

Title: Real Time GNSS for studying geohazards through data mining and modelling processes

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Research program

The RING (Integrated National GPS Network) infrastructure managed by INGV consists of 215 receivers throughout Italy with some of them installed abroad (Malta and Greece). Most of the receivers are GPS, but gradually the network is being upgraded to full-GNSS configuration thanks to infrastructure funding (PON GRINT). Data are transmitted in real time via satellite connection, wi-fi, Internet and UMTS connections. Daily data sampled at 30 seconds, and recently also at 1 second, are archived and made free available to the scientific community. To date, the RING infrastructure has proved to be fundamental for the study of tectonic deformations and strain accumulation, coseismic (static and dynamic) and post-seismic deformations of major seismic events.

The proposal of the research activity concerns the possibility of investigating how GNSS data streams can contribute to real-time geodetic monitoring of earthquakes and other geohazards where deformation is less well known, such as crustal outgassing, changes in groundwater levels in aquifers, subsidence phenomena, Deep Seated Gravitational Slope Deformations (DSGSD) and landslides. Achieving these general objectives requires not only a GNSS infrastructure with advanced technological features, but also the development of new methods and algorithms for data analysis, capable to fully exploit the technological features of the new receivers. To date, in fact, most centres that deal with the analysis of GNSS data use models that are, in fact, mostly calibrated for single-cell receivers. The development of better-performing algorithms, calibrated to the different geohazards, will allow an improvement in terms of real-time positioning with an increase in accuracy.

Proposal for a PhD position

The research project aims to investigate data mining processes to characterise, model and verify the spatio-temporal occurrence of possible geohazard types that interact with the geological context of selected urban and suburban areas. To this end, we will initially make use of the large amount of data provided by the RING infrastructure, and then continue with the acquisition and interpretation of specific data according to the needs of the research project; previous knowledge and data acquired during the

PhD student's training period will allow us to progress in knowledge, adopting state-of-the-art methodologies. The final objective of the research project will concern the development of decision support platforms (DSS - Decision Support Systems) for forecasting and quantitatively assessing geohazards, starting from the analysis of multi-source geological and geophysical datasets, suitably processed with appropriately modelled big data analysis algorithms. Potential study areas will fall in settings affected by different geohazards already known in the literature, where the availability of monitoring data is known as well.

The research will be structured over the three years of the doctoral programme as follows:

- first year: training, institutionally foreseen for all the doctoral students in the college and specific for the doctoral student, to tackle the research topic; collection and reasoned analysis of the specific bibliography; acquisition of skills relating to methods of analysis and data mining; choice of study areas; collection of data for the construction of a database;
- second year: integration of the available knowledge with the acquisition of ad hoc data in the study areas; development of a multi-hazard analysis procedure inherent to the project objectives and the identified study areas;
- third year: verification and validation of the multi-hazard analysis procedure; drafting of the thesis paper.

Costs for field surveys and other project-related activities will be covered by funds available to both institutions.

The candidate should have a solid background in natural hazard analysis, mathematics, physics, geo-statistics, computer science and GIS. Knowledge of programming languages represents an appreciated skill (Matlab, R, etc.).