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The Parallel SBAS-DInSAR algorithm: an effective and scalable tool for Earth's surface displacement retrieval

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Differential Synthetic Aperture Radar Interferometry (DInSAR) is an effective technique to estimate and monitor ground displacements with centimetre accuracy [1]. In the last decade, advanced DInSAR algorithms, such as the Small Baseline Subset (SBAS) [2] one that is aimed at following the temporal evolution of the ground deformation, showed to be significantly useful remote sensing tools for the geoscience communities as well as for those related to hazard monitoring and risk mitigation. DInSAR scenario is currently characterized by the large and steady increasing availability of huge SAR data archives that have a broad range of diversified features according to the characteristics of the employed sensor. Indeed, besides the old generation sensors, that include ERS, ENVISAT and RADARSAT systems, the new X-band generation constellations, such as COSMO-SkyMed and TerraSAR-X, have permitted an overall study of ground deformations with an unprecedented detail thanks to their improved spatial resolution and reduced revisit time. Furthermore, the incoming ESA Sentinel-1 SAR satellite is characterized by a global coverage acquisition strategy and 12-day revisit time and, therefore, will further contribute to improve deformation analyses and monitoring capabilities. However, in this context, the capability to process such huge SAR data archives is strongly limited by the existing DInSAR algorithms, which are not specifically designed to exploit modern high performance computational infrastructures (e.g. cluster, grid and cloud computing platforms).
The goal of this paper is to present a Parallel version of the SBAS algorithm (P-SBAS) which is based on a dual-level parallelization approach and embraces combined parallel strategies [3], [4]. A detailed description of the P-SBAS algorithm will be provided together with a scalability analysis focused on studying its performances. In particular, a P-SBAS scalability analysis with respect to the number of exploited CPUs has been carried out on real data acquired by ENVISAT and COSMO-SkyMed sensors. Moreover, the P-SBAS performances with respect to the size of the input dataset will also be investigated.
This kind of analysis is essential for assessing the goodness of the P-SBAS algorithm and gaining insight into its applicability to different scenarios. Besides, such results will also become crucial to identify and evaluate how to appropriately exploit P-SBAS to process the forthcoming large Sentinel-1 data stream.

References

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