**Application of data grid and graphics processing units for distributed cloud-based high-performance computing**

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Simulation of biological and physical systems, namely large systems of coupled non-linear oscillators, are computationally demanding due to the large scale networks of units, variativity of system parameters state space and sophisticated inter-element coupling. In our study, software for simulation of biological model given by system of differential equations in clusters, data grids and clouds using graphical processing units (GPU) was designed, developed, tested and applied for scientific simulations.

The software provides easy integration of new oscillators' models support, dynamic load distribution between hosts' central processing units (CPU) and several GPU devices. Different GPU devices provide speed-up of $12 - 50$ compared to single core Intel Xeon, 2.4 GHz depending on GPU and job types. The software was efficiently applied for modelling of 3D networks with $10^7 - 10^8$ oscillators described by Kuramoto-Sakaguchi model and new phenomena related to phase transitions, synchronization, and network effects were observed in such simulations.

In the talk, we mostly focus on computing system architecture design and setup, and discuss optimizations made to achieve scalable parallel performance.