SOAMED Coherence Report 2013

The SOAMED Ph.D. candidates

January 15, 2014

1 The big picture

The graduate school SOAMED introduces theoretically well-founded service-oriented concepts to health care systems and medical devices. To this end, SOAMED aims at providing decisive improvements of concepts, methods, and tools for service-oriented systems. Currently, twenty-six Ph.D. candidates, of which six are associated, and fourteen supervisors contribute to and participate in SOAMED.

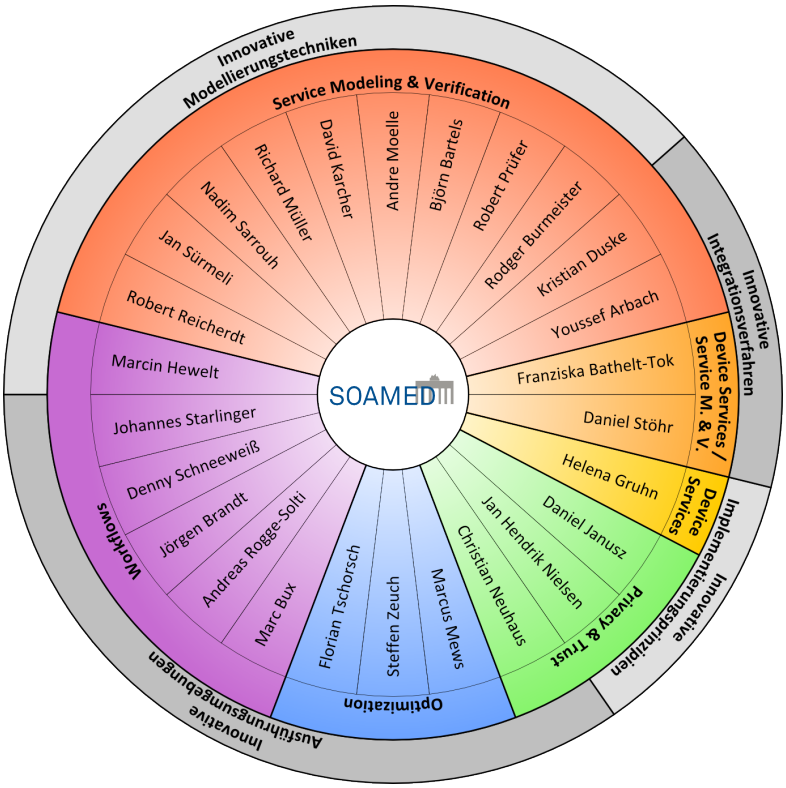

Figure 1: The fields of interest of the SOAMED Ph.D. candidates.

For a better overview of the Ph.D. candidates' research, we coarsely classified their fields of interest into five groups, i.e., (1) Service Modeling & Verification, (2) Device Services, (3) Privacy & Trust, (4) Optimizazion, and (5) Workflows. See Fig. 1 for a visualization of these groups.

The modeling and verification of health care services is in the field of interest of Robert Reicherdt, Jan Sürmeli, Nadim Sarrouh, Richard Müller, David Karcher, Andre Moelle, Björn Bartels, Robert Prüfer, Rodger Burmeister, Kristian Duske, Youssef Arbach, Franziska Bathelt-Tok, and Daniel Stöhr. Franziska Bathelt-Tok and Daniel Stöhr, together with Helena Gruhn, also focus on service-oriented concepts for medical devices. Daniel Janusz, Jan Hendrik Nielsen, and Christian Neuhaus investigate privacy and trust in service-oriented systems. Optimization of computationally intensive or otherwise complex tasks in the medical domain is the shared topic of Marcus Mews, Steffen Zeuch, and Florian Tschosch. Finally, Marcin Hewelt, Denny Schneeweiss, and Andreas Rogge-Solti are involved in research about health care workflows in general, whereas Johannes Starlinger, Jörgen Brandt, and Marc Bux specifically target scientific workflows.

