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Tecnologie per le Scienze della Terra e del Mare

45° 27' 39.384" N
9° 07' 30.145" E

Metasensing FastGBSAR

Interferometro radar da terra in modalità SAR e RAR

Metasensing produce i più performanti sistemi radar interferometrici terrestri, progettati per

- **> Monitoraggio deformazioni**
- **> Misura di vibrazioni**
- **> Valutazione della stabilità di pendii naturali o strutture artificiali**

Modalità SAR	Versanti e pendii
	Miniere e cave
	Dighe e bacini
	Frane e smottamenti
Modalità RAR	Cavalcavia autostradali
	Ponti ferroviari
	Torri di telecomunicazione
	Pale eoliche

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Sistemi FastGBSAR
Fast Ground Based Synthetic Aperture Radar

Metasensing ha sviluppato con successo sensori innovativi per il monitoraggio di

- **Dighe**
- **Ponti**
- **Frane**
- **Cave**
- **Argini**

Features

- Dual-operation mode (SAR and RAR)
- Fast acquisition time for high temporal resolution (scan time less than 5 s)
- Full polarimetry for selection of responding scatterers
- System robustness for operations in harsh environmental conditions (high/low temperatures, inclement weather, dust, smoke, ashes etc.).

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Gli interferometri Metasensing operano in modalità SAR (controllo di movimenti e deformazioni in frane, argini, dighe, edifici…) e RAR (monitoraggio statico e dinamico di strutture, ponti, torri…).

SAR – Synthetic Aperture Radar

In SAR (Synthetic Aperture Radar) mode, the FastGBSAR is installed on a linear rail to produce two-dimensional (range and azimuth) images. It is suitable for deformation monitoring of man-made structures such as mines, dams, dikes, buildings and natural hazards, such as slopes, landslides.
The FastGBSAR is unique for two main reasons:

- Short acquisition time: one image is produced in 4 seconds. The deformation monitoring is less sensitive to changes in the scenario (weather changes passing objects) and the images have higher quality.
- Short acquisition interval: one image is acquired every 10 seconds. Issues due to phase unwrapping are minimized and faster changes and deformations are captured.

RAR – Real Aperture Radar

In RAR mode the FastGBSAR is particularly suitable for static and dynamic structural monitoring of man-made structures such as bridges, towers, buildings, pillars, wind turbines, and similar structures. Being compact and portable, the system can operate in all weather conditions, producing range profiles with a sampling frequency up to 4 kHz.

Operating mode	SAR	RAR
Operating frequency	17.2 GHz (Ku band)	
Range resolution (1)	Up to 0.5 m	
Maximum range	4 km	
EIRP power	19 to 42 dBm	
Operating temperature range	-20° C to 60° C	
Environment	IP65	
Sensor weight	10 kg	
Accuracy (2)	± 0.1 mm	± 0.01 mm
Azimuth resolution (3)	Up to 4.8 mrad	-
Aquisition time	5 s	0.25 ms
Power consumption	<200 W	70 W
Rail weight	82 kg	-
Rail length (customizable)	2606 mm	-
Rail effective length (4)	1900 mm	-

(1) Range resolution depends on the frequency bandwidth allowed by locai authorities, which is generally limited to 200 MHz, leading to a range resolution of 0.75 m.

(2) Measurement accuracy depends on target characteristics and distance from the sensor. Listed values are for a corner reflector at 1 km distance.

(3) In SAR Mode, azimuth resolution depends on rail effective length. Effective length is the length over which the sensor moves with constant velocity.

(4) Rail effective length is slightly dependent on sensor velocity. Listed value corresponds to minimum velocity of 0.1 m/s. Effective rail length at maximum velocity of 0.5 m/s is 1800 mm.

