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DYNAMIC PROPERTIES OF COMPLEX SYSTEMS USING GRID COMPUTING

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Overview

The Complexity Science research group at the Aristotle University of Thessaloniki specializes in the field of complex systems. One of the active research projects focuses on site percolation based on what is known as Achlioptas processes, a new technique for generating discontinuous transitions. Research in this field is both time and computational power consuming. Thus, we have chosen to perform the bulk of the computational work on the European Grid infrastructure via the vo.complex-systems.eu Virtual Organization, in order to achieve fast and reliable results.

Impact

Explosive percolation is a relatively new topic, with only two years of life and already has opened up many questions about the actual nature of this phenomenon and the investigation of other possible techniques to generate such a behavior. Up to date, numerous publications on "explosive"percolation have been presented, for various systems (scale-free and random networks, lattices), focusing only for bond percolation. We intent to shed light on the evolution of a system under the site percolation procedure. However, because of the computational sizes involved, the increase of computational resources with respect to CPU speed and memory availability is of great importance.

Description of the work

One of our typical case studies involves the study of the percolation transition on a square lattice of the order of 10^6 sites. In order to narrow down statistical variations within each case study, we have to perform multiple simulations, of the order of 10^3, with a similar dataset of initial conditions and extract an average result at the end. This typical case study takes approximately one day to complete on a single CPU core. Thus, to complete our total set of one thousand simulations we would need a little less than 3 years on a single CPU. Using the parametric job framework, provided by the gLite Workload Management System, we have been able to break down our simulations into several "nodejobs"and compute them individually on Grid Worker Nodes. Since the beginning, one of our main considerations has been to avoid all kinds of failures due to infrastructure malfunctions or limitations. To this end we have used several submission filters to exclude either Grid resources that occasionally did not operate as expected or had a short wall clock limitation, therefore prohibiting our case studies. Using these we have been able to efficiently make use of the Grid infrastructure and produce reliable results.

Conclusions

The European Grid infrastructure is an essential part of our every day work on complex systems. There is a lot to be improved from both sides (user side and operation/maintenance). To improve the systems usability, we would like to increase the upper wall clock time limit per job, as well as exploiting the full capacity of GPGPU cards for speeding up computation times. Even so, the Grid infrastructure has been an invaluable resource in our study of stability of the Achlioptas processes under various circumstances

Primary author: MPASTAS, Nikos (AUTH)

Co-authors: KOSMIDIS, Kosmas (AUTH); Prof. ARGYRAKIS, Panos (AUTH); KOROSOGLOU, Paschalis (AUTH)

Presenters: MPASTAS, Nikos (AUTH); KOROSOGLOU, Paschalis (AUTH)

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