We have established a voluntary SOAMED Ph.D. candidates meeting at the Humboldt Graduate School since the middle of 2011, which takes place twice a month. This meeting gives all participants the opportunity to closely cooperate in related topics, talk about papers or important contributions to SOAMED, practice presentations for upcoming workshops or conferences, and administrate their teamwork in general. Moreover, SOAMED members of both generations attend various soft skill courses as a group, further promoting solidarity and joint work.

In the following, each Ph.D. candidate gives a brief overview of how their research integrates into the big picture of SOAMED, and describes ongoing or planned cooperations with other SOAMED Ph.D. candidates.

2 Individual cooperation reports

2.1 Youssef Arbach

Youssef Arbach is working on the topic of Dynamic Coalitions (DCs) using Event Structures as a formalism. For him the cooperation comes in two folds, one with his colleage N. Sarrouh which share him the same main topic of DCs, and the other is with his college D. Karcher concerning event structures.

Cooperation with N. Sarrouh Although they work on DCs, the difference between Arbach's work and Sarrouh's is that Youssef Arbach is dealing with the problem of DC formation and creation. This phenomenon holds the dynamicity and evolution of such coalitions, i.e., it holds the key feature. On the other hand, Nadim Sarrouh is working on the privacy problem of DCs, using a different formalism, namely ASM. From that

perspective they worked on a joint paper on how to connect the formalisms they use to create an integrated modeling platform for DCs. It was submitted to ICDPSS 2013 [1].

Cooperation with D. Karcher On the other hand, after a deep analysis to the phenomenon of DCs and their formation, it is found that there is an overlap between DCs and processes, but still there is a difference. Therefore, Arbach and Kracher, which started recently, are working together with event structures formalism to differentiate DCs from classical processes. Precisely speaking, they are working on defining a dynamic version of causality in event structures. This joint work captures the interaction between events and members of DCs. It is to be published soon.

2.2 Björn Bartels

The research topic of Björn Bartels dissertation deals with the formal verification of low-level code. Furthermore, conformance relations between low-level code representations and abstract specifications given in a process-algebraic formalism can be established using the verification environment discussed in Björn Bartels thesis. The entire environment is rigorously formalized using the theorem prover Isabelle/HOL.

Regarding verification techniques, i.e., the application of automated theorem proving and model checking techniques, the topic is related to the work of Daniel Stöhr and Robert Reicherdt. Questions motivated by the application of verification techniques are regularly discussed in a group of Daniel Stöhr, Robert Reicherdt and Björn Bartels.

Furthermore, the work of Björn Bartels connects with the research questions investigated by Rodger Burmeister, Kristian Duske and Marcus Mews regarding modeling and analysis techniques on the abstract level. Problems, solutions and potential synergy effects are examined on a regular basis as well.

2.3 Franziska Bathelt-Tok

The research topic of Franziska Bathelt-Tok's dissertation deals with the question how the interoperability between various medical devices can be enabled. In particular, the main focus of the dissertation lies on the fully automated controller synthesis for data-dependent services.

Hence, this topic is closely related to the topic of Robert Prüfer. Franziska Bathelt-Tok as well as Robert Prüfer focus on the question how to ensure correct interactions of data-dependent services. Both approaches are based on variants of high-level Petri nets and add data to the formal models. While Robert Prüfer focuses on the modeling of data-dependent services such that they interact correctly by construction, Franziska Bathelt-Tok deals with the question how an controller can be synthesized automatically and correctly if the services are data-dependent.

Problems occurring by the use of Petri nets were discussed in a therefore developed group. This group consists of Richard Müller, Marcin Hewelt, Andre Mölle, Robert Prüfer,Kristian Duske and Franziska Bathelt-Tok.

Because Helena Gruhn and Daniel Stöhr are also working on device services, there is a weak correlation to the work of Franziska Bathelt-Tok. At the beginning of the year, the Ph.D. students Helena Gruhn, Daniel Stöhr and Franziska Bathelt-Tok had supervised a seminar that focuses on research topics within the service-oriented domain. [1].

