Halmstad University ITE PhD Conference 2016
List of abstracts of presentations

Submission 1
Essayas Gebrewahid
Title: Support for Data Parallelism in the CAL Actor Language
Abstract:
With the arrival of heterogeneous manycores comprising various features to support task, data and instruction level parallelism, developing applications that take full advantage of the hardware parallel features has become a major challenge. In this paper, we present an extension to our CAL compilation framework (CAL2Many) that supports data parallelism in the CAL Actor Language. Our compilation framework makes it possible to program architectures with SIMD support using high-level language and provides efficient code generation. We support general SIMD instructions but the code generation back-end is currently implemented for two custom architectures, namely ePUMA and EIT. Our experiments were carried out for two custom SIMD processor architectures and two applications. The experiment shows the possibility of achieving performance comparable to hand-written machine code with much less programming effort.

Submission 2
Hassan Mashad Nemati, Anita Sant'Anna and Slawomir Nowaczyk
Title: Bayesian Network Representation of Meaningful Patterns in Electricity Distribution Grids
Abstract:
The diversity of components in electricity distribution grids makes it impossible, or at least very expensive, to deploy monitoring and fault diagnostics to every individual element. Therefore, power distribution companies are looking for cheap and reliable approaches that can help them to estimate the condition of their assets and to predict the when and where the faults may occur.
Several common approaches are based on statistical analysis of historical failures. In general, by exploiting such historical information, it is possible to predict future problems. However, those prediction algorithms need to be clear and easy to understand for managers and maintenance staff.
In this paper we propose a simplified representation of patterns within historical faults database, which facilitates visualization of association rules using Bayesian Networks. Our approach is based on exploring the failure history and detecting correlations between different features available in those records. We show that a small subset of the most interesting rules is enough to obtain a good and sufficiently accurate approximation of the original dataset. A Bayesian Network created from those rules can serve as an easy to understand visualization of the most relevant failure patterns. In addition, by varying the threshold values of support and confidence that we consider interesting, we are able to control the tradeoff between accuracy of the model and its complexity in an intuitive way.

Submission 3
Benjamin Vedder, Jonny Vinter and Magnus Jonsson
Title: A Testing Platform for Fault-Tolerant Intelligent Vehicles Applied on Physical and Simulated Quadcopters
Abstract:
Testing and evaluating fault tolerance of intelligent flying vehicles is complex and there is a need for the right set of tools. In this paper we report the experience of using our testing platform based on FaultCheck and QuickCheck on a quadcopter system. The quadcopter system consists of several quadcopers, a custom localization system and a simulator. The simulator shares much code with the embedded implementation and emulates both the quadcopters and the localization system. A

collision-avoidance mechanism based on risk contours is implemented on each quadcopter to avoid collisions. We show how to derive realistic fault models from the hardware quadcopters, and how to inject faults in the simulator using FaultCheck, while using QuickCheck to automatically generate test cases. Further, we have developed a motor controller test bench with fault injection support to test functional and safety requirements of motor controllers for quadcopters and other electric vehicles.

Submission 4
Adam Duracz
Title: A Semantic Account of Hybrid Systems
Abstract:
Both language semantics and verification methods aim to improve engineering processes by making it possible to specify and achieve the correctness of engineering products. Semantics and verification have intersected in discrete domains. However, their coverage of continuous or hybrid (continuous/discrete) is currently limited to verification methods. Moreover, the current formulations of hybrid systems in the verification community are either algorithmic (based on automata) or logical (based on notions of acceptable trajectories), rendering them somewhat distant from the contemporary focus of semantics on denotational and operational questions.
To help bridge this gap, this paper presents a semantic treatment of hybrid systems, consisting of an operational semantics and a denotational semantics, and basic theorems that establish the fundamental connection between the two. We then show how this semantic framework can be used to provide more insight into a recently proposed method for dealing with a core problem of hybrid systems, namely, Zeno behavior.

Submission 5
Susanne Lindberg, Petra Svedberg and Jens Nygren
Title: Evaluating with Sensitive Context Awareness: Involving Children in the Evaluation of a Digital Health Promoting Service
Abstract:
Performing evaluations in sensitive contexts with vulnerable participants is inherently difficult, and little researched. We have designed a prototype of a digital peer support service for children cured from cancer and need to ensure that the design meets the users' requirements. We report on how we evaluated this prototype together with children between 8-12. We present a framework for sensitive context awareness in the evaluation of digital artefacts. Challenges that are identified include the varying abilities of participating children, the difficulty in accessing participants, the risk of cognitive overload and necessity of building trust.

