Small-Scale Raster Map Projection using the Compute Unified Device Architecture (CUDA)

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ABSTRACT
Geographic Information Science has emerged as a growing area of research driven by geospatial problems in several topics that are increasingly computationally intensive. Exploration in the use of computing in various scientific communities, termed cyberinfrastructure (CI) research is substantially relevant to data infrastructure research for Web- and cloud-based geospatial services and applications. Map projections are commonly used in geospatial research and can be computationally intense. pRasterBlaster is a small-scale map projection software package that implements a suite of map projection techniques in a high-performance computing (HPC) environment. A variation of pRasterBlaster was tested with the possible use of massive computing resources in a Compute Unified Device Architecture (CUDA) environment.

The CUDA environment is a parallel computing programming model utilizing Graphics Processing Units (GPUs) for general purpose processing implemented on Nvidia Corporation's GPUs. This preliminary test is an antecedent to a larger project that will compare the CUDA model to the existing HPC Central Processing Unit (CPU)-dominant environment, implementation of pRasterBlaser. The intent is to discern potential efficiency gains in computing large geospatial datasets, up to 100s of megabytes. This paper reports initial results of CUDA testing of rigorous map projection that is using exact projection formulas rather than approximation, of raster datasets that show greater than an order of magnitude reduction in run time of the model compared to run time on a desktop personal computer with a quad-core CPU and 1 GPU. The testing involved implementing an input Geospatially referenced Tagged Interchange File Format (GeoTIFF) dataset using C++/ CUDA, on datasets of various sizes and different map projections. Near term improvement before the comparison tests include expanded input/ output handling of GeoTIFF and a capability to handle Network Common Data Form (NetCDF) formatted datasets.

KEYWORDS: raster datasets, parallel throughput architecture, geospatial data, map projection, CUDA, multi-threading

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