2.4 Jörgen Brandt

Jörgen Brandt, as an associated student, studies a language-based approach to specification and execution of scientific workflows. With the focus on workflows for Next Generation Sequencing (NGS) data processing, he examines ways to express bioinformatics workflows to process the ever growing amounts of data in distributed compute environments.

In this respect he works closely with Marc Bux whose research subject is an adaptive scheduler for scientific workflows. In a joint software development effort, they create a workflow language processor and an execution environment.

Furthermore, Jörgen Brandt cooperates with Johannes Starlinger whose research subject is workflow similarity. The mining of workflow repositories for related workflows is intended to improve the workflow author's user experience.

2.5 Rodger Burmeister

Rodger Burmeister's dissertation deals with the formal specification and automated verification of concurrent systems. In the DFG Project COPY, he develops a language that enables abstract design-pattern specifications on top of the actor model. He uses the Temporal Logic of Actions and its related model checking toolchain to mechanize and automatically verify sequential consistency and the absence of deadlocks.

As a member of the TUB Software Engineering group, Mr. Burmeister collaborates with several students in the post graduate programme. Together with Mr. Mews and Mr. Duske there is a regular meeting, where each is presenting the progress of it's work and where aspects regarding each students formalization are discussed. In addition there is also a common ground between Mr. Burmeister and Mrs. Gruhn. Both students use the actor model to describe concurrent systems and do exchange their experiences in the field. Beside that, there is also common link to Mr. Bartels in the field of process algebras, and here especially in the field of system refinement and emergent process behavior.

[1] http://tinyurl.com/czc3sjy

2.6 Marc Bux

Marc Bux investigates adaptive scheduling techniques for executing data-intensive scientific workflows on heterogeneous distributed resources, such as compute clouds. Scientific workflows are high-level compositions of sequential and concurrent data processing tasks. Increasingly large amounts of data produced in most fields of scientific research along with the maturation of cloud computing technology have led to a demand for strategies towards distributing workflow execution among several compute resources with possibly instable performance.

In the context of a joint project, Jörgen Brandt and Marc Bux contribute to the development of a distributed computational infrastructure for the storage and processing of large amounts of genomic data. While Jörgen Brandt researches and develops a workflow specification language, Marc Bux develops the underlying distributed workflow execution engine as well as the adaptive scheduling mechanism at its core. Both parts of this collaboration are heavily intertwined and have resulted in a considerable amount of fruitful discussion and collective research.

Additionally, Marc Bux's research topic is closely related to the work of Steffen Zeuch, Johannes Starlinger, and Denny Schneeweiss. Steffen Zeuch researches parallelization from a multicore perspective, which shares many fundamental ideas with parallel execution of scientific workflows. On the other hand, Johannes Starlinger focuses on similarity measures for scientific workflows, which overlaps with Marc Bux's topic in the underlying computing paradigm of scientific workflows. Denny Schneeweiss researches scheduling of treatment processes in clinical environments, the approaches to which are closely related to adaptive workflow scheduling.

2.7 Kristian Duske

Kristian Duske's research focuses on runtime correctness verification. Specifically, the goal of his work is to develop a method to verify deadlock freeness of a timed service composition at runtime. Since this dissertation is in the area of formal verification, it is related to the works of Franziska-Bathelt-Tok, Daniel Stöhr, Richard Müller, and, to a lesser extent, the works of Andre Moelle and Robert Prüfer. There is a close link between Daniel Stöhr's work and Kristian Duske's work because both deal with timing properties of services.

Kristian Duske has also worked closely with Richard Mülller on the topic of timed services since 2012. Together with Richard Müller and Robert Prf̈er, he is conducting a case study at the Charité Berlin. In 2013, they have observed a treatment process for stroke victims at the emergency unit. A publication of a BPMN model of this process is in preparation.