Submission 6
Sebastian Kunze
Title: Characterising Structural Changes using Differential Symbolic Execution
Abstract:
Validation and verification of Software Product Lines is particularly challenging due to their huge configuration space. Any approach to save analysis effort for Software Product Lines can have a major effect in the development cost and effort. Therefore, we propose an approach to avoid redundant analysis in Software Product Lines which uses Differential Symbolic Execution, an automated technique for proving functional be- havioural equivalence based on satisfiability module theories. The approach identifies the behavioural difference of one software product relative to another and exploits it in order to establish an efficient model-based testing trajectory.

Submission 7
Vanderson Hafemann Fragal, Adenilso Da Silva Simão and André Takeshi Endo
Title: Reducing Concretization Effort in Software Product Lines
Abstract:
In the Model-Based Testing approach, test cases are concretized to be executed in an implementation for conformance testing. In general, the concretization cost of a test case is greater than the execution cost, since it is usually a human intensive activity. Regression testing has been used to reduce test effort of Software Product Lines (SPLs). In this context, incremental testing concepts can be combined to reduce the amount of new tests that need to be concretized for new products. This paper presents an incremental regression-based SPL testing strategy, which can reduce the total concretization cost of a set of SPL products. The generation method P is used to increment existing tests for new products considering Finite State Machines test models. An experimental study was conducted to evaluate the strategy against other two regression-based SPL strategies. The results show a meaningful reduction of total test concretization cost.

Submission 8
Alexey Vinel, Lin Lan and Nikita Lyamin
Title:Vehicle-to-Vehicle Communication in C-ACC/Platooning Scenarios
Abstract:
Cooperative adaptive cruise control (C-ACC) and platooning are two emerging automotive intelligent transportation systems (ITS) applica- tions. In this tutorial article we explain their principles, describe related ongoing standardiza- tion activities, and conduct performance evaluation of the underlying communication technology.

Submission 9
Maria Luiza Recena Menezes
Title:Person Aware Ambient Intelligence
Abstract:
Abstract—Ambient Intelligence refers to environments equipped with sensors, controllers, human-machine interfaces and actuators that are able to sense, interact and adapt to the user. Using the concept of Ubiquitous Computing envisioned by Mark Weiser, such interaction should be done seamlessly. But one main challenge that we see in the accomplishment of this ideal, is the communication channel between the user and the intelligent environment. In this paper we survey about different forms of interaction with such a system and it's applications, including some of the technologies used.

Submission 10
Mahsa Varshosaz and Mohammadreza Mousavi
Title:Input Output Conformance Testing using QuickCheck
Abstract: Model based testing has become common practice for testing software systems. Input output conformance (ioco) testing is a well-known model-based testing approach. We use QuickCheck, a promising model-based testing tool that has been used for testing several industrial cases, to check ioco conformance between given specifications and implementations.

Submission 11
Hawar Ramazanali, Agapi Mesodiakaki and Alexey Vinel
Title:User Association in 5G HetNets
Abstract:

Heterogeneous networks (HetNets) are considered a key enabling technology to provide high capacity for next generation, also known as fifth generation (5G), networks. However, in order to efficiently exploit the advantages of HetNets and strive towards high network efficiency, efficient user equipment (UE) association is decisive for targeting network performance goals. To that end, in this work, user association algorithms are classified based on the criterion they use for association with the base stations (macrocells or small cells). Special focus is given on the suitability of the user association algorithms for 5G as well as their complexity.

Submission 12
Yuantao Fan
Title:A Self-Organized Approach for Predicting Compressor Faults in a City Bus Fleet
Abstract:
Managing the maintenance of a commercial vehicle fleet is an attractive application domain of ubiquitous knowledge discovery. Cost effective methods for predictive maintenance are progressively demanded in the automotive industry. The traditional approach for developing diagnostic methods on commercial vehicles is heavily based on knowledge of human experts, and thus it does not scale well to modern vehicles with many components and subsystems. A more autonomous approach must be developed.
In previous work we have presented a generic self-organising approach called COSMO that can detect, in an unsupervised manner, many different faults. In a study based on a commercial fleet of 19 buses operating in Kungsbacka, we have been able to predict, for example, fifty percent of the compressors that break down on the road, in many cases weeks before the failure.
In this paper we employ two models for representing the signal, histograms and Recurrent Neural Network, in detecting compressor failures. Moreover, we compare those results with a state of the art approach currently used in the industry, and we investigate how features suggested by experts for detecting compressor failures can be incorporated into the COSMO method. We perform several experiments, using both real and synthetic data, to identify issues that need to be considered to improve the accuracy. The final results show that the COSMO method outperforms the expert method. Last but not least, we compare all those results with several traditional supervised learning method using all extracted features from on-board sensor stream.