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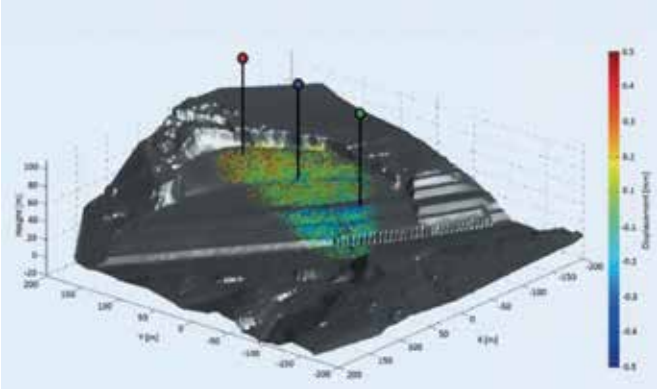
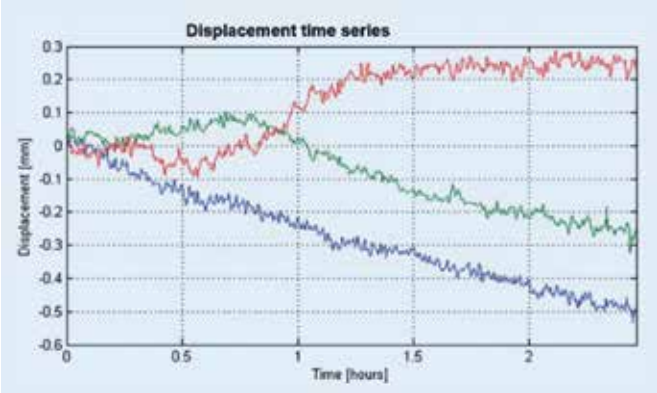
FastGBSAR – SAR mode

Monitoring a land slope

The FastGBSAR has been deployed on the side of a high-speed railway track in the Shanxi province in China, to monitor a land slope next to the railway.
The measured displacement ranges from - 0.6 to 0.3 mm capturing the movement of the dry sand blown away from the wind caused by the passing train.
The diagram reports the time series of the displacement for the three selected points.





Monitoring a land slope next to a high-speed railway track.

Monitoring an open-pit mine

FastGBSAR has been intensively monitoring an open-pit mine in Czech Republic to produce accurate displacement maps of the area.

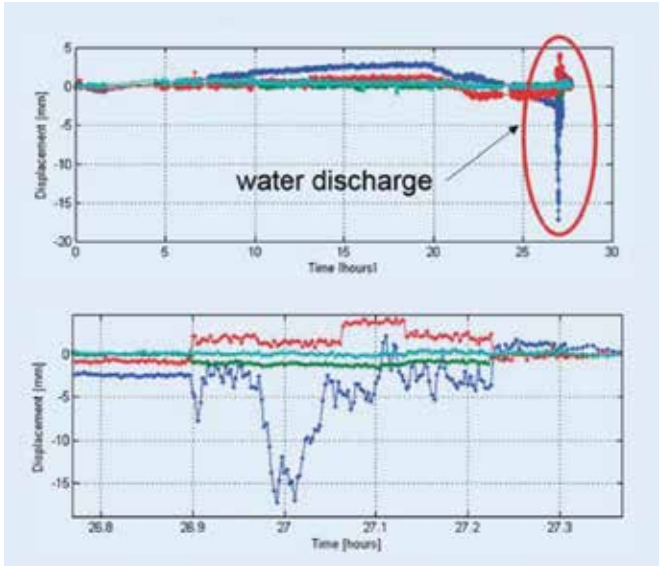
The maximum distance was set to 1500 m, with a range resolution of 0.5 m and azimuth resolution of 5.4 mrad. The displacement is close to zero in almost all the area except in one part where a deformation of about 100 mm appears, this is due to the excavation works.

Figure shows the displacement map measured by the FastGBSAR around the open-pit mine and projected on a Digital Elevation Model.
The movement of the excavator machine creates a movement away from the radar in the area behind it (red arrow) probably caused by the removal of material from the slope with relief of stress. A movements towards the radar (blue arrow) is also due to the accumulation of material.

Monitoring a water reservoir dam

FastGBSAR has been deployed to monitor the response behavior of the Three Gorges test dam in China with respect to four different intensities of water discharge.
The four steps of the water discharge are clearly visible from the red line corresponding to the gate of the dam.

Deployment site for the FastGBSAR, about 400 meters in front of the dam.

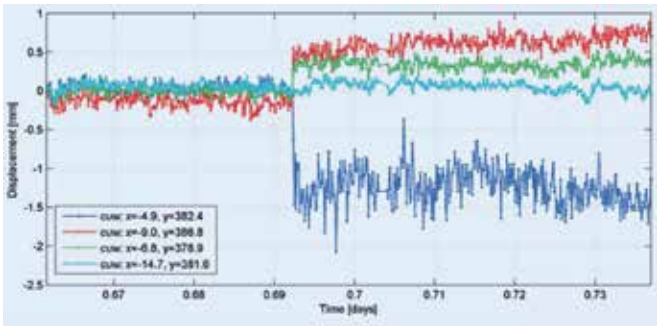


Time series of the displacement in four points of the dam before the water discharge (top) and during the water discharge (bottom).

