

Chair of Computer Science 2 (Programming Systems)

Address: Martensstr. 3, 91058 Erlangen

Phone: +49 9131 85-27621

Fax: +49 9131 85-28809

E-Mail: info@i2.informatik.uni-erlangen.de

Ordinarius:

Prof. Dr. Michael Philippsen

Honorary Professors:

Hon.-Prof. Dr.-Ing. Bernd Hindel

Hon.-Prof. Dr.-Ing. Detlef Kips

Professor Emeritus:

Prof. em. Dr. Hans Jürgen Schneider

Secretary:

Agnes Brütting

Margit Zenk

Technicians/Administrators:

Dipl.-Inf. (FH) Helmut Allendorf

Manfred Uebler

Scientific Staff:

Dipl.-Inf. Thorsten Blaß

Dipl.-Inf. Daniel Brinkers (from January 10, 2011)

Dipl.-Inf. Georg Dotzler

Dr. Alexander Dreweke (until January 31, 2011)

Dr. Thorsten Edelhäußer (until September 30, 2011)

Dipl.-Inf. Ralf Ellner (until September 30, 2011)

Dipl.-Inf. Philipp Janda (until January 31, 2011)

Dipl.-Inf. Stefan Kempf

Dipl.-Math. Jakob Krainz (from July 1, 2011)

M. Sc. Andreas Kumlehn (since September 15, 2011)

Dipl.-Inf. Christopher Mutschler

Dr.-Ing. Norbert Oster

M. Eng. Norbert Tausch, Dipl.-Ing. (FH)

PD Ronald Veldema, Ph.D.

Dipl.-Inf. Tobias Werth

Dipl.-Inf. Marc Wörlein (until January 31, 2011)

Guests:

Dipl.-Inf. (FH) Josef Adersberger

Sören Stange, M.Sc.

External Teaching Staff:

Dr.-Ing. Klaudia Dussa-Zieger

Dr.-Ing. Martin Jung

The Chair of Computer Science 2 (programming systems) was founded in 1972 and is headed by Prof. Michael Philippsen (as the successor of Prof. H.-J. Schneider) since April 2002. Closely associated with the programming systems group are the professorship for Didactics of Computer Science and the professorship for Open Source Software.

1. Focus of research

The main research topics in the programming systems group are programming of parallel or distributed systems and programming of embedded or mobile systems. Software (and its development) for such systems should ideally be as complex, portable, maintainable and robust as existing software for single core systems and workstations. It is our long-term goal to allow applications to take full advantage of the available computing and network power. A particular focus lies on programming systems for multi-cores because more and more cheap multi-core high-performance parallel hardware (for example graphics cards or FPA-Hardware) is available. This will have an unpredictable impact on the future of the software landscape. Research results of the group are always evaluated by means of prototypes and demonstrators.

Important Research Areas

- **Exploit the available parallelization potential.** In the future the clock rate of multi-core systems will grow only slowly whereas the number of cores will grow. This makes it necessary to exploit the parallelization potential of already older, existing software to allow it to benefit from the new hardware. As a consequence, in most application areas a change to parallel computing is unavoidable. Therefore, the programming systems group develops tools to support the programmer interactively in reengineering existing sequential applications. It also develops architectural patterns for new software projects that scale automatically to support a growing number of cores.
- **Achieve portability in high-performance applications.** Up to the present, application programmers achieve the best possible performance results only if they handle latency issues and communications between different components of the system manually, optimize their code with hardware specific "tricks" and split their application into multiple sections to outsource them to other hardware (for example graphics cards). To change this situation, the programming systems group researches the performance impact of higher programming abstraction layers that would improve programming productivity and software portability. The improvements are caused by generated code that allows the distribution

of the program onto multiple heterogeneous system components to permit parallel execution. The higher abstraction layer makes the communication between the components transparent for the developer. To increase the efficiency of this approach it is necessary to give the programmer the possibility to express available domain knowledge in the programming language. For the higher abstraction layer, the details of the hardware architecture are hidden from the developer (for example by library functions or programming language extensions).

