

6 Selected tasks and technical achievements by job

This section proves that I am able to work practically as a computer scientist.

6.1 Post-Doc, Utrecht University, May 2006 – Apr 2010, Project *WITCHCRAFT*

Goal of the *WITCHCRAFT* (*What Is Topical in Cultural Heritage: Content-based Retrieval Among Folk song Tunes*) project was to develop a content-based retrieval system for folk song melodies. The main parts were: guiding and supporting the folk song encoding process at the Meertens Institute, gathering *ground truth* meta-data for evaluation, developing algorithms to measure melodic similarity, data conversion, testing and maintaining the database and the web-application. **Tasks:**

Developing Mac OS X applications: *WITCHCRAFT-Editor* and *MelodyNormAnnotator*

- Designed and implemented a melody editor and a relationship annotator using InterfaceBuilder and CoreData.
- Wrapped Lilypond's point-and-locate feature to support fixing errors found in sheet music.
- Mac OS integration: Spotlight-importer, Quicklook and URL-handler.

Integrating data and programming languages

- Wrote converters and Makefile-based representation-on-demand system.
- Used Simplified Wrapper Interface Generator (SWIG) to make C++ functionality accessible.
- Reused the *Reisewissen* user interface (see below) and extended it into a general configuration and testing environment for ranking applications (Java).

Developing the web application

- Understood, maintained and extended PHP, MySQL, Perl and C++ based melody search engine.
- Integrated and adopted JavaScript and Java-based client-interfaces for melody querying.

Developing algorithms

- Developed a method to structurally align melodies and measure co-occurrence ratios between (*log-odd-scores*) that can be used in better aligning melodies and measuring sequence similarity.
- Designed and implemented melodic similarity algorithms using C++ and STL.
- Detected theoretically that a database index for vantage-indexing was only partly used.

6.2 Research Staff, Free University of Berlin, Nov 2004 – Apr 2006, Semantic Web Project *Reisewissen*

Goal of the *Reisewissen* project was to support users finding the right hotel using semantic web technologies. The idea was that the user profile is matched against all kind of available data about the hotel and the hotel location. The hotels are ranked according to the match score. **Tasks:**

Developing semantic web technologies

- Designed and implemented a Java module for mapping complex Jena RDQL queries to as few SQL queries as possible based on the D2RQ database to RDF mapping language.
- Integrated a fast Semantic Web module for SWI-Prolog with Java.
- Introduced mechanisms to the Semantic Web module to enable compile time type checks against ontologies. This makes coding complex RDF/Prolog queries more manageable.

Developing a prototype user interface for ranking and testing

- Designed programming interfaces for matchers. A matcher takes a user profile, a number of parameters (for tuning) and rates the hotels.
- Developed a Java/Swing front-end to apply, combine and compare a number of matchers.
- Integrated Java and Prolog scripting into the engine. This allows to run generic semantic web queries within our system for testing purposes.
- Generalized and extended the system later in the ₂*WITCHCRAFT* project.

Data conversion

- Mapped data from the *eHotel*-Web-service to RDF.
- Mapped data from `openguides.org` to a controlled and cleared vocabulary using a Prolog Semantic Web module.

6.3 Research Staff, Technical University of Berlin, Dec 1998 – Aug 2003, Project *MaMuTh*

The goal of the *MaMuTh* (*Mathematical Music Theory*) project was the *Representation, Analysis and Conveyance of Musical and Music Theoretical Structures*. The code of the software *Rubato* was inherited from a previous project. *Rubato* is a desktop application with which musicologists can experiment with analytic approaches and with a performance theory. This way rational performances can be created from a *dead pan* MIDI file. **Tasks:**

Porting *Rubato*

- Ported 40.000 lines of Objective-C code from NeXTStep class libraries to Apple (OpenStep) libraries.
- Kept the references from and to the additional 30 User Interface description files intact.
- Chose a porting strategy that is content agnostic.
- Had to replace some of the inherited utility classes by standard OpenStep classes.
- Maintained *Rubato* since then, kept in touch with the *MusicKit* and *FScript* OpenSource projects.
- Released a Snow-Leopard version 2009.

Providing services

- Taught hands on computer courses on *Computer based music theory*.
- Did the system administration of our work group Macintosh computers.
- Implemented many helper tools, algorithms and user interfaces for our interdisciplinary work group members. Discussed, what is make-able, how long it will take and what is desirable.
- Found a reformulation of the implemented harmonic path analysis theory. This reduced exponential to linear complexity and made the implemented theory explorable in praxis.

Developing generic user interfaces

- Strived to stop a mathematical data representation formalism to be implemented for our system, which is far too complex for users and to be useful requires a lot of tools to be implemented.
- Instead integrated our system with an existing graphical programming and experimentation system (OpenMusic), which enables the user now to define and experiment with his own algorithms, based on our libraries. The resulting system combines three music software packages and is open to a wider field of bringing system integration to the user.
- Did this by using the reflexion capabilities of scripting languages and mapping the visual programming constructs to those of the scripting languages. By providing a scripting language interface to a runtime system to the outside, requests from other processes or remote computers can be handled very efficiently compared to just providing remote procedure call entries.
- Could minimize developments on the scripting side by engaging myself in the *FScript* OpenSource project.
- The decision processes, architecture and implementation details are described in my PhD dissertation: *Integration of user interfaces and programming languages* (in German).