Furthermore, there has been some cooperation and frequent discussion with associated Ph.D. students Björn Bartels and Rodger Burmeister due to some overlap of the respective dissertation topics.

2.8 Helena Gruhn

Helena Gruhn focuses on the development of mobile, service-oriented sensor-actuator networks. Her primary goal is to verify correct network behavior after topology changes at design level and to ensure the correctness at runtime.

There exist common ground with the dissertations of Franziska Bathelt-Tok and Daniel Stöhr concerning the issue of interoperability of medical devices. While Helena Gruhn researches the specifics of services in resource-restricted sensor-actor networks, Daniel Stöhr investigates the interaction of device services on a control flow level and Franziska Bathelt-Tok on a data flow level. All 3 Ph.D. students were supervising a seminar focusing on service-oriented architectures together.

Additionally, a joint case study is performed together with Daniel Stöhr in the surroundings of the geriatrics group of the Charité. The basic idea is to model and extend a driver assistance system for elderly people. The system can discover a heart attack or tunnel vision and reacts appropriately, e.g. by actuating an emergency brake. The results were jointly published at the 7th International Conference on Pervasive Computing Technologies for Healthcare .

Furthermore, there is a relation between the work of Helena Gruhn and Rodger Burmeister. Both Ph.D. students use the actor model as foundation for their models, allowing them to discuss ideas and problems and to benefit from each others knowledge.

2.9 Marcin Hewelt

Marcin Hewelt investigates innovative modeling and analysis techniques for processes in the hospital. Hospital processes can be divided into organizational and medical treatment processes. While the former are very much like the usual processes of companies, the latter display a high degree of flexibility caused by unexpected changes of the patient's health. This property of medical treatment processes is probably one of the reasons why business process management is not broadly adopted in the medical sector. Marcin Hewelt's research so far focused on displaying interdependencies between process instances as so-called business process architectures (BPA). These BPAs can be extracted from process model collections as well as used in a top-down fashion to model process architectures.

Since the semantics of BPAs is defined by Petri nets, there are links to other doctorate students employing this formalism in their research. In 2013 a group of SOAMED doctorate students (Prüfer, Duske, Bathelt-Tok, Moelle) met regularly to discuss topics of interest in the domain of Petri nets. Naturally, the collaboration with Andreas Rogge-Solti, working on statistics of missing data in process logs, was very close, because we both used BPMN process models.

Another line of work is the investigation of adaptation in medical treatment processes. Here, standard operating procedures can be thought of as the basic building blocks of adaptation. Concerning the composition of treatment plans from SOPs there is a close connection to the work of Robert Prüfer about scenario-based modeling. This line of work also bore resemblance to the adaptive case-based reasoning approach pursued by Cem Sürücü.

2.10 Daniel Janusz

Daniel Janusz is working on *privacy enhancing service-interfaces*. Health care providers need to exchange medical data to provide complex medical treatments. In general, privacy concerns arise whenever personal data is exchanged across company borders. This approach aims to handle these concerns by adding privacy enhancing service-interfaces to existing services used in medical treatments. Thereby, a protocol was developed, that enables health care provider to query remote data sources about a specific patient.

The work of Christian Neuhaus and Daniel Janusz complement one another, as the protocol developed by Daniel Janusz can run on top of Christian Neuhaus' cloud infrastructure. Another cooperation within SOAMED with Steffen Zeuch is working in the context of a *Mobility Lab* at Humboldt University. With the Mobility Lab, we simulate ambient assisted living scenarios, which includes automatic privacy-preserving processing of so-called big data.

In June 2013, Daniel Janusz and Jan Hendrik Nielsen organized the event *Daten-Striptease* at the 13th *Langen Nacht der Wissenschaften* in Berlin[1].

2.11 David Karcher

David Karcher is working on event structures. This work is based on the work by Nadim Sarrouh and Youssef Arbach on Dynamic Coalitions (DCs) and on Arbach's modeling with event structures.