- **Adapt the degree of parallelism dynamically.** High-performance applications are often developed for a fixed number of cores. As requested cluster nodes of a batch system are statically assigned for a fixed time period, inefficient reservation gaps are unavoidable. Similar problems appear in multi-threaded applications on multi-core systems. The programming systems group works on the dynamic adaptation of the extent of parallelism by the means of code transformations (under consideration of the resulting data redistribution) and operating system interactions. As control flow based synchronisation measures interfere with the necessary analyzes, the programming systems group researches new programming constructs that can replace the existing ones and allow to specify the synchronisation in a data-centric way.
- **Develop Testing for Parallelism.** In software engineering, testing has always assumed an important role. Code coverage, test data generation, reliability assessment etc. are tools of the trade. Unfortunately, current research insufficiently covers the indeterminism caused by concurrency. To deal with that issue, the programming systems group develops tools that consider (based on the coverage criteria) interleavings of parallel threads in their test data generation. This topic also includes research on operating systems and schedulers. As concurrency considerably increases the search space of the test generation it is necessary to develop infrastructures that allow the test generation and execution on a cluster.
- **Improve of Software Development Processes.** The current development practice of complex, business or security critical software in global distributed teams (commonly found in the software industry) demands compliance with well-defined software development processes. To support the enforcement of this requirement, appropriate development tools are used. The corresponding research area is covered by the Practical Software Engineering research group that is lead by the honorary professors Dr. Bernd Hindel and Dr. Detlef Kips. Both possess long term experience in industrial software projects as managers of medium sized software companies. The goal of the Practical Software Engineering group is the development of a machine executable notation for modelling of software development processes. For that purpose the research group examines the semi-automatic

retrieval of traceability information from the artefacts of different tools and notations as well as the model based development, integration and configurations of software components, used in the design of automotive embedded systems.

2. Research projects

In 2011 twice as many students have taken on their studies due to a change in the secondary education system in Bavaria. The resulting double burden in education kept us from presenting our research projects in detail here. For the latest news on our research projects please check <https://www2.informatik.uni-erlangen.de/research>

3. Publications

- Adersberger, Josef ; Philippsen, Michael: ReflexML: UML-based architecture-to-code traceability and consistency checking . In: Crnkovic, Ivica ; Gruhn, Volker ; Book, Matthias (Ed.) : Proceedings of the 5th European Conference on Software Architecture (ECSA 2011) (5th European Conference on Software Architecture (ECSA 2011) Essen 13.-16.09.2011). Berlin, Heidelberg : Springer-Verlag Berlin, Heidelberg, 2011, pp 344-359. - ISBN 978-3-642-23797-3
- Edelhäuser, Thorsten ; Philippsen, Michael ; Mutschler, Christopher: Trajectory Behavior Language . In: Artesis University College of Antwerp (Org.) : Proceedings of the 2nd International Conference on Positioning and Context-Awareness (PoCA 2011 Brussels 2011). 2011, pp 51-58. - ISBN 978-94-90705-04-6
- Ellner, Ralf ; Al-Hilank, Samir ; Drexler, Johannes ; Jung, Martin ; Kips, Detlef ; Philippsen, Michael: A FUMML-Based Distributed Execution Machine for Enacting Software Process Models . In: France, Robert ; Kuester, Jochen ; Bordbar, Behzad ; Paige, Richard (Ed.) : Proceedings 7th European Conference on Modeling Foundations and Applications (Modelling Foundations and Applications Birmingham 06.-09.06.2011). Berlin / Heidelberg : Springer, 2011, pp 19-34. (Lecture Notes in Computer Science Vol. 6698) - ISBN 978-3-642-21469-1
- Kempf, Stefan ; Veldema, Ronald ; Philippsen, Michael: Is There Hope for Automatic Parallelization of Legacy Industry Automation Applications? In: GI (Ed.) : In Proceedings of the 24th Workshop on Parallel Systems and Algorithms (PARS 2011) (24th Workshop on Parallel Systems and Algorithms (PARS 2011) Rüşchlikon, Switzerland 26.-27.05.2011). 2011, pp 80-89.
- Kempf, Stefan ; Veldema, Ronald ; Philippsen, Michael: Source Code Transformations to Increase the Performance of Software Transactional Memory (Poster

