Mobile Devices and GPU Parallelism in Ionospheric Data Processing

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Scientific data acquisition in the field is often constrained by data transfer backchannels to analysis environments. Geoscientists are therefore facing practical bottlenecks with increasing sensor density and variety. Mobile devices, such as smartphones and tablets, offer promising solutions to key problems in scientific data acquisition, pre-processing, and validation by providing advanced capabilities in the field. This is due to affordable network connectivity options and the increasing mobile computational power.

This contribution exemplifies a scenario faced by scientists in the field and presents the "Mahali TEC Processing App" developed in the context of the NSF-funded Mahali project. Aimed at atmospheric science and the study of ionospheric Total Electron Content (TEC), this app is able to gather data from various dual-frequency GPS receivers. It demonstrates parsing of full-day RINEX files on mobile devices and on-the-fly computation of vertical TEC values based on satellite ephemeris models that are obtained from NASA. Our experiments show how parallel computing on the mobile device GPU enables fast processing and visualization of up to 2 million datapoints in real-time using OpenGL. GPS receiver bias is estimated through minimum TEC approximations that can be interactively adjusted by scientists in the graphical user interface. Scientists can also perform approximate computations for "quickviews" to reduce CPU processing time and memory consumption. In the final stage of our mobile processing pipeline, scientists can upload data to the cloud for further processing.

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The Mahali Project http://mahali.mit.edu