

ESF – Exchange Grants – Scientific Report

Exchange grant:

Reference number: 4431

Activity Title:

Applied and Computational Algebraic Topology

Project:

Computational Algebraic Topology in Concurrency Theory

Date of visit: 25/09/2011 – 08/10/2011

Applicants Name: Mateusz Juda, Jagiellonian University, Krakow, Poland

Host Institute:

Prof. Martin Raussen, Aalborg University, Denmark

Purpose of the visit.

The purpose of the visit was to participate in a workshop on Computational Algebraic Topology in Concurrency Theory at the Department of Mathematical Sciences at Aalborg University organized by Lisbeth Fajstrup and Martin Raussen. In the workshop participated researchers from following organizations:

- Aalborg University, Denmark: Lisbeth Fajstrup and Martin Raussen.
- CEA, Saclay, France: Eric Goubault, Emmanuel Haucourt and Samuel Mimram.
- Jagiellonian University, Krakow, Poland: Marian Mrozek, Mateusz Juda.

Description of the work carried out during the visit.

During the visit we discussed possible application of homology calculations in analysis of execution spaces [4] in a concurrent environment. We were able to compute homology groups of prodsimplicial complexes of trace spaces for concurrent programs. Using Alcool software [1] we generated data for Capd::RedHom [2] software and we got homology groups which describes an execution space of a concurrent process.

Description of the main results obtained.

The main result obtained during the visit was an analysis of thousands of concurrent programs described in PV model. We see that homology groups give us useful information about execution space. Statistics collected during experiments [3] shows that homology groups may be an important tool in concurrency analysis.

During the second week of the visit we discussed possible approaches to concurrency analysis using other topological criterion: persistence homology, sheaf theory. We were also talking about possible application of methods well known in concurrency theory to analysis of distributed algorithms in sensor networks [5].

Future collaboration with host institution.

We are going to continue the collaboration with Aalborg University and CEA group. In the future we would like to understand better topological information hidden in homology groups of trace spaces.

References

[1] Alcool software, <http://www-list.cea.fr/labos/gb/LSL/alcool/index.html>

[2] Capd::RedHom software, <http://redhom.ii.uj.edu.pl/>

[3] Statistics collected during experiments, <http://redhom.ii.uj.edu.pl/pv/>

[4] Martin Raussen, Simplicial models of trace spaces, Algebraic & Geometric Topology 10 (2010)