Advanced Geomatics solutions: from Academy to Industry

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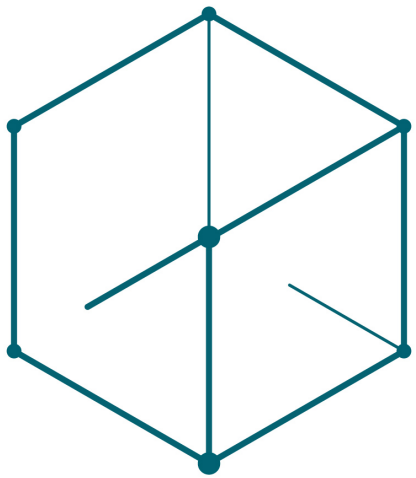
The Research Team

The Geodesy and Geomatics Division
is part of the University of Rome "La Sapienza"

The team is composed by young engineers specialized in Geomatics and Positioning:

- we are professional group engaged in university **Research&Development**
- our vision is to encourage **technology transfer** from university to industry
- we want to apply scientific knowledge of our country in innovative projects and services
- we have recently founded **Kuaternion**, an innovative start-up (`www.kuaternion.com`)



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In the last years the following main fields of research were developed:

- **Applications of low-cost range cameras for 3D close range modeling**
  - Sensor calibration
  - Accuracy assessment
  - Advanced software solutions

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  - Matching strategy
  - DSM generation & validation
  - Imagery orthorectification

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- **Real-time applications of the GNSS, low-cost oriented**
  - GNSS seismology & tsunami early warning system and structural monitoring
  - GNSS permanent networks for real-time positioning services
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SISAR software

SISAR is a complete photogrammetric software able to produce **Digital Surface Models (DSMs)** and **Orthoimagery** from the most common optical and SAR imagery

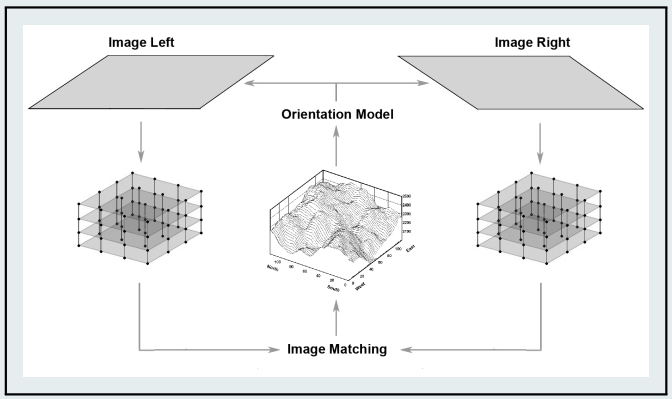
Main characteristics:

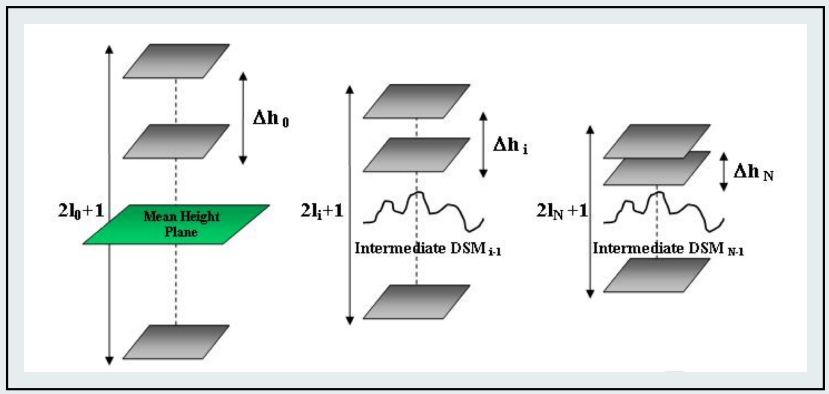
- Rigorous orientation models for imagery acquired by several optical sensors (EROS A, Ikonos, QuickBird, Cartosat-1, WorldView-1/2, GeoEye-1) and SAR sensors (COSMO-SkyMed, TerraSAR-X, RADARSAT-2, Sentinel-1)
- Rational Polynomial Coefficients - RPCs generation tools based on a terrain independent approach
- **Image matching algorithm (patented)** specially designed both for SAR and optical high resolution imagery