Monitoring a land slide

FastGBSAR was deployed to observe a land slide in Italy to monitor slope stability and falling rocks.
Figure shows the time series of the displacement for several points. The very high acquisitions rate (one image every 10 seconds) allowed a more efficient detection of falling rocks.
The falling rock event can be seen as a abrupt and instantaneous change in the displacement series.

Monitoring the Corniolo (FC) land slide.



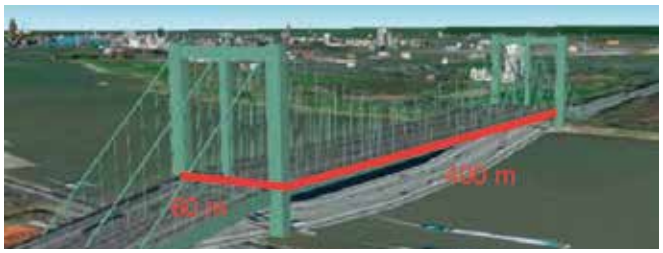
Time series of the displacement monitored for four different points.

FastGBSAR – RAR mode

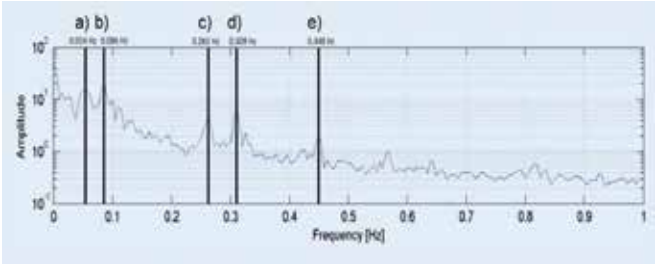
Monitoring of a highway bridge

The simultaneous observation of many points along the bridge is particularly suitable for the determination of the mode shapes.
A mode shape is the vibration pattern of the structure executed at one particular frequency. It only variates according to material properties and is indipendent from the exciting force. Figure shows exemplary the mode shapes corresponding to the frequencies that are marked.

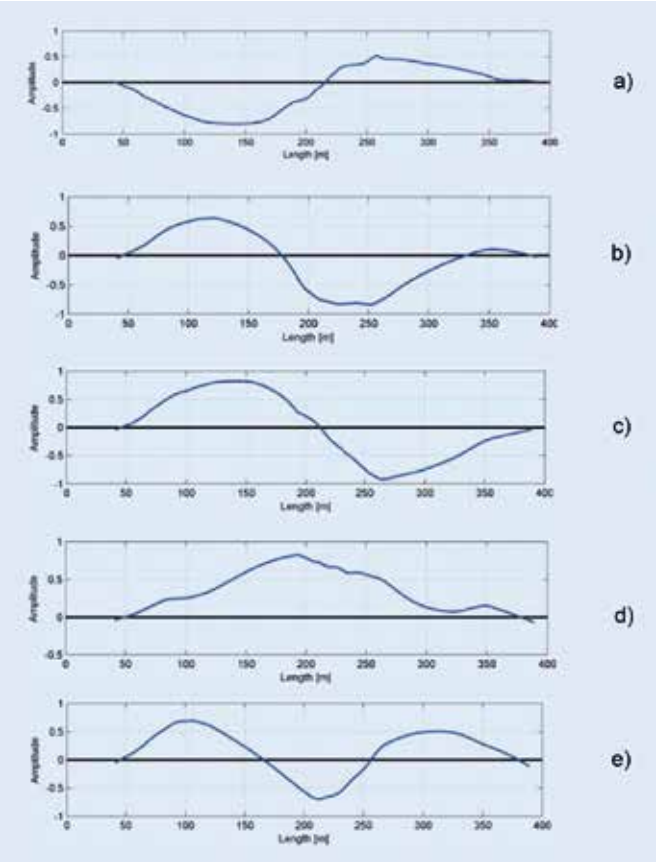
In order to distinguish between vertical, torsional and horizontal modes, measurements can be repeated from different viewing angles.



