

Flux-Based Satellite Conjunction Detection on the GPU using Julia



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Applicable for students as M.Sc. Thesis

Keywords: GPU, Hybrid Computing, Space Safety, Space Debris

Background

As part of the ongoing research in the Space Safety domain of FSR, a simulation environment for Space Traffic Management has been developed in Python. This simulation will be further enhanced in the context of the CASCADE project to provide actors in the space domain the means for pre-mission analyses of collision risks and the elaboration of appropriate rules for collision avoidance. In order to assess the collision risks, the conjunctions of satellites in orbit around Earth shall be determined with a flux-based approach based on methods from kinetic gas theory.



Task

The objective of this thesis is to accelerate an existing simulation of the satellite population in Earth orbit. For this end, your task is to implement the conjunction detection module as a GPU-parallel application using the Julia language.

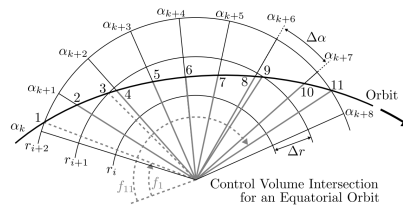
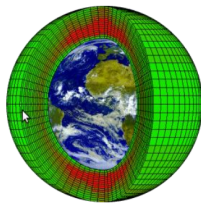


Figure 1: Left: 3-dimensional distribution of spatial density (range, right ascension, declination) Right: Sequence of Cell Passage Events for a Satellite Orbit.
Source: Space Debris Script

Tasks

- Familiarization with stochastic conjunction detection methods and with the CASCADE project
- Development of an approach and suitable data structures to parallelize the conjunction detection module
- Implementation of the conjunction detection for the GPU in Julia
- Testing, validation and performance evaluation of the developed software

Qualifications

- Currently enrolled in Master's degree program in Computer Science, Computational Engineering, Mechanical Engineering, Aerospace, or similar.
- Knowledge in parallel computing and data structures.
- Experience in GPU programming
- Optional: Experience in Julia (also: CUDA.jl, KernelAbstractions.jl, etc.)
- Strong interest and enthusiasm for space topics

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