At the moment David Karcher and Youssef Arbach are working together on a dynamic version of event structures, in which causality is not static anymore but can be changed by events during a system run. Here many interesting questions arise, for example the expressiveness in comparison to well known event structures, or concerning concurrency.

Additionally, David Karcher is coordinating with other people, like Robert Pruefer and Marcin Hewelt, who are dealing (or heave dealt) with similar kinds of formalisms to the one he is using (e.g., Petri Nets) to gain a mature overview on related work.

[1] http://www.langenachtderwissenschaften.de/

2.12 Marcus Mews

The research topic of Marcus Mews dissertation deals with the refactoring of software source code. His approach combines static analyses, code dependencies and constraint solving to improve the current state art in the field of software refactoring. The goals of the approach are: (1) Improving known refactoring by preserving the code semantics. (2) Making refactorings available even in complex situations with a multitude of dependencies. (3) Using a generic, extensible and multi-language framework.

The work of Marcus Mews connects with the research questions investigated by Björn Bartels, Rodger Burmeister, and Kristian Duske regarding modeling and analysis techniques on the abstract level. There is a regular meeting, where each is presenting the progress of it's work and where aspects regarding each students formalization are discussed. Problems, solutions and potential synergy effects are examined on a regular basis.

2.13 Andre Moelle

Andre Moelle is researching in the area of correct service interaction. In his dissertation he aims to finitely represent the set of partners with which a given service interacts correctly. Such a finite representation is also known as *Operating Guideline* (OG). Both Kristian Duske's and Jan Sürmeli's work is based on OGs. Kristian Duske extends OGs such that they take timing properties into account whereas Jan Sürmeli extends OGs with costs. Therefore there is a close link between Andre Moelle's dissertation and both Kristian Duske's and Jan Sürmeli's dissertation. Andre Moelle is generalizing OGs such that correctness criteria can be stated in the temporal logic CTL. Daniel Stöhr, who works on the composition of timed services, uses a variant CTL, namely Timed CTL, so there is also a link between their work.

2.14 Richard Müller

Best engineering practices suggest specifying a system before actually implementing it. Both the implementation as well as its specification exhibit behavioral properties. Conformance checking decides whether the implementation of a system preserves a certain behavioral property of its specification. This is the central scientific problem of Richard Müller's thesis.

Conformance checking on formal models of services can be used to ensure functional correctness - that is, Kristian Duske's research topic. In 2013, Kristian Duske, Richard Müller and Robert Prüfer jointly recorded a process model for treating strokes at the Charité Berlin.

Richard Müller presented his topic at the annual meeting of the DFG research training groups in Schloss Dagstuhl.

2.15 Christian Neuhaus

The topic of Christian Neuhaus' dissertation is *Quantitative Analysis of Security and Availability in Service-based Software Systems*. The motivation of this topic is the current shift from local to cloud resources for computation and storage needs. As medical applications are highly sensitive with regard to data privacy and system availability, using cloud resources poses challenges and risks. Key to engineering of such software systems is the recognition and mitigation of these risk during the design phase. This dissertation investigates reusable software techniques to improve security properties. Calculation models derived from reliability engineering are then applied to analyze the security properties of the resulting system.

The work of this thesis touches the work of Nadim Sarrouh, who is regarding access control in distributed scenarios from a formal perspective. The cooperation resulted in the identification of a formal model, which can be used to implement access control based on user interaction history in distributed systems. The work also touches the one of Daniel Janusz, who develops privacy-preserving communication protocols.

2.16 Jan Hendrik Nielsen

Jan Hendrik Nielsen is working on *Privacy Aware Data Exchange in Distributed Health Infrastructures*. The publication of medical data plays a key role in the validation of medical findings. Since medical records often contain sensitive information about individuals special care must be taken when releasing sensitive medical information. Algorithms have emerged that provide utility of the data while maintaining the privacy of individuals contained in the release. However, little effort has been made in adapting existing algorithms to protect more than one sensitive attribute. In a distributed environment this scenario is induced by the existence of multiple parties wanting to jointly publish data. Motivated by the problems mentioned before Jan Hendrik Nielsen focuses on the development of an anonymization protocol meeting the needs of an distributed environment.