400 m long Highway bridge under observation Google, 2014.



Frequency analysis of the time series. The marked frequencies are identified modes shown hereunder.



Mode shapes at
a) 0.054 Hz, b) 0.086 Hz, c) 0.261 Hz, d) 0.309 Hz, e) 0.448 Hz.

Monitoring of telecommunication tower

A 42 meter high telecommunication tower has been monitored in moderate-low wind conditions. The measurements were performed by the polarimetric FastGBSAR version, equipped with four antennas. The use of the four polarimetric channels gives sensitivity to different scattering mechanism.

Figure shows the oscillation of the tower plotted at three different heights for an osservation time of 10 seconds. The sub-millimeter horizontal displacement value of the tower depends on the considered height.

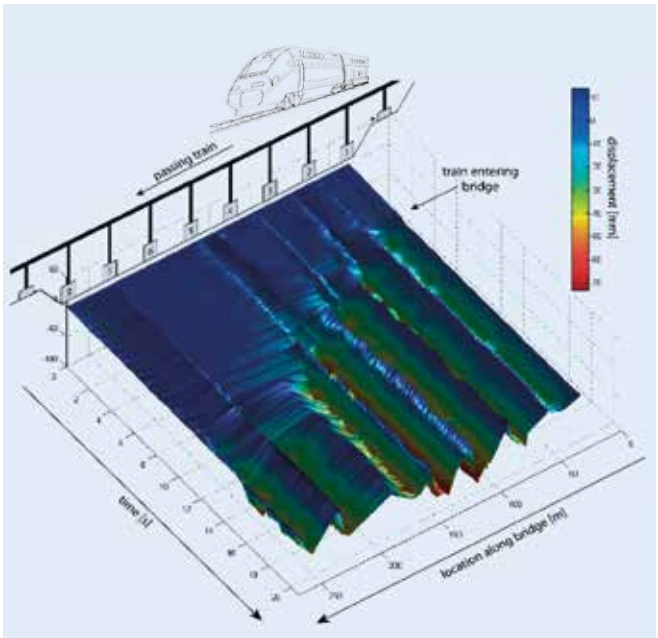
Monitoring of wind turbines

The determination of vibrations and modal parameters of wind turbines can assist in the optimization of their design and performance.
To avoid structural failure, the knowledge of the eigenfrequencies of the tower and rotor blades is essential. In the following an example is shown of the smultaneous monitoring of two wind turbines at different distance.

FastGBSAR installation for monitoring wind turbines.

Monitoring of a railway bridge

The fixed installation of the sensor on a tripod, allows simultaneous measurement of multiple spans along the bridge and gives the complete picture over time of the behavior of the entire bridge during the passing of a train.



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Codevintec Days 2018




Trieste 30-31 maggio 2018

Workshop di due giorni con presentazioni, dimostrazioni sul campo e in mare.
Opportunità di networking, possibilità di venire a contatto con le ultime tecnologie dei principali produttori di strumenti per le Scienze della Terra.

Monitoraggio deformazioni, vibrazioni e cedimenti: interferometri radar da terra, SAR, RAR

Studio del sottosuolo: georadar, georadar 3D Step Frequency, sismografi, geoelettrica...

Vulcanologia e Monitoraggio sismico: sismometri, OBS, magnetometri, gravimetri, strong motion...

Rilievi dei fondali e delle coste: Droni idrografici,Multibeam, SideScanSonar e SubBottom Profiler, Correntometri Doppler, Sonar3D, Release, software idrografici…

Navigazione, Posizionamento e misura di Assetto, anche sott'acqua: GNSS, INS, IMU e USBL, anche integrati, Modem Acustici.

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Trovi il programma e il modulo di iscrizione su
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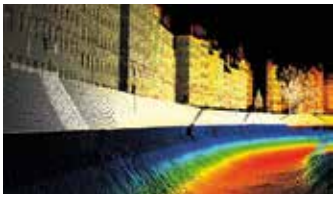

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Codevintec Italiana srl

Milano via Labus, 13 – 20147 Milano
Roma Lungomare P.Toscanelli,64 – 00122 Roma

info@codevintec.it ph +39 02 4830.2175
www.codevintec.it fax +39 02 4830.2169