COLATUS - GPU Simulation of Cosmological Particles for Galaxies formation (with the NAtional Space Agency)

Recently alternative approaches in cosmology seek to explain the nature of dark matter as a direct result of the non-linear space-time curvature due to different types of deformation potentials. In this context, a key test for this hypothesis is to examine the effects of deformation on the evolution of large scales structures. An important requirement for the fine analysis of this pure gravitational signature (without dark matter elements) is to characterize the position of a galaxy during its trajectory to the gravitational collapse of super clusters at low redshifts. In this context, each element in an gravitational N-body simulation behaves as a tracer of collapse governed by the process known as chaotic advection (or lagrangian turbulence). In order to develop a detailed study of this new approach we develop the COsmic LAgrangian TUrbulence Simulator (COLATUS) to perform gravitational N-body simulations based on Compute Unified Device Architecture (CUDA) for graphics processing units (GPUs). In this paper we report the first robust results obtained from COLATUS.

GPUGRID - Middleware for intelligent tasks distribution for the National GPU GRID (with NVIDIA)

GPU based Grids are becoming common, due its powerful and cheap parallization. GPUGRID is a middleware that helps the distribution of large scale amount of tasks between different GPU clusters, taking into consideration each node configuration, each client specification, problems details. Many heuristics are being used for an intelligent and efficient job distribution.

Simulation of Traffic for Rio de Janeiro roads (Smartcities, with Rio de Janeiro State Government)

This work introduces an innovation Cellular Automaton (CA) model applied for freeway traffic. In addition to its capacity for reproducing basic traffic proprieties our system is also capable of mimicking different behavioral variation. The model herein considers different concepts of acceleration rate to describe the drivers' nature. Furthermore, the proposed model includes randomness in the anticipation policy. The project is being built upon cluster based architecture, making real time predictions and visualization possible.

Wave propagation with GPUs for Oil and Gas Boreholes estimation (with Petrobras)

The scattering of acoustic waves in non-homogeneous medium has been considered of practical interest for petroleum industry, mainly in the determination of new oil deposits. One computational modeling to represent this phenomenon employs an approach that uses finite difference methods, which is a process that demands a high computational effort. In this project we implement in GPU different solutions of typical finite difference methods for solving a 2D wave propagation problem. This system is already being used at Petrobras Oil and Gas production.

DOMINOES - GPU tools for software evolution estimation

Analyzing software repositories with thousands of artifacts is data intensive and is currently only possible as a post-hoc analysis. We introduce a novel approach, Dominoes, that supports exploration of relationships among project elements, where users have the flexibility to explore on the fly the numerous types of relationships that can exist. Dominoes organize data extracted from software repositories into multiple dimensional matrices that can be treated as domino pieces (e.g., [commit|method]). It allows connecting such pieces based on a set of matrix operations to derive additional domino pieces. These derived domino pieces represent semantics on project entity relationships (e.g., number of commits in which two methods co-occurred) and can be used for further explorations. This opens a vast possibility of data analysis, since these domino pieces can be iteratively combined. Furthermore, our proposed matrix representation and operation definitions allow for fast and efficient processing of a large volume of data using a highly parallel architecture, such as GPUs.