Submission 13
Maytheewat Aramrattana, Tony Larsson, Jonas Jansson and Arne Nåbo
Title:Extended Driving Simulator for Evaluation of Cooperative Intelligent Transport Systems
Abstract:
Vehicles in cooperative intelligent transport systems (C-ITS) often need to interact with each other in order to achieve their goal, which is to create safe and efficient services. Since human drivers are involved, driving simulators are appropriate simulation tools for evaluation of the C-ITS functions. However, driving simulators often do not consider interactions or influences from the ego vehicle on the traffic. Neither it support vehicle-to-vehicle and vehicle-to-infrastructure (V2X) communication, which is the main enabler for C-ITS. Therefore, to increase the C-ITS evaluation capability, a proposal how to extend a driving simulator with traffic and network simulators to handle cooperative systems is presented in this paper. The results aim to answer two research questions: a) how feasible is this approach with respect to evaluation of C-ITS? and b) what are the limitations and problems of this approach?

Submission 14
Le-Nam Hoang, Elisabeth Uhlemann and Magnus Jonsson

Title: A Framework for Reliable Exchange of Periodic and Event-Driven Messages in Platoons
Abstract:
Platooning is widely considered a promising approach to decrease fuel consumption by reducing the air drag. However, in order to achieve the benefits of aerodynamic efficiency, the inter-vehicle distances must be kept short. This implies that the intra-platoon communication must not only be reliable but also able to meet strict timing deadlines. In this paper, we propose a framework that reliably handles the co-existence of both time-triggered and event-driven control messages in platooning applications and we derive an efficient message dissemination technique. We propose a semi-centralized time division multiple access (TDMA) approach, which e.g., can be placed on top of the current standard IEEE 802.11p and we evaluate the resulting error probability and delay, when using it to broadcast periodic beacons and disseminating event-driven messages within a platoon. Simulation results indicate that the proposed dissemination policy significantly enhances the reliability for a given number of available time-slots, or alternatively, reduces the delay, in terms of time-slots, required to achieve a certain target error probability, without degrading the performance of co-existing time-triggered messages.

Submission 15
Suleyman Savas
Title: Parallel QR Decomposition on Epiphany Architecture
Abstract:
Parallel computer architectures have become mainstream, however, implementation of parallel applications are still challenging. Therefore, there is a need for new tools, languages and programming models. Additionally, there is a lack of knowledge about the performance of the different parallel approaches of basic but important operations, such as the QR decomposition of a matrix, on current commercial manycore architectures.
This paper evaluates a high level dataflow language, a source-to-source compiler and three different parallel approaches of QR decomposition on a manycore architecture. The dataflow language is CAL actor language and the source-to-source compiler is Cal2Many, which takes CAL code as input and generates native code for several different architectures including the Epiphany architecture. Different QR decomposition approaches such as Givens Rotations, Householder and Gram-Schmidt are implemented both in CAL and C languages and executed on Epiphany architecture. Householder approach outperforms the other approaches while using the most resources. When the resources are taken into account, Given Rotations shows a performance close to the Householder.
The performance of the CAL (generated C) implementations gets as good as 4\% slower than the hand-written versions with one exception where the generated implementation is 65\% slower. CAL implementations require an average of 33\% less source line of code and approximately half the development time and effort.