- Presentation) .Talk: 24th International Workshop on Languages and Compilers for Parallel Computing (LCPC 2011), Colorado, USA, 09.09.2011
- Mutschler, Christopher ; Franke, Norbert ; Wolf, Daniel ; Witt, Nicolas: Apparatus and Method for Analyzing Sensor Data . Schutzrecht PCT/EP2011/069166 patent application (31.10.2011)
 - Mutschler, Christopher ; Witt, Nicolas ; Philippsen, Michael ; Otto, Stephan: Apparatus and Method for Synchronizing Events . Schutzrecht PCT/EP2011/069160 patent application (31.10.2011)
 - Mutschler, Christopher: Apparatus and Method for Transferring Event Detector Processes . Schutzrecht PCT/EP2011/069159 patent application (31.10.2011)
 - Mutschler, Christopher: Apparatus and Method for Transmitting A Message to Multiple Receivers . Schutzrecht PCT/EP2011/069169 patent application (31.10.2011)
 - Mutschler, Christopher ; Kókai, Gabriella ; Edelhäuser, Thorsten: Online Data Stream Mining on Interactive Trajectories in Soccer Games . In: Artesis University College of Antwerp (Org.) : Proceedings of the 2nd International Conference on Positioning and Context-Awareness (PoCA 2011 Brussels 2011). 2011, pp 15-22. - ISBN 978-94-90705-04-6
 - Mutschler, Christopher ; Otto, Stephan ; Witt, Nicolas: Portable Device, Virtual Reality System and Method . Schutzrecht EP11183970.0 patent application (05.10.2011)
 - Oster, Norbert ; Philippsen, Michael: Structural Equivalence Partition and Boundary Testing . In: Reussner, Ralf ; Grund, Matthias ; Oberweis, Andreas ; Tichy, Walter (Ed.) : Proceedings 183 Software Engineering 2011 - Fachtagung des GI-Fachbereichs Softwaretechnik (Software Engineering 2011 - Fachtagung des GI-Fachbereichs Softwaretechnik Karlsruhe 21.02.-25.02.2011). Vol. 183. Karlsruhe : Köllen, 2011, pp 75-86. (Lecture Notes in Informatics Vol. 183) - ISBN 978-3-88579-277-2
 - Philippsen, Michael ; Tillmann, Nikolai ; Brinkers, Daniel: Double inspection for run-time loop parallelization . In: ' (Ed.) : Proceedings of the 24th International Workshop on Languages and Compilers for Parallel Computing (LCPC 2011) (International Workshop on Languages and Compilers for Parallel Computing (LCPC 2011) Colorado, USA 08.-10.09.2011). 2011, pp '.

- Tausch, Norbert ; Philippsen, Michael ; Adersberger, Josef: A Statically Typed Query Language for Property Graphs . In: Bernardino, Jorge ; Cruz, Isabel ; Desai, Bipin C. (Ed.) : Proceedings of 15th International Database Engineering and Applications Symposium (IDEAS'11) (15th International Database Engineering and Applications Symposium (IDEAS'11) Lissabon, Portugal 21.-23.09.2011). online : ACM, 2011, pp 219-225. - ISBN 978-1-4503-0627-0
- Veldema, Ronald ; Philippsen, Michael: A Hybrid Functional and Object-Oriented Language for a Multi-Core Future . In: it-Information Technology (ISSN 1611-2776) 53 (2011), No. 2, pp 84-90
- Veldema, Ronald ; Blaß, Thorsten ; Philippsen, Michael: Enabling Multiple Accelerator Acceleration for Java/OpenMP . In: McCool, Michael ; Rosenblum, Mendel (Ed.) : Proceedings 3rd USENIX Workshop on Hot Topics in Parallelism (HotPar '11) (3rd USENIX Workshop on Hot Topics in Parallelism (HotPar '11) Berkeley, CA 26.-27.05.2011). 2011, pp 1-6.
- Veldema, Ronald ; Philippsen, Michael: Iterative data-parallel mark & sweep on a GPU . In: Boehm, Hans-Juergen ; Bacon, David F. (Ed.) : Proceedings of the International Symposium on Memory Management (International Symposium on Memory Management (ISMM '11) San Jose, California, USA). New York : ACM, 2011, pp 1-10. - ISBN 978-1-4503-0263-0
- Weigend, Johannes ; Siedersleben, Johannes ; Adersberger, Josef: Dynamische Analyse mit dem Software-EKG . In: Reussner, Ralf ; Grund, Matthias ; Oberweis, Andreas ; Walter, Tichy (Ed.) : Proceedings 183 Software Engineering 2011 - Fachtagung des GI-Fachbereichs Softwaretechnik (Software Engineering 2011 - Fachtagung des GI-Fachbereichs Softwaretechnik Karlsruhe 21.02.-25.02.2011). Vol. 183. Karlsruhe : Köllen, 2011, pp 3-18. (Lecture Notes in Informatics Vol. 183) - ISBN 978-3-88579-277-2
- Werth, Tobias ; Schreier, Silvia ; Philippsen, Michael: CellCilk: Extending Cilk for heterogeneous multicore platforms . In: ' (Ed.) : Proceedings of the 24th International Workshop on Languages and Compilers for Parallel Computing (LCPC 2011) (24th International Workshop on Languages and Compilers for Parallel Computing (LCPC 2011) Colorado, USA 08.-10.09.2011). 2011, pp '.