6.4 Research Staff, Technical University of Berlin, July 1997 – Nov 1998, National machine translation project *Verbmobil*, subproject *Context Evaluation*

The goal of the *Verbmobil* project was to implement an automatic translation system between spoken German, English and Japanese for the limited domain of hotel reservation and traveling information. The subproject *Context Evaluation* had to resolve ambiguities using context information to find the right translation for words that have different meanings in the source language. **Tasks:**

Maintaining the knowledge representation system

- Evaluated two knowledge representation and inference systems and decided to drop the development of our predecessor project, to have enough coder resources for the content.
- Reengineered knowledge and rules, written by other members for the old system.
- Implemented a logic for spoken time and date references.
- Integrated Prolog and Lisp runtime systems.

Developing the build system

- Established version control rules.
- Made our makefiles compatible to other sub-projects and designed a test system.

6.5 Master Thesis, Free University of Berlin, Sept 1995 – June 1996, *Extending a system for parsing german sentences*

The goal of my master thesis (Diplomarbeit) was to extend and apply Stefan Müller's *Babel* system. *Babel* is a rule-based system that produces (all correct) parse-trees for correct german sentences. It captures many complex grammar rules and contained several thousand classified words. **Tasks:**

Understanding and improving the given system

- Understood the foreign Prolog source code architecture and relations to linguistic theory.
- Therefore made a hyperlink system and tools for browsing the dependencies in Prolog files.
- Speeded up startup time and reduced memory requirements significantly by indexing and fetching only the needed lexicon entries.

Developing new linguistic tools

- Found simple solutions for adding lexicon entries (words plus grammatical categories).
- Therefore did morphologic clustering of *ispell* word lists (works for german much better than for english)
- and tested random categories with the sentence parser.
- Used real world sentences from german online newspapers of the upcoming WWW.
- Made a tool for my mexican professor to help him get german noun phrases right (case, number, gender must match for article, adjective, noun). The tool adds color hints to RTF texts.

6.6 Research Tutor, Free University of Berlin, 1993, Project *User interface for blind people*

The goal of the project was to sonify objects from graphical user interfaces. **Task: Developing a mixing tool for sounds stemming from multiple locations**

- Used Borland C++ and Windows 3.1 sound API.
- Employed multiple macro expansion to achieve a kind of loop unrolling for different sound formats (sampling frequency and bit resolution).

6.7 Freelance Programmer, Liebing & Ullfors EDV Development Inc, 1991, Student job

Task: Developing in-house tools for version control in Modula 2.

Finished this job after fulfilling the task to concentrate on my studies.