Submission 17
Siddhartha Khandelwal and Nicholas Wickström
Title: Gait Event Detection in Real-World Environment for Long-Term Applications: Incorporating Domain Knowledge into Time-Frequency Analysis
Abstract:
Detecting gait events is the key to many gait analysis applications that would benefit from continuous monitoring or long-term analysis. Most gait event detection algorithms using wearable sensors that offer a potential for use in daily living have been developed from data collected in controlled indoor experiments. However, for real-word applications, it is essential that the analysis is carried out in humans' natural environment; that involves different gait speeds, changing walking terrains, varying

surface inclinations and regular turns among other factors. Existing domain knowledge in the form of principles or underlying fundamental gait relationships can be utilized to drive and support the data analysis In order to develop robust algorithms that can tackle real-world challenges in gait analysis. This paper presents a novel approach that exhibits how domain knowledge about human gait can be incorporated into time-frequency analysis in order to detect gait events from long-term accelerometer signals. The accuracy and robustness of the proposed algorithm are validated by experiments done in indoor and outdoor environments with approximately 93,600 gait events in total. The proposed algorithm exhibits consistently high performance scores across all datasets in both, indoor and outdoor environments.

Submission 18
Sebastian Raase
Title: A Dataflow Communications Library for Adapteva's Epiphany
Abstract:
Adapteva's Epiphany platform is a scalable low-power manycore architecture. Even though Adapteva provides an ANSI C compatible compiler and runtime as well as a Software Development Kit (eSDK), developing for this platform is not particularly easy. At Halmstad University, we are interested in dataflow applications and have developed a suitable communications library (e-commlib) for the Epiphany, which we would like to release to the public domain. Given sufficiently aware compute kernels, e-commlib projects can also be compiled and run in a Linux-pthreads environment, which simplifies both development and (functional) debugging. This Technical Report shall document both e-commlib (version 3) and our surrounding infrastructure.

Submission 19
Jennifer David
Title: Multi-Vehicle Task Allocation with Conflict Resolution
Abstract:
General methodologies used for multi vehicle planning usually trades off between optimality and computational complexity. The idea of using task allocation methods for multi-vehicle planning is complete and less computational with near optimal solutions. In this paper, a multi-robot task allocation method coupled with trajectory planning is introduced. This problem specifically addresses the needs of task scheduling of containers with AGVs in a ship-container terminal area. This approach reduces conflict/collision avoidance between the vehicles by taking into account path planning during task allocation, thus reducing the complications that arise in dynamic trajectory planning. The problem is formulated as a constrained-based optimization problem treating the path planning problem as a set of temporal and spatial constraints and is solved using an MILP solver.

Submission 20
Iulian Carpatorea and Slawomir Nowaczyk
Title: APPES Maps: Extracting features for correlating driver behavior to fuel consumption
Abstract:
In this paper we present a continuation of the work of using APPES maps for extracting useful information regarding driver behavior and performance during normal truck driving operations. We propose to use APPES maps to transform data in a way that can be used to understand and classify driver maneuvers with respect to some criterion. The main interest is the relation between driver and fuel consumption, therefore our choice of a criterion must be fuel consumption. By using fuel consumption as a criterion we can divide our data in multiple classes which gives a way for interpreting the usefulness of our method. We investigate the relation between fuel and driver by extracting short

term driving maneuvers from APPES maps that can be used as input for the classifier. We can use these maneuvers to classify drivers; however a problem for the future is to sort out which of them are due to driver and which are due to other factors, such as traffic or truck characteristics. The frequency of the maneuvers also play an important role as they can be seen as weight for the importance of that maneuver.

Submission 21
Marcus Larsson, Magnus Jonsson, Fredrik Warg and Kristian Karlsson
Title: A Data Age Dependent Broadcast Forwarding Algorithm for Reliable Platooning Applications
In this paper we propose a broadcast message forwarding algorithm for V2V communication in a platooning scenario for heavy duty trucks. The algorithm utilizes link information, which is piggybacked on the original data packet, to estimate which nodes are best suited to forward the packet. The aim is to reach all nodes in the platoon with as few forward messages as possible in order to avoid channel congestion. The algorithm is evaluated by simulation using real world V2V measurement data as input. We show that the algorithm performs almost as good as two ETSI standardized forwarding algorithms with respect to keeping the data age for the entire platoon at a low level. But when it comes to keeping the message intensity low, our algorithm outperforms the better of the ETSI algorithms by 35%.

Guest presentation
Denis Kleyko
Abstract:
The presentation describes a comparison of different machine learning algorithms for vehicle classification according to the “Nordic system for intelligent classification of vehicles” standard using measurements of road surface vibrations and magnetic field disturbances caused by vehicles. The considered algorithms are logistic regression, neural networks, and support vector machines. They were evaluated on a large dataset consisting of 3074 samples. Hence, a good estimate of the actual classification rate was obtained. The results show that for the considered classification problem the logistic regression is the best choice with the overall classification rate of 93.4%.