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A strategy of territorial control: from the standard comparison techniques to the Advanced Unsupervised Deep Learning Change Detection in high resolution SAR images

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The need to monitor and evaluate the impact of natural phenomena on structures, infrastructures, as well as on the natural environment, in recent years, plays a role of considerable importance for society also due to the continuous occurrence of "catastrophic events" which recently faster change our Planet.

Innovation and research have allowed a profound change in the data acquisition and acquisitions methodology coming to develop increasingly complex and innovative technologies. From an application point of view, remote sensing gives the possibility to easily manage the layer information which is indispensable for the best characterization of the environment from a numerical and a chemical-physical point of view.

NeMeA Sistemi srl, observant to the environment and its protection for years, began to study it using RADAR / SAR (Synthetic Aperture RADAR) data thanks to the opportunity to use in the best way the COSMO-SkyMed data through the tender Open Call for SMEs (Small and Medium Enterprises) of the Italian Space Agency in 2015.

Since then, NeMeA Sistemi srl has started a highly focused and innovative training that led us to observe the Earth in a new way. The path undertaken in NeMeA Sistemi srl is constantly growing and allowed us to know the RADAR / SAR data and the enormous potential.

The COSMO-SkyMed data provided is treated, processed and transformed by providing various information, allows you to identify changes, classify objects and artifacts measuring them.

In this context, NeMeA Sistemi srl in 2016 proposed a first project for the monitoring of illegal buildings in the Municipality of Ventimiglia (Liguria), with positive results. In this context, the final product was obtained with classic standard classification techniques of the SAR data.

Following this positive experience, NeMeA Sistemi srl applied also to the regional call issued by Sardegna Ricerche for the Sardinia Region where the source of funding is the European Regional Development Fund (ERDF) 2014-2020.

The SardOS project (Sardinia Observed from Space), proposed by NeMeA Sistemi srl, aims to monitor and safeguard environmental and anthropogenic health in the territory of 4 Sardinian

municipalities (Alghero, Capoterra, Quartu and Arzachena), also identifying the coast profiles, the evolutionary trend of sediments in the riverbed and buildings not present in the land registry. For environmental monitoring purposes, COSMO-SkyMed data are exploited and combined with bathymetric measurements acquired using the Hydra aquatic drone owned by NeMeA Sistemi srl. SAR data were processed using innovative specific territorial analysis algorithms in urban environment.

After these successful cases studies, which allowed the development of new services for the territorial monitoring and control, NeMeA Sistemi srl is working on a new project, 3xA (Creation of Machine Learning and Deep Learning algorithms dedicated to pattern recognition in SAR data). By exploiting Artificial Intelligence, the implemented algorithms use innovative unsupervised techniques to identify any changes.

The objective of this document is to provide an overview of the experience gained in NeMeA Sistemi srl, the value-added products and innovative services developed in the company aimed at environmental monitoring, the prevention of dangers and natural risks.