SISAR Patent

MATCHING (Authors: A. Nascetti, P. Capaldo, M. Crespi, F. Fratarcangeli, F. Pieralice)

2013 patent: Matching strategy for optical and SAR high resolution satellite imagery (Matching procedure and device for the digital modelling of objects by stereoscopic images)





DATE - Digital Automatic Terrain Extractor

Software

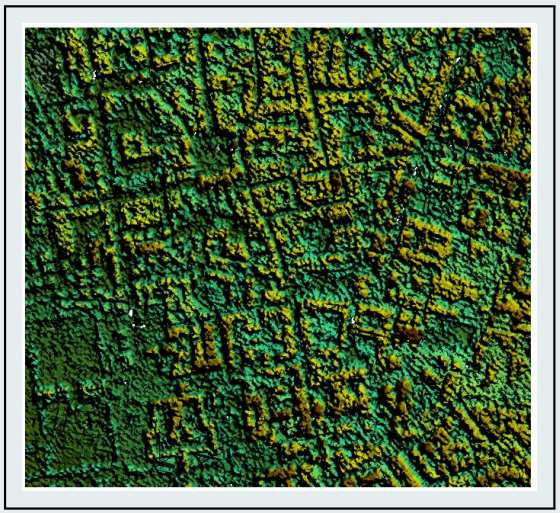
DATE is a software for **Digital Surface Model** generation from:

- high resolution optical satellite imagery
- high resolution SAR satellite imagery

overcome the issues related to the **epipolar resampling** of satellite images

DATE features

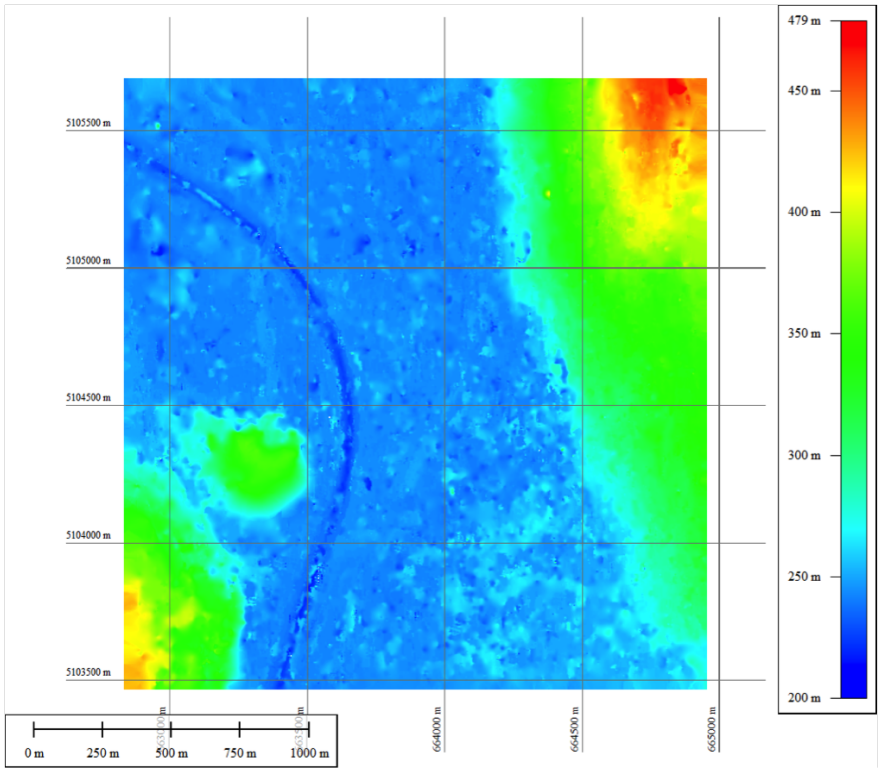
- Images ground projection (GrEI)
- Coarse-to-fine pyramidal strategy
- Modular structure to manage upcoming sensors
- Multi-view approach
- Computer vision state of the art algorithms
- Totally automatic (intensity production capabilities)