The work of Jan Hendrik Nielsen complements the work of Daniel Janusz who utilizes established anonymization techniques to safeguard queries about specific health records. In addition Daniel Janusz and Jan Hendrik Nielsen organized the event *Daten-Striptease* at the 13th *Langen Nacht der Wissenschaften* in June 2013 at Humboldt University Berlin[1]. Another cooperation within SOAMED lies in the challenging field of privacy-preserving monitoring of network statistics to which Florian Tschorsch is attributed to. Gathering privacy-preserving statistics in an anonymous network is a non-trivial problem. Distributed anonymization algorithms may prove useful for this challenging task.

[1] http://www.langenachtderwissenschaften.de/

2.17 Robert Prüfer

The topic of Robert Prüfer's dissertation, "Scenario-based Design of Data-dependent Services", is closely related to the topic of Franziska Bathelt-Tok. Both topics generally deal with the problem of how to ensure correct interaction of data-dependent services on the level of formal models. In both approaches, variants of high-level Petri nets serve as an underlying formalism. While Franziska Bathelt-Tok deals with the question how to synthesize an adapter that ensures correct interaction of data-dependent services, Robert Prüfer focuses on the question how to model data-dependent services in a way that they interact correctly by construction.

Further, as the technique developed by Robert Prüfer is based on Petri nets, there are also similarities to the topics of Richard Müller, Kristian Duske, and Jan Sürmeli. Consequently, all of these Ph.D. students benefit from the knowledge and insight the others gain working with Petri nets.

Together with Kristian Duske and Richard Müller, Robert Prüfer is working on a case study where a process model for treating strokes at the Charité Berlin is elicited.

2.18 Robert Reicherdt

The research topic of Robert Reicherdt's dissertation deals with the formal verification of models in domain-specific languages used for the development of embedded systems. In particular, the main focus of the dissertation lies on the fully automated verification of MATLAB/Simulink models using verification techniques based on satisfiability modulo theories (SMT) and first order logic.

This topic is weakly related to the topic of Daniel Stöhr. Both, Robert Reicherdt as well as Daniel Stöhr use verification techniques in their approaches. Problems occurring by the use of these verification techniques, especially in decision diagrams, first order logic and satisfiability have been discussed in a group of Daniel Stöhr, Robert Reicherdt and Björn Bartels.

2.19 Andreas Rogge-Solti

Andreas Rogge-Solti has developed a framework for probabilistic analysis of process models that can be used to estimate probabilities of certain events and distributions of the time of their occurrence. His work deals with different questions that arise when not all state changes are reported to the monitoring system. When a nurse forgets to document a treatment step, a probabilistic answer can still be provided, of when the treatment step was most likely to happen.

Integration of the probabilistic analysis framework with the approach of Denny Schneeweiss in a constraint solving method that uses the probabilities as information to speed up

search through possible assignment combinations is promising. Further, the framework can be used for probabilistic analysis of business process architectures, as planned by Marcin Hewelt.

2.20 Nadim Sarrouh

Nadim Sarrouh's research deals with the creation of a formal modeling framework for privacy-sensitive dynamic coalitions. Since privacy is an important topic in the development of service-oriented architectures as well as in medicine, there are various researchers investigating this field from different perspectives, such as Christian Neuhaus and Daniel Janusz.

The closest coherence is to be found with Youssef Arbach, who works on formalizing the creation of dynamic coalitions. Therefore Sarrouh and Arbach worked on a joint to connect their formalisms so that they create an integrated modeling platform for dynamic coalitions. It was submitted to ICDPSS 2013.

