CIS 565, GPU Programming, Spring 2012: Final Project Proposal GPU Accelerated Simplified General Perturbation No. 4 (SGP4) Model

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Description

There is a need to track every orbiting object in space. However, it is infeasible to actively track all artificial satellite continuously which motivated the effort to create orbit propagation models. In theory, given an observation and measurement of an ephemeris of a single orbiting object, the orbit propagation models should extrapolate ephemeris vectors accurately to any given point in time. In 1969, the Simplified General Perturbations No. 4 model (SGP4) was developed to calculate the ephemeris vectors of orbiting satellites. The models were able to predict the degree of perturbation on the orbiting due to gravitational effects of large orbiting bodies (Sun and Moon), Earth's oblong body, atmospheric drag, and radiation. [1]

Proposal

The orbit propagation of an orbiting body is massively parallel. I propose GPU accelerating the propagation of orbits to leverage the parallelism of orbit propagation. Satellites will be propagated from Two Line Elements with CUDA and their respective trajectories will be animated and rendered using OpenGL.

Goals

1. Understand the SGP4 algorithm and parallelize SPG4 to the GPU Architecture.
2. Develop code for CPU Architecture.
   (a) Test software with Two Line Elements from www.space-track.org TLE database.
3. Develop code for CUDA.
   (a) Test software with Two Line Elements from www.space-track.org TLE database.
4. Develop code to render orbits.

References

[1] Wikipedia. Simplified perturbations models — Wikipedia, the free encyclopedia, 2012. URL `http://en.wikipedia.org/wiki/SGP4`. [Online; accessed 11-March-2012].