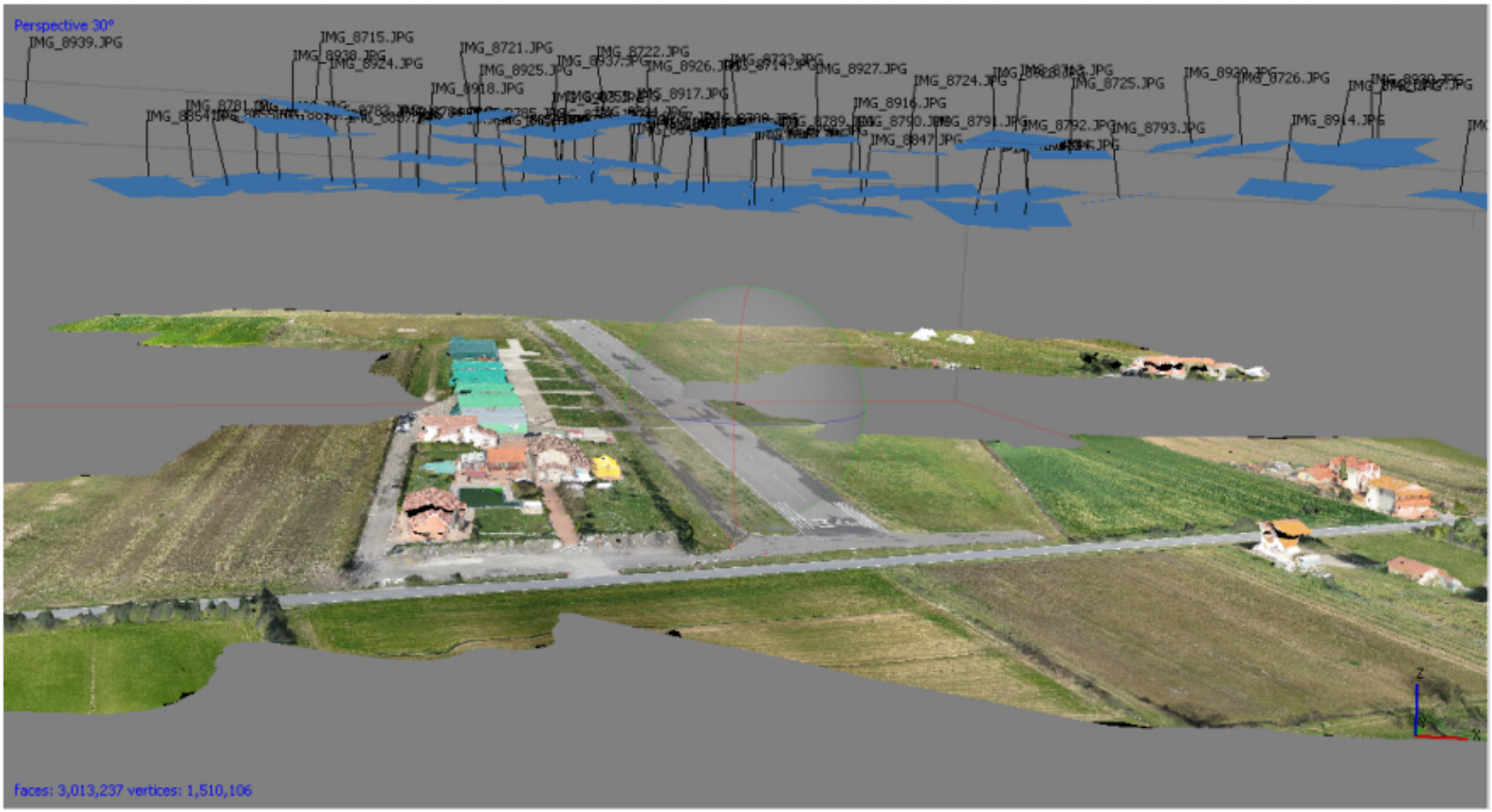
DSM Generation

Example of Trento dataset:

- extracted DSM compared with LiDAR reference
- RMSE range from 4 to 6 meter



Aerial and UAV photogrammetry



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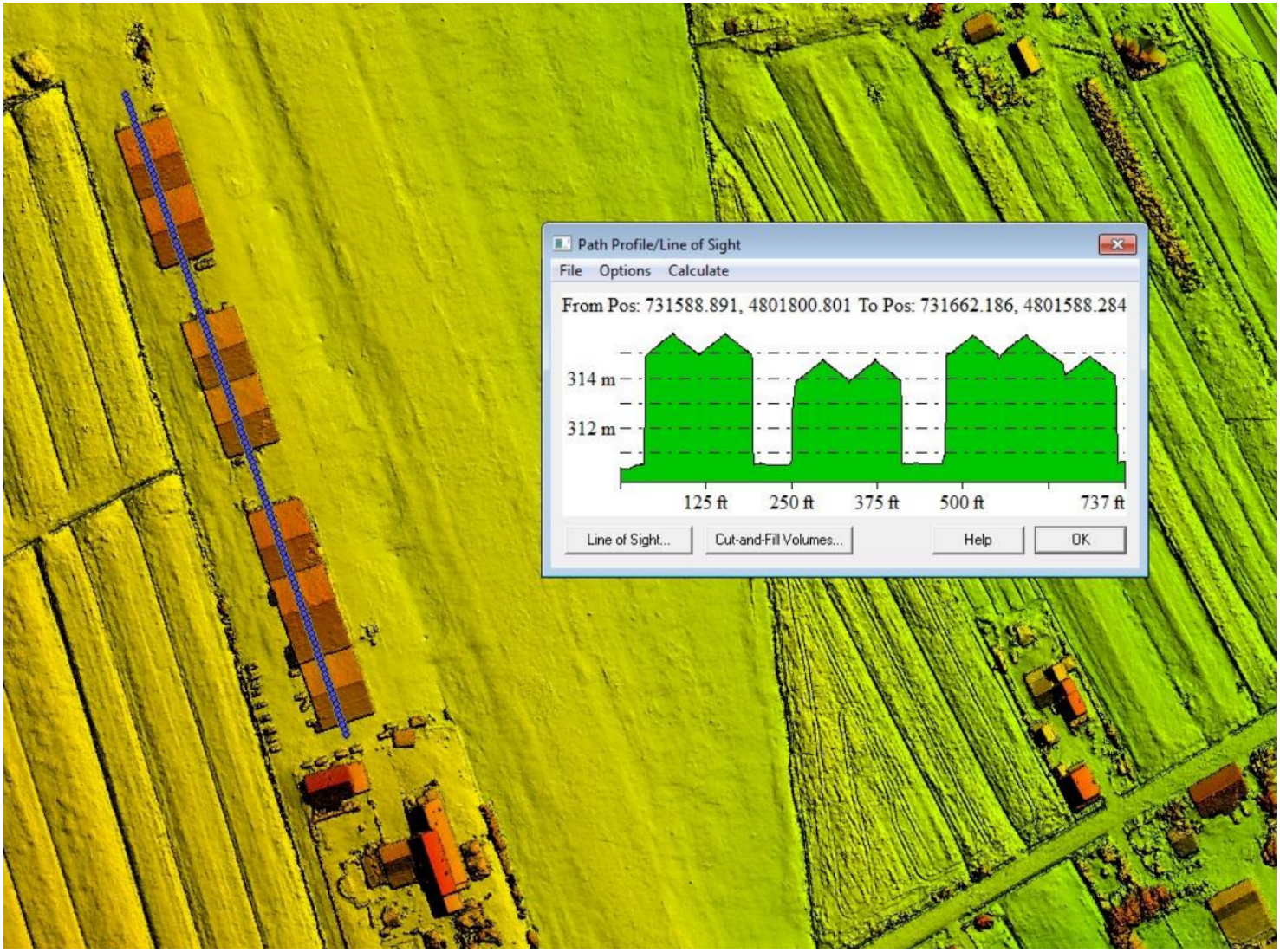
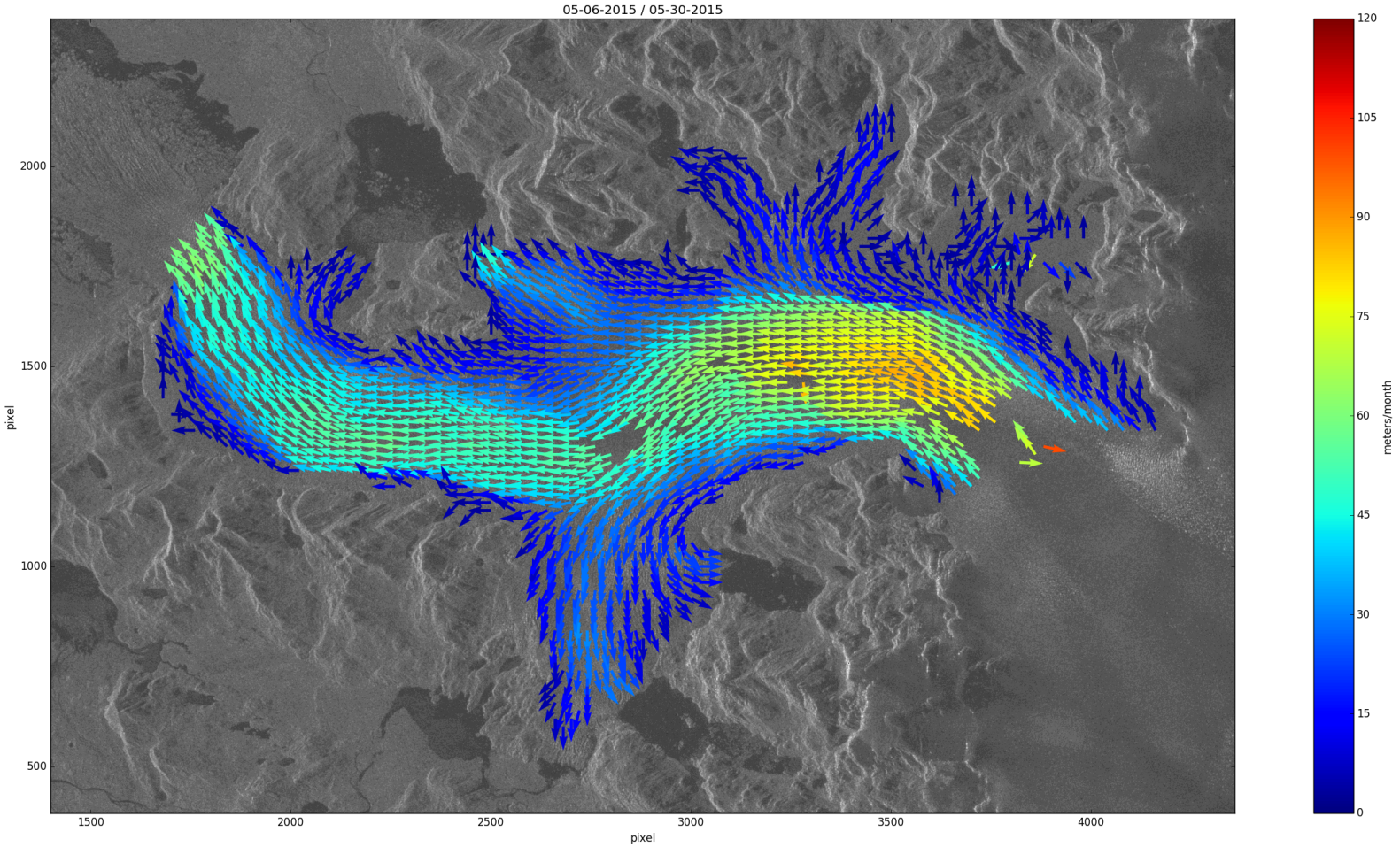