7 Publications

- [1] KRANENBURG, P. v. ; GARBERS, J. ; VOLK, A. ; WIERING, F. ; GRIJP, L.P. ; VELTKAMP, R.C.: Collaboration perspectives for folk Song research and music information retrieval: The indispensable role of computational musicology. In: *Journal of Interdisciplinary Music Studies* (2009)
- [2] WIERING, Frans ; VELTKAMP, Remco C. ; GARBERS, Jörg ; VOLK, Anja ; VAN KRANENBURG, Peter ; GRIJP, Louis P.: Modelling Folksong Melodies. In: *Interdisciplinary Science Reviews 34(2-3)* (2009)
- [3] GARBERS, J.: Software frameworks for systematic music processing. In: *Dagstuhl Seminar Proceedings 09051, Knowledge representation for intelligent music processing* (2009)
- [4] GARBERS, J.: Bridging Music Information Retrieval and Folk Song Research - The Computational Setup of the WITCHCRAFT Project. In: *International Conference on Acoustics* (2009)
- [5] GARBERS, J. ; WIERING, F. ; BADE, Korinna ; NÜRNBERGER, Andreas ; STOBER, Sebastian: Supporting Folk-Song Research By Automatic Metric Learning and Ranking. In: *Proceedings of the International Society on Music Information Retrieval (ISMIR 2009) conference, 2009*, S. 741–746
- [6] VOLK, A. ; GARBERS, J. ; KRANENBURG, P. v. ; WIERING, F. ; GRIJP, L.P. ; VELTKAMP, R. C.: A manual annotation method for melodic similarity and the study of melody feature sets. In: BELLO, J. P. (Hrsg.) ; CHEW, E. (Hrsg.): *Proceedings of the ninth International Conference on Music Information Retrieval, 2008*
- [7] GARBERS, J. ; WIERING, F.: Towards structural alignment of folk songs. In: BELLO, J. P. (Hrsg.) ; CHEW, E. (Hrsg.): *Proceedings of the ninth International Conference on Music Information Retrieval, 2008*
- [8] KRANENBURG, P. v. ; GARBERS, J. ; VOLK, A. ; WIERING, F. ; GRIJP, L.P. ; VELTKAMP, R. C.: Towards Integration of MIR and Folk Song Research. In: DIXON, Simon (Hrsg.) ; BAINBRIDGE, David (Hrsg.) ; TYPKE, Rainer (Hrsg.): *Proceedings of the Eighth International Conference on Music Information Retrieval*, Austrian Computer Society, 2007, S. 505–508
- [9] GARBERS, J. ; VOLK, A. ; KRANENBURG, P. v. ; WIERING, F. ; GRIJP, L. ; VELTKAMP, R. C.: On pitch and chord stability in folk song variation retrieval. In: *Proceedings of the First International Conference of the Society for Mathematics and Computation in Music (to be published), 2007*
- [10] GARBERS, J. ; VOLK, A. ; KRANENBURG, P. v. ; WIERING, F. ; GRIJP, L. ; VELTKAMP, R. C.: Comparing Computational Approaches to Rhythmic and Melodic Similarity in Folksong Research. In: *Proceedings of the First International Conference of the Society for Mathematics and Computation in Music (to be published), 2007*
- [11] GARBERS, J. ; KRANENBURG, P. v. ; VOLK, A. ; WIERING, F. ; GRIJP, L. ; VELTKAMP, R. C.: Using pitch stability among a group of aligned query melodies to retrieve unidentified variant melodies. In: DIXON, Simon (Hrsg.) ; BAINBRIDGE, David (Hrsg.) ; TYPKE, Rainer (Hrsg.): *Proceedings of the eighth International Conference on Music Information Retrieval*, Austrian Computer Society, 2007, S. 451–456
- [12] VOLK, A. ; GARBERS, J. ; KRANENBURG, P. v. ; WIERING, F. ; GRIJP, L.P. ; VELTKAMP, R. C.: Applying Rhythmic Similarity Based on Inner Metric Analysis to Folksong Research. In: DIXON, Simon (Hrsg.) ; BAINBRIDGE, David (Hrsg.) ; TYPKE, Rainer (Hrsg.): *Proceedings of the Eighth International Conference on Music Information Retrieval*, Austrian Computer Society, 2007, S. 293–296
- [13] GARBERS, J.: An integrated MIR programming and testing environment. In: *Proceedings of the seventh International Conference on Music Information Retrieval*, University of Victoria, 2006
- [14] GARBERS, J. ; NIEMANN, M. ; MOCHOL, M.: A Personalized Hotel Selection Engine. In: *Proceedings of the European Semantic Web Conference 2006* (2006)
- [15] GARBERS, Jörg: Geist-eScience: Programmieren für die Wissenschaft (Manuskript). In: *Geburtstagsband für Bernd Mahr* (2005)
- [16] NOLL, Thomas ; GARBERS, Jörg ; BRAND, Monika ; NESTKE, Andreas ; VOLK, Anja: Computer-Aided Representation, Analysis and Conveyance of Musical and Music-Theoretical Structures / TU-Berlin. 2004. – Forschungsbericht

- [17] GARBERS, Jörg: *Integration von Bedien- und Programmiersprachen am Beispiel von OpenMusic, Humdrum und Rubato*, Fakultät IV – Elektrotechnik und Informatik der Technischen Universität Berlin, Diss., 2004
- [18] GARBERS, Jörg ; NOLL, Thomas: Harmonic Path Analysis. In: *Lluis-Puebla, Emilio, Guerino Mazzola und Thomas Noll (eds.): Perspectives in Mathematical and Computer-Aided Music Theory*, Verlag epOs-Music, Osnabrück (2003)
- [19] GARBERS, Jörg: User Participation in Software Configuration and Integration of OpenMusic, Humdrum and Rubato. In: *Lluis-Puebla, Emilio, Guerino Mazzola und Thomas Noll (eds.): Perspectives in Mathematical and Computer-Aided Music Theory*, Verlag epOs-Music, Osnabrück (2003)
- [20] GARBERS, Jörg: Konzept eines Musiktheorie-Servers. In: *Enders, B. (ed.): Global Village, Global Brain, Global Music, KlangArt '99 Proceedings*, Osnabrück (2003)
- [21] GARBERS, Jörg: KIT-MaMuTh Zwischenbericht: Softwareentwicklung / TU-Berlin. 2002. – Forschungsbericht
- [22] GARBERS, Jörg: *Erweiterung eines Systems zum Parsen deutscher Sätze*, Institut für Informatik der Freien Universität Berlin, Diplomarbeit, 1997

8 Conference Talks

- International Conference on Music Information Retrieval (ISMIR), 2009 (Kobe, Japan), 2007 (Vienna, Austria), 2006 (Victoria, Canada)
- International Conference on Acoustics, NAG/DAGA 2009 (Rotterdam, Netherlands)
- International Conference of the Society of Mathematics and Computation in Music, MCM 2006 (Berlin, Germany)
- Several IRCAM Forum Software Workshops, 2000–2003 (Paris, France)
- International Seminar on Mathematical Music Theory 2002 (Zurich, Switzerland), 2000 (Sauen, Germany)
- Society IFM/i2musics 2000 (Zurich, Switzerland)
- IMS Study Group on Computer Applications in Musicology 2002 (Leuven, Belgium)
- Klangart 1999 (Osnabrück, Germany)