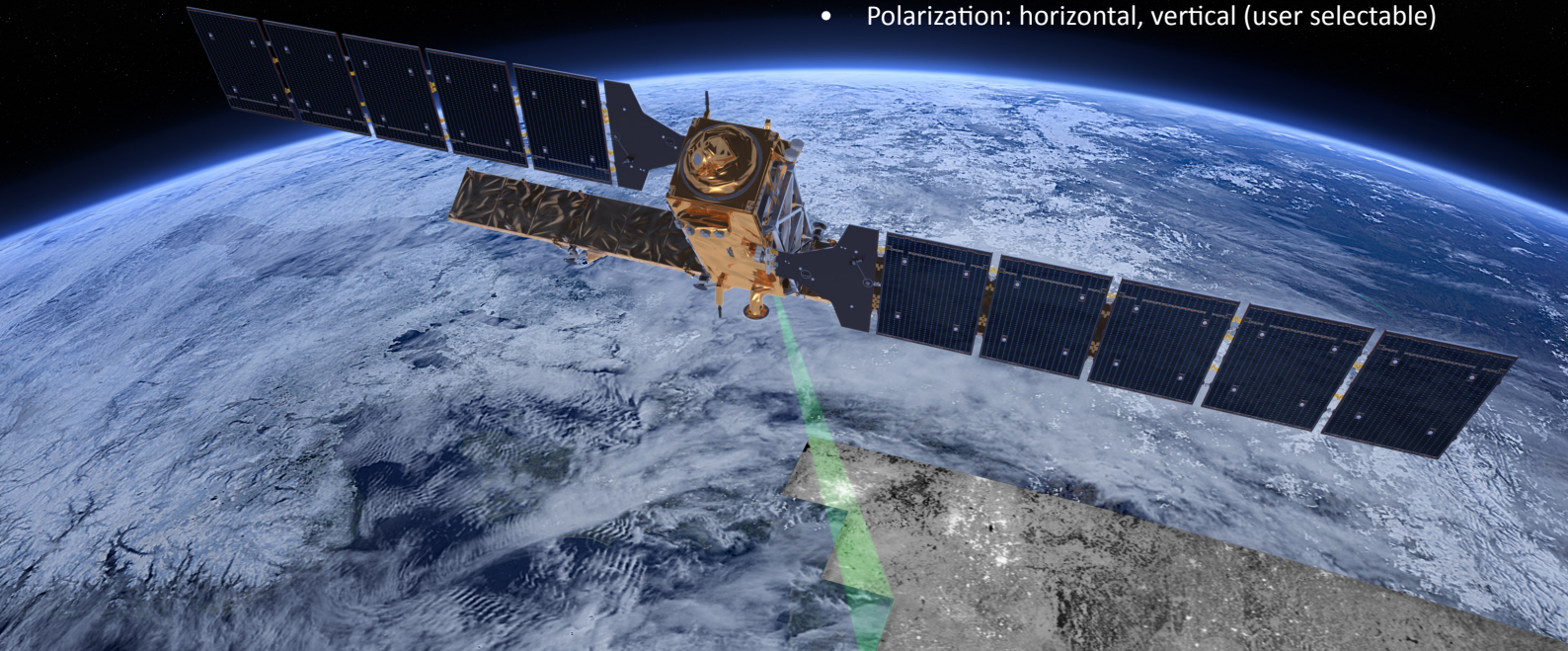


Advantages

- A more compact alternative to standard passive corner reflectors, which can be meters in size
- Allows for accurate calibration of satellite radar data, including location and atmospheric data
- Up to 1 year autonomous operation
- Operation frequencies compatible with Sentinel-1A and -1B and RADARSAT-2

Key features

- Operational frequency: C-band (5.4 GHz)
- Bandwidth: up to 100MHz
- Capability to measure vertical displacements of 1 mm
- Control and Configurations with a provided GUI
- GSM/WiFi for remote control
- GPS for clock and position information
- Standard USB connection
- Storage of up to 1000 activation and deactivation times
- Size [cm]: 45 (L) x 31 (W) x 20 (H)
- Weight: < 2.5 Kg
- Power Supply: two field-replaceable batteries, solar panels
- Polarization: horizontal, vertical (user selectable)



ECR-C

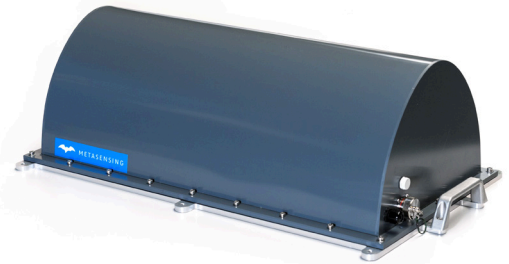
The MetaSensing Electronic Corner Reflector - C band (ECR-C) is a compact active transponder designed for the end-users of satellite-borne C-band Synthetic Aperture Radars.

What is it?

ECR-C is a user-deployed permanent scatterer designed to receive a weak signal from a satellite radar, amplify and filter this signal, and transmit it back to the satellite. This allows for very precise measurements of location and relative displacement, invaluable for satellite-based Differential Interferometric Synthetic Aperture Radar (DInSAR) measurements.

This information can be used when interpreting the satellite images, for example, to precisely monitor terrain deformation or discover information about the atmosphere the signal has travelled through. From the point of view of a satellite radar, the ECR-C looks very much like a corner reflector, however, it is much more compact and uses an active rather than passive design.

The user is required to provide the time and duration of satellite overpasses, which can be uploaded to the ECR-C with a user-friendly control software over USB connection. The ECR-C is designed to have an active amplification mode while a satellite is passing overhead, and a sleep mode while waiting for a satellite to pass over.



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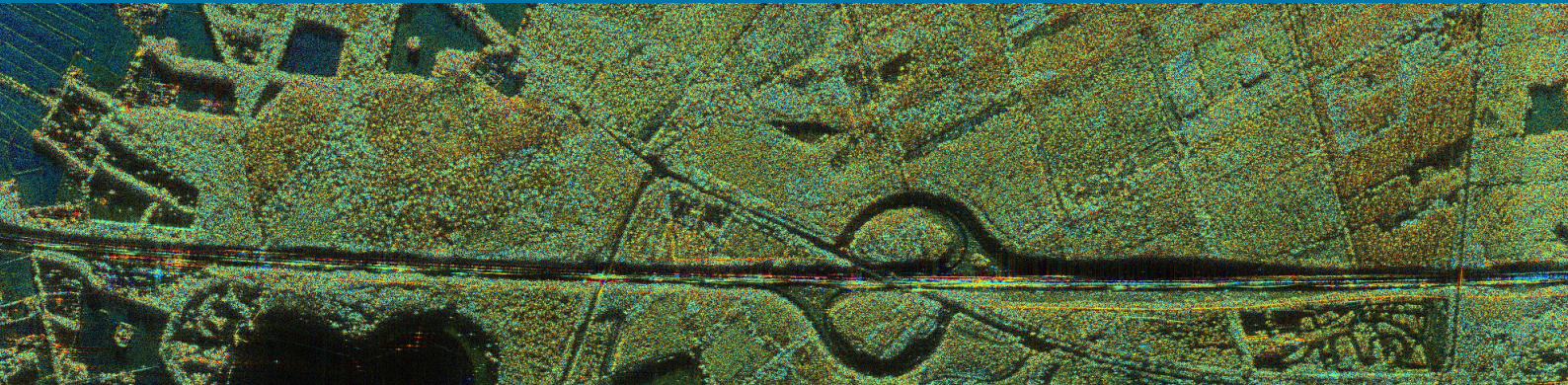
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