One of N. Sarrouh current case studies in the medical field, is the rehabilitation process for stroke patients at Charité Berlin. Cem Sürücü is also working at that case and therefor in close exchange with N. Sarrouh. There have been several talks to integrate the formal modeling approach of N. Sarrouh with C.Sürücü's efforts to create a machine learning tool in the ambulant treatment sector, which can be seen as a dynamic coalition too. Further possibilities or cooperation are currently investigated.

Christian Neuhaus investigates trust-based access control mechanisms in cloud-scenarios. Trust-based access control is also proposed by Nadim Sarrouh to provide the means to control access in highly dynamic coalitions. A common case study for a trust-based research exchange platform is currently envisioned under supervision of Dr. Med. Blankenstein.

2.21 Denny Schneeweiss

The focus of Denny Schneeweiss' research is AI-based scheduling of human centric workflows in medical environments with constraint-technologies. His research area belongs to the Workflows-area of SOAMED.

Medical treatments activities can be described as workflows or processes that can be modeled in workflow languages like the *Business Process Model and Notation*-language (BPMN). BPMN is easy to comprehend even by non-IT-experts. The central aim of this dissertation is a automatic transformation that turns BPMN process models of treatment activities into Constraint-Satisfaction-Problems for time- and resource scheduling. A constraint-solver can then read these CSPs and calculate a schedule that allocates the process activities to the medical personnel like physicians and nurses and the available medical resources (rooms, medical devices) in an optimal way.

Cem Sürücü worked on concepts to adapt treatment processes to the individual needs and medical conditions of patients. This methodology could have benefited from enhanced scheduling and resource-planning of treatment activities.

There also exists a connection to the research of Andreas Rogge-Solti which dealt with the probabilistic estimation of process status and process mining in medical facilities. In such environments a process monitoring system can only gather sparse information which is mainly generated by the medical staff. The informations and projections inferred by this models could be used to enrich the CSPs generated by D. Schneeweiss' transformation. This would help a constraint-solver to find the plans faster, that are most likely. Denny Schneeweiss plans to incorporate the results of Andreas Rogge-Solti into the optimization components of the automatic transformation developed in his dissertation in order to generate such process-specific search-heuristics.

2.22 Johannes Starlinger

Johannes Starlinger's research targets the establishment of similarity measures for Scientific Workflows. The research area of Scientific Workflows is shared with Marc Bux, a Ph.D. student from the second generation of SOAMED students, who is exploring parallelization and distributed execution of these workflows. The interlink between both topics not only resides in the common object of study. It is also reflected in the application of scientific workflows to any problem requiring large scale computation. As a consequence, Marc and me co-supervised a seminar held during the summer term of 2012 which dealt with the problem of large scale data analysis, including the use of scientific workflows in general, and the specific questions arising from their application to large scale scenarios.

Closely related to scientific workflows are the fields of business workflows and business process models, investigated by SOAMED student Andreas Rogge-Solti. Similarity measures for business workflows have seen great scientific interest already and the methods developed for them, while not being directly transferable to scientific workflows, provide some interesting ideas for my endeavors.

2.23 Daniel Stöhr

The topic of Daniel Stöhr's work is the "Automated Composition of Timed Services for Synchronizing Medical Devices". The aspect of timed services is related to the works of Kristian Duske and Richard Müller, while the aspect of device services is related to the works of Franziska Bathelt-Tok, Kristian Duske, and Helena Gruhn. Additionally, techniques that are used within the approach of Daniel Stöhr are linked to the work of Robert Reicherdt and Bjoïn Bartels.

The link between Daniel Stöhr, Kristian Duske, and Richard Müller is the analysis of formal service models containing timed properties. However, the focus of Daniel Stöhr's work is on the generation of service compositions described as timed automata. In

contrast, the other two works deal with how services, represented as timed petri nets, can be analyzed regarding properties like controllability, correctness and conformance.

Device services are an interlink to the works of Franziska Bathelt-Tok and Helena Gruhn. While Daniel Stöhr investigates the interaction of device services on a control flow level, the former deals with device services on a data flow level. The latter examines the specifics of device services in sensor-actuator-networks. Together, all three Ph.D. students have supervised a seminar on recent SOA research.

