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3D Mapping of Active Underground Faults Enabled by Heterogeneous Parallel Processing Spatio-Temporal Proximity and Clustering Algorithms

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Underground faults cast energy storage elements of the accumulated strain energy in border areas of active tectonic plates. Particularly in the southern front of the Hellenic seismic arc, a steady yearly flow in the accumulation of strain energy is being due to the constant rate of motion at which the African plate sub-sinks beneath the Eurasian plate. Partial release of the stored energy from a particular underground fold manifests in the form of an earthquake once reaching the surface of the Earth's crust. The information obtained for each recorded earthquake includes among others the surface location and the estimated hypocentre depth. Considering that hundreds of thousands earthquakes have been recorded in that particular area, the accumulated hypocentre depths provide a most valuable source of information regarding the in-depth extent of the seismically active parts of the underground faults. This research work applies expert knowledge spatio-temporal clustering in previously reported distinct seismic cluster zones, aiming to associate each individual main earthquake along with its recoded foreshocks and aftershocks to a single underground fault in existing two-dimensional mappings. This process is being enabled by heterogeneous parallel processing algorithms encompassing both proximity and agglomerative density-based clustering algorithms upon main seismic events only to mapped. Once a main earthquake is being associated to a particular known underground fault, then the underground fault's point with maximum proximity to the earthquake's hypocentre appends its location parameters, additionally incorporating the dimension of depth to the initial planar dimensions of latitude and longitude. The ranges of depth variations provide a notable indication of the in-depth extent of the seismically active part(s) of underground faults enabling their 3D model mapping.

Indexing terms: spatio-temporal proximity and clustering algorithms, heterogeneous parallel processing, Cuda, 3D underground faults' mapping

References

Axaridou A., I. Chrysakis, C. Georgis, M. Theodoridou, M. Doerr, A. Konstantaras, and E. Maravelakis. 3D-SYSTEK: Recording and exploiting the production workflow of 3D-models in

cultural heritage. IISA 2014 - 5th International Conference on Information, Intelligence, Systems and Applications, 51-56, 2014.

Konstantaras A. Deep learning and parallel processing spatio-temporal clustering unveil new Ionian distinct seismic zone. Informatics. 7 (4), 39, 2020.

Konstantaras A.J. Expert knowledge-based algorithm for the dynamic discrimination of interactive natural clusters. Earth Science Informatics. 9 (1), 95-100, 2016.

Konstantaras A.J., E. Katsifarakis, E. Maravelakis, E. Skounakis, E. Kokkinos and E. Karapidakis. Intelligent spatial-clustering of seismicity in the vicinity of the Hellenic Seismic Arc. Earth Science Research 1 (2), 1-10, 2012.

Konstantaras A., F. Valianatos, M.R. Varley, J.P. Makris. Soft-Computing modelling of seismicity in the southern Hellenic Arc. IEEE Geoscience and Remote Sensing Letters, 5 (3), 323-327, 2008.

Konstantaras A., M.R. Varley, F. Valianatos, G. Collins and P. Holifield. Recognition of electric earthquake precursors using neuro-fuzzy methods: methodology and simulation results. Proc. IASTED Int. Conf. Signal Processing, Pattern Recognition and Applications (SPPRA 2002), Crete, Greece, 303-308, 2002.

Maravelakis E., A. Konstantaras, K. Kabassi, I. Chrysakis, C. Georgis and A. Axaridou. 3DSYSTEK web-based point cloud viewer. IISA 2014 - 5th International Conference on Information, Intelligence, Systems and Applications, 262-266, 2014.