CIS 565, GPU Programming, Spring 2012: Final Project Proposal
GPU Accelerated Satellite Orbits and Closest Approach

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Description

There is a need to GPU accelerate the propagation of orbits of a multitude of satellites and predict closest approach between two satellites. On February 10, 2009, two satellites collided in outer space 490 miles above the Taymyr Peninsula in Siberia. This marked the first accidental collision between two artificial satellites in space[1]. It has been estimated that the collision created over 1,000 pieces of debris larger than 4 inches[1]. This creates a monolithic computational task to propagate orbits of each satellite and to calculate the distances between two satellites at every time step.

Proposal

Orbit propagation of satellites and closest approach between two satellites is massively parallel. I propose GPU accelerating the propagation of orbits and calculation of closest approach 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 WebGL.

Goals

1. Develop algorithm to propagate satellite in orbit and calculate closest approach.
   (a) Add J2 term to include perturbations of accelerations due to equatorial bulge.
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. 2009 satellite collision — Wikipedia, the free encyclopedia, 2004. URL `http://en.wikipedia.org/wiki/2009_satellite_collision`. [Online; accessed 11-March-2012].