A joint case study has been performed together with Helena Gruhn in the context of the SmartSenior project within the geriatrics group of the Charité. Here, we model a use case where patients with a high risk of heart stroke are monitored while driving. If the patient's health parameters are critical, the monitoring system can take steps against the risk of car accidents. Helena Gruhn and Daniel Stöhr published their case study at the International Conference on Pervasive Computing Technologies for Healthcare 2013 (PervasiveHealth'13).

Robert Reicherdt, Bjoïn Bartels, and Daniel Stoḧr use verification techniques in their approaches. The applied techniques are based on decision diagrams, first order logic, and satisfiability. They have been discussed in detail by Robert Reicherdt, Bjoïn Bartels, and Daniel Stoḧr.

2.24 Jan Sürmeli

The topic "Cost-optimal partners for Services" of Jan Sürmeli's dissertation is closely related to the topics of Kristian Duske and Franziska Bathelt-Tok: All three dissertations tackle the problem of synthesizing services in order to ensure overall correctness and optimality of service compositions. Jan Sürmeli and Kristian Duske both study partner synthesis for behavioral and non-functional requirements and preferences. Whereas Jan Sürmeli considers abstract notions of costs caused by the execution of activities, Kristian Duske studies timed models. Franziska Bathelt-Tok studies the problem of service adaptation which may in some cases be reduced to partner synthesis. In contrast to Jan Sürmeli, Franziska Bathelt-Tok focuses on data-dependent services. Jan Sürmeli, Kristian Duske and Franziska Bathelt-Tok share Petri nets as a common base for formal modeling the behavior of services.

Additionally, the work of Richard Müller on conformance of services aims at the shared goal of the correctness of service compositions. Finally, the work of Robert Prüfer on the modeling of scenarios with Petri nets may serve as a foundation for the modeling of use cases of a service, which is beneficial in modeling and analyzing the costs of a service.

2.25 Florian Tschorsch

Florian Tschorsch focuses on routing overlays from a network performance perspective: Since new distributed services evolve but cannot be provided by the Internet architecture alone, they often are deployed on overlay networks. Surprisingly, there are little insights into how to design the overlay in such a way that it makes efficient and proper use of network resources. Particularly, congestion control is challenging.

The research topic is related to the work of Marc Bux and Steffen Zeuch. Both, deal with coordinating and scheduling heterogeneous resources in a distributed environment, which shares many fundamental ideas with the design of a congestion control algorithm.

Beyond performance metrics, Florian Tschorsch considers security and privacy aspects. This includes the resilience of protocols against exploits and privacy-preserving monitoring of network statistics. The work relates to the research of Daniel Janusz, Christian Neuhaus and Jan Hendrik Nielsen.

2.26 Steffen Zeuch

Steffen Zeuch's research deals with multicore and main memory challenges for data access in query optimization. There are two contributions. First, modern chipset extension are utilized to speed up processing. Second, the parallel processing capacities of modern CPU shall be exploited more efficiently.

This research area is most likely shared with the approach of Marc Bux, another Ph.D. student from the second generation of SOAMED, who deals with parallelization from the workflow point of view in a distributed environment. In contrast, my research focus on a single physical machine.

Furthermore this research task will interfere with Daniel Janusz within the new founded *Mobility Lab* in the database research group. The target of this lab is to evaluate the SOA technologies for the mobile area. Because modern cellphones consist of multiple processors and cores, this will be another area of application for Multicore technologies.

The first Project in the Mobility Lab will be the plunge detection with smartphones. This project will take place in conjunction with Daniel Janusz. He will investigate the privacy related issues and I focus on the data processing and plunge detection. We develop a first prototype, which gather the information provided by the smartphone and visualize them graphically.

References

[1] Arbach, Y., Sarrouh, N., Nestmann, U.: Dynamic coalitions: Towards an integrated formal framework (2013)