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# A large scale exploitation of high resolution satellite SAR data to analyze surface deformation in urban areas through the parallel full resolution SBAS-DInSAR approach

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The Earth Observation (EO) scenario is experiencing a real revolution, thanks to the huge volume of radar remote sensing data nowadays available, and is moving fast towards a Big Data context, opening promising investigation opportunities.
Among several EO applications, the advanced Differential Synthetic Aperture Radar Interferometry (DInSAR) technique referred to as Small BAseline Subset (SBAS) algorithm has already largely demonstrated its effectiveness to generate displacement maps and long-term deformation time series at both regional (low resolution analysis) and local (full resolution analysis) spatial scales. Moreover, it covers a wide range of applicability fields, from the natural hazard risk mitigation and prevention, to the management of many anthropogenic actions, such as ground-water exploitation, oil and gas extraction, mining activities, tunnelling, buildings, dams construction, transportation.
In this scenario characterized by large collections of satellite SAR data, the aspects related to their management and storage, efficient processing and deep exploitation are becoming high priorities, requiring the use of High Performance Computing (HPC) from distributed infrastructures (such as Clusters, Grid and Cloud Computing) to handle and process these large SAR data flows, guaranteeing high efficiency in terms of portability, scalability and velocity. On the other hand, the development of hardware and software tools (Graphical Processing Units (GPU) acceleration, Machine and Deep Learning (ML, DL) approaches) can have a great impact in extracting and creating value added information from the generated DInSAR products, thus maximizing and optimizing their exploitation.
This work is aimed at developing innovative Differential SAR Interferometry (DInSAR) solutions exploiting parallel programming techniques (multi-node, multi-core, GPU) and Machine/Deep Learning algorithms, based on the exploitation of distributed HPC environments, to be implemented within an automatic full resolution SBAS-DInSAR processing pipeline to massively analyze surface deformation phenomena in extended urban areas at the scale of single buildings, starting from large EO SAR datasets acquired by the COSMO-SkyMed constellation. Such a processing chain exploits several parallel programming strategies in order to take full advantage of distributing computing infrastructures and, in particular, of Cloud Computing platforms. Specifically, we consider a coarse/medium-grained parallelization strategy, based on multi-node and multi-core programming techniques, addressed to parallel distribute the computational load among different computing nodes and/or CPUs. Moreover, a fine-grained parallelization approach, focused on the use of Graphical Processing Unit (GPU), is also exploited.
A relevant impact of this work is the creation of a bridge between the EO community and the HPC infrastructures and tools, which are particularly suitable for Big Data processing and analysis. The possibility to massively perform high-resolution DInSAR analyses in automatic way, at wide spatial scale and in short time frames, will pave the way to new resilience scenarios for the territory monitoring.