

Report on Paul Feautrier's Visit to the University of Passau in June 2010

June 17, 2010

In November 2009, Prof. Lengauer and I submitted to the BFHZ a request for support for a four-week visit of mine to Passau. The request was granted in a letter dated March 22, 2010. Due to circumstances beyond my control, I was able to be in Passau only for three weeks, from April 5 to April 23. This is a report of my activities during these three weeks.

1 The Polyhedron Model

Prof. David Padua from the University of Illinois at Urbana Champaign is editing an Encyclopedia of Parallel Programming, to be published soon by Springer-Verlag. Prof. Lengauer and myself are members of the scientific committee for this work, and we have been requested to write an entry, among others, on the polyhedron model for the automatic parallelization of loop programs, which we have been promoting since the 1980s. This task was undertaken and completed in the first week of my stay in Passau; the version that has been submitted and is currently under review is attached. In this effort, we obtained advice from Prof. Dr. Peter Faber (FH Deggendorf, former Ph.D. student at the Lehrstuhl für Programmierung), Dr. Armin Größlinger (recent doctorate and currently habilitation post-doc at the Lehrstuhl für Programmierung), and Tobias Grosser (diploma student at the Lehrstuhl für Programmierung).

2 A Perspective on New Compilation Problems

I have been asked by Dr. Martin Griebel (head of the EDV-Schulen Plattling/Deggendorf with a doctoral and habilitation degree from the Lehrstuhl für Programmierung) who is an adjunct lecturer at the department to give the introductory lecture in his master course on loop parallelization. I took this opportunity to gather and organize my thoughts on the impact of the

technology changes on computer architecture, which will in turn pose new problems to the compiler community. I centered my exposition on three points: power management, reconfigurable architectures (FPGA) and memory management in multicores. The lecture was delivered on April 20, 2010.

3 DFG Priority Programme Proposal Manycore

In February, the DFG announced to the Lehrstuhl für Programmierung, that a proposal for a priority programme (Schwerpunktprogramm) on manycore programming had a 95% chance of success in the senate meeting at the end of April. This would have meant a six-year, national research activity of upto 25 German research groups under the leadership of the Lehrstuhl für Programmierung. In many discussions, I advised Prof. Lengauer on matters of planning and content of this programme and we made plans for a research proposal in the programme to be submitted by the Lehrstuhl itself. This proposal is on dynamic methods of loop parallelization for use on manycore processors; the project has the name PolyJIT (polyhedral loop parallelization just-in-time).

Against all expectations, and to the great shock of the Lehrstuhl, the final decision was negative. What remains is plans for the PolyJIT proposal, whose progress I will follow, as an isolated project under the direction of Dr. Armin Größlinger.

4 Interaction with Young Scientists

One purpose of my trip was to advise young scientists. I talked to and worked with Dr. Armin Größlinger, Michael Claßen and Jens Dörre (doctoral students at the Lehrstuhl für Programmierung), Tobias Grosser and Ramakrishna Upadrasta (doctoral student at INRIA-Rocquencourt and visiting Passau during my stay).

4.1 Armin Größlinger and Ramakrishna Upadrasta

Items of discussion were:

- Memory management in parallel programs.
- Scalability problems in the polyhedron model. In this context, we discussed dependence abstraction, and the shape of the schedule constraints with a view of finding totally unimodular submatrices, which can be solved more efficiently than general matrices. I also gave a demonstration of my tool Syntol, which implements another solution to the scalability problem.

- The use of alias information in the polyhedron model, with possible applications to the GRAPHITE extension of the gcc compiler. (GRAPHITE is a gcc tool for polyhedral loop parallelization currently under development in Paris.)
- Just-in-time application of the polyhedron model. I suggested that a just-in-time version of Louis-Noel Pouchet dynamic optimization method may be a good starting point for this study.

4.2 Michael Classen

He presented his work on the use of Passau's loop parallelizer LooPo for the construction of Grid programs. We discussed mainly tiling problems. (Tiling is a technique for adjusting the grain of parallelism.)

4.3 Jens Dörre

We discussed the MapReduce paradigm, which has been introduced by several companies that offer Cloud computing, its eventual use for multicore programming, and its relation to the polyhedron model. MapReduce is the research subject of Jens Dörre's dissertation.

4.4 Tobias Grosser

He is involved in the design and implementation of GRAPHITE. This interested me very much, since I have plans to use gcc as a front end for some of my work. We had an interesting discussion on the constraints that the design of gcc imposes on such uses.

4.5 Future Plans

The close contacts between the Lehrstuhl für Programmierung and myself will be maintained. In particular, I will follow the development of project PolyJIT, Michael Claßen's work on loop parallelization for the Grid, and Jens Dörre's work on MapReduce.

5 Conclusion

I am grateful to the BFHZ for having given me the opportunity to refresh my contacts with the Lehrstuhl für Programmierung. We will maintain this closer level of contact in the future.