SAR Intensity Offset Tracking

Glacier surface velocity field with Sentinel-1 data: San Quintin (Chile)



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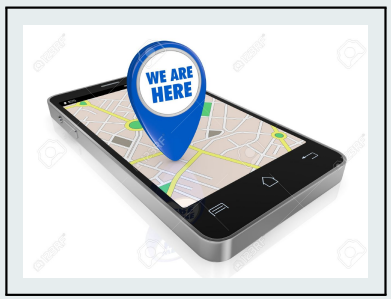
GNSS available receivers

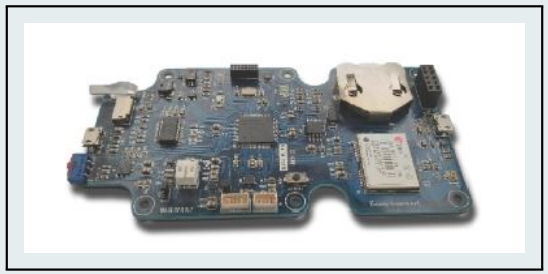
Mass Market (10 €)

- **Raw observations will soon be available for the user**
- By now, coordinates estimation performed on board (Black box)



Low-cost (1000 €)

- **One frequency (L1) code and phase raw observations available**
- Research activities in progress
- High impact on applications



Geodetic (10K €)

- **"All" raw observations available, are now the benchmark**
- Used in surveys and geodetic applications

Which is our vision for GNSS market evolution?

Exploiting low-cost GNSS receivers potentialities

GNSS monitoring:

- Fast displacements detection through real-time VADASE
- Slow displacements detection through post-processing

Real-time low-cost and fast surveys (NTRK)

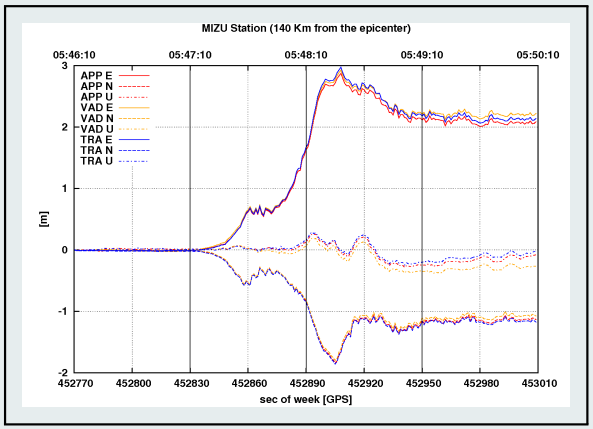
- Civil Engineering and Cadastral Survey
- Close-Range Photogrammetry
- UAV precise navigation

Atmospheric GNSS real-time remote sensing

- Contribution to tsunami early warning systems - VARION
- Contribution to meteo forecasting and nowcasting models

VADASE (Authors: G. Colosimo, M. Crespi, A. Mazzoni)

2010 patent: VADASE (System for measuring coseismic movements or vibrations of structures based on global navigation satellite systems-gnss and/or pseudolites)



The vision: VADASE onboard a commercial GNSS receiver

- an autonomous, real-time monitoring solution

Leica Geosystems

- key market player providing reliable, robust, precise GNSS solutions (HW/SW)
- tens of years of experience, open to innovation, interested in new technologies
- large existing network of customers and receivers, blue world-wide

Win-Win situation

- combine the innovative algorithm from Academia and the experience and resources from Leica Geosystems to turn VADASE into an accessible, usable, customer-oriented product

Thank you for your attention