Use of GPU for time series analysis

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Summary

In the last decade the number of continuous operating Global Navigation Satellite System (GNSS) stations within Europe has increased to several thousands. The position of these stations changes over time due to tectonic plate motion and other geophysical signals. This tectonic motion can be estimated using the Hector software, developed at UBI. However, this motion is not equal over Europe which produces areas where the stress in the Earth's crust is increasing. The build-up of stress increases the likelihood of the occurrence of earthquakes along fault lines. For that reason, recent years have seen much development of using GNSS to create strain rate maps to gain insight into the stress accumulation in the Earth's crust. However, it is equally important to know the accuracy of the estimated tectonic motions from GNSS and the derived strain rate map. To do so, one must take correct for the fact that the GNSS observations are correlated in time and space.
Some GNSS time series analysis method, such as Hector, only consider the temporal correlation that exists within the time series, while others only consider the spatial correlation that exist between time series of different GNSS stations or components. There is an urgent need to combine the two in order to get the most realistic uncertainties. To include also the spatial correlations into the Hector software package, more computing power is needed. For that reason, we propose to modify the Hector software to make use of powerful graphical processing units (GPU) on modern graphical cards. At UBI we have recently received a powerful NVIDIA card which can be used for dedicated tests. The objective of this study is to adapt the source C++ code of Hector to make use of GPU parallelization capabilities in order to allow full spatio-temporal analysis of the tectonic motion estimation. The fact that NVIDIA provides C++ libraries for matrix operations and fast Fourier transform will facilitate the work. Data used to test the new algorithm will be provided in the scope of the EPOS project (epos-ip.org), for which UBI is leading the Thematical Core Service on GNSS Data & Products.

Work Plan

1. Literature and State of the Art Review
2. Study of the characteristics, algorithms and architectures to be used.
3. Implementation, Testing and Evaluation of the proposed solution
4. Publication of the results
5. Writing of the Dissertation.

Expected Results

- 1 Working and fully implemented software solution
- 1 Paper in Congress
- 1 Final Report

Timeline

	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
T1	**X**	**X**						
T2		**X**	**X**	**X**				
T3			**X**	**X**	**X**	**X**		
T4						**X**	**X**	
T5							**X**	**X**

References

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