



Ray-Tracing of GNSS signals through the Atmosphere powered by GPUs

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Ray-Tracing of Global Navigation Satellite Systems (GNSS) signals on Graphics Processing Units (GPUs) is realized by two different GPU coding techniques: the C extended Compute Unified Device Architecture (NVIDIA CUDA), the C/C++/Fortran directive-based Hybrid Multicore Parallel Programming (HMPP) developed by the CAPS Entreprise. The propagation of one ray is performed by the integration with the Runge–Kutta method of the differential system deriving from the eikonal equation. The computation of atmospheric delays on GPUs preserves the millimeter accuracy using double precision arithmetic. The methodology describes how to optimize the ray-tracing of 8,100 rays on a Fermi GPU. In comparison to a basic CPU version, GPU speed-up by 20 to 50 are obtained when software improvements gradually harnesses hardware capabilities. HMPP and CUDA versions provide the same speed-up. HMPP provides moreover an easy implementation in Fortran for multiple targets. A speed-up by 75 is finally obtained when the ray-tracing algorithm is applied with 130,000 rays.