4. Exam theses (german only)

- Diplomarbeit: Erweiterung des modellbasierten Testdatengenerators AFRA CASE um die Unterstützung von Skriptsprachen und Verbesserung der Performance

- bei der Behandlung von Verzweigungen. Bearbeiter: Chuanru Ma (beendet am 14.01.2011); Betreuer: Prof. Dr. Michael Philippsen; Dr.-Ing. Norbert Oster
- Diplomarbeit: Entwicklung und Realisierung eines Konzepts zur Qualitätssicherung von (Code-) Generatoren im MDSD-Kontext. Bearbeiter: Thomas Fischer (beendet am 16.01.2011); Betreuer: Dipl.-Inf. Ralf Ellner; Dr.-Ing. Norbert Oster; Prof. Dr. Michael Philippsen
 - Bachelor Thesis: Plattformunabhängige Parallelisierung des Lattice-Boltzmann-Verfahrens mit OpenCL. Bearbeiter: Carolin Wolf (beendet am 17.01.2011); Betreuer: Dipl.-Inf. Tobias Werth; Prof. Dr. Michael Philippsen
 - Diplomarbeit: Portierung eines Ansatzes zur Unterstützung der automatischen Datenfluss- und Bedingungsüberdeckung beim Testen von C / C++ / C# - Programmen. Bearbeiter: Eugen Wagner (beendet am 15.03.2011); Betreuer: Dr.-Ing. Norbert Oster; Prof. Dr. Michael Philippsen
 - Diplomarbeit: Compilerunterstützte Parallelisierung des Lattice-Boltzmann-Verfahrens mit OpenCL. Bearbeiter: Dimitrij Kotrev (beendet am 28.04.2011); Betreuer: Dipl.-Inf. Tobias Werth; Prof. Dr. Michael Philippsen
 - Studien-/Bachelor-/Diplom-/Masterarbeit: A Tool-Chain to Generate a Context Sensitive Process Documentation. Bearbeiter: Halimatou Poussami (beendet am 13.05.2011); Betreuer: Dipl.-Inf. Ralf Ellner; Hon.-Prof. Dr.-Ing. Detlef Kips
 - Bachelor Thesis: Entwurf und Implementierung eines Plugin-Frameworks zur Quellcode Analyse. Bearbeiter: Drescher Matthias (beendet am 02.08.2011); Betreuer: Dipl.-Inf. Georg Dotzler; Prof. Dr. Michael Philippsen
 - Bachelor Thesis: Erweiterung eines C-Compilers zur Codeerzeugung für Systeme der Industrieautomatisierung. Bearbeiter: Christoph Romstöck (beendet am 23.10.2011); Betreuer: Dipl.-Inf. Stefan Kempf; Prof. Dr. Michael Philippsen
 - Diplomarbeit: Erhebung und Analyse von Kennzahlen aus dem fachlichen Performance-Monitoring. Bearbeiter: Stefan Eberlein (beendet am 14.11.2011); Betreuer: M. Eng. Norbert Tausch, Dipl.-Ing. (FH); Dr.-Ing. Norbert Oster; Prof. Dr. Michael Philippsen