

EcoCloud e-newsletter

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Welcome Message from the Executive Committee

Welcome to the 2017 edition of our newsletter. In this edition we bring to you a snapshot of our latest activities and accomplishments by our community members. We started 2017 with the same enthusiasm, energy and momentum we had at the end of 2016 with many new funded projects, sponsored events on campus, two visiting scholars, and a rousing line-up of industry speakers for our upcoming annual event. We look forward to seeing you at the annual event.

In the News

2017 EcoCloud Annual Event Around the Corner

Please join industry experts from HP Enterprise, Google, IBM, Microsoft, and Xilinx and EcoCloud researchers to share insights on future data and cloud computing platforms on **June 12th and 13th, 2017 at the sixth EcoCloud annual event at the Royal Savoy Hotel in Lausanne, Switzerland**. You can find more information on the event including agenda and speakers' information [here](#).

ByzCoin to Accelerate Bitcoin Transactions

Bryan Ford has developed an innovative and effective solution to counter delays, inconsistencies and attacks encountered by users of the increasingly popular virtual currency Bitcoin. Dubbed **ByzCoin**, the solution is inspired by protocols such as Practical Byzantine Fault Tolerance (PBFT). It is based on the idea that an active group of Bitcoin miners using novel cryptographic algorithms work collectively on the transaction blocks that, once verified, are added to the

blockchain – the Bitcoin network’s public ledger. The miners would only require the approval of two-thirds of other members of their group for each transaction to be processed. This approach would guarantee a higher level of consistency within the blockchain and allow transactions to be irreversibly confirmed within seconds. Accelerated confirmation would mitigate dishonest practices such as double spending and selfish mining.

[David Atienza Hosts DATE 2017](#)

David Atienza hosted the 20th edition of the Design Automation and Test in Europe (DATE) Conference at SwissTech from March 27th to 31st. The conference, traditionally alternating between Dresden (Germany) and Montpellier (France) came to Switzerland for the first time and was attended by more than 1400 people and 21 exhibiting companies from over 50 countries in the world. As a sponsor, EcoCloud organized a technical session with our industrial partner, Microsoft. The session focused on challenges associated with server benchmarking using CloudSuite 3.0, and data protection in rack-scale architectures using Catapult. The demos provided further hands-on experience on the topics discussed during the technical session on prototyping communication mechanisms in rack-scale architectures using FPGA's. You can find more information on DATE [here](#).

[Martin Jaggi Hosts Applied Machine Learning Days](#)

Martin Jaggi and fellow computer science professors Robert West and Marcel Salathé co-chaired the very first Applied Machine Learning Days at EPFL on January 30th and 31st 2017 at SwissTech. The event hosted more than 450 participants and gave an opportunity to industrial experts as well as academic researchers to share valuable insights on the role and future of artificial intelligence. More information on the EcoCloud co-sponsored event can be found [here](#).

[RTS 1 Hosts Rachid Guerraoui & Martin Jaggi](#)

Rachid Guerraoui and Martin Jaggi independently appeared on Swiss Radio and TV RTS 1 to discuss the history and origin of algorithms and artificial intelligence. The programs are in French and can be found [here](#) and [here](#).

[Ten Swiss Joint Research Center Projects Launch at Workshop](#)

Researchers from EPFL, ETH Zurich and Microsoft Research – all partners of the Swiss Joint Research Center (Swiss JRC) – assembled for a workshop at the UK-based Microsoft Research Cambridge Lab in February.

During the workshop, the researchers presented the **10 projects selected for funding by the Swiss JRC steering committee**. The selection was made on the basis of the projects' intellectual merit, potential scientific and societal impact and evidence of strong collaborative interest between the project partners

Four of the projects bring together researchers from ETH Zurich and Microsoft Research. The six projects between EPFL and Microsoft Research are: Towards Resource-Efficient Data Centers; Near-Memory System Services; Coltrain: Co-located Deep Learning Training and Inference; From Companion Drones to Personal Trainers; Revisiting Transactional Computing on Modern Hardware, and Fast and Accurate Algorithms for Clustering.

Visiting Scholars

We are delighted to host Ayse Kivilcim Coskun and Ashvin Goel as visiting scholars. Ayse is an associate professor in the Electrical and Computer Engineering Department at Boston University with research focus on energy awareness in computing systems, computer architecture, embedded systems, and efficient management in data centers and the cloud. Ashvin is an associate professor in the Electrical and Computer Engineering Department at the University of Toronto. His research interests are on operating systems, with a focus on dependability and performance of software systems.

New Projects

Applied Machine Learning

EPFL's Laboratory for Information and Inference Systems (LIONS), led by Volkan Cevher, is to receive funding from the Swiss National Science Foundation (SNSF) for its research project "Theory and Methods for Accurate and Scalable Learning Machines".

The project focuses on applying machine learning – the ability of computers to learn from data – to the design of the next generation of online education

systems. The researchers' goal is to automatically adapt such systems to the background, skills and learning style of students to improve the delivery of knowledge.

Effects as Implicit Capabilities

A project aiming to investigate an approach to effect checking that is fundamentally different from previous research is to receive funding from the Swiss National Science Foundation. To understand a program that makes use of effects – the interaction of a procedure with its environment in a way that goes beyond just taking arguments and producing a result – its execution history must be taken into account.

The central idea of the research, headed by the Programming Methods Laboratory, is to talk about capabilities instead of effects. For example, instead of saying a function “throws an IOException”, the researchers will use the approach that the function “needs the capabilities to throw an IOException”. The research will explore the ideas of effects as capabilities in detail. On the basis of the theoretical modeling, they will develop a specification and implementation for adding effects to the programming language Scala in order to validate them. Scala, like most languages, does not currently track effects. The researchers will need to investigate how effects can be gradually migrated to an existing codebase and library ecosystem. As Scala runs on host languages such as Java or JavaScript, they will also examine how those techniques can be extended to a multi-language environment.

Out-of-Core Graph Processing

The Swiss National Science Foundation (SNSF) has awarded a grant to a big data project at EPFL's **Operating Systems Laboratory (LABOS)**. Entitled “Building Flexible Large-Graph Processing Systems on Commodity Hardware”, the project aims to advance the state of the art in graph processing.

A great variety of information is naturally encoded as graphs. Large graphs are present in social networks as well as many other applications, including biology, forensics and logistics. Yet many first-generation graph processing systems are inflexible, restricting users to a particular environment and computation on static graphs.

The LABOS researchers, led by Willy Zwaenepoel, will build on their earlier work on out-of-core graph processing systems. Their project will involve building systems that scale gracefully between memory and storage and are capable of dealing with dynamic graphs. The research team also intends to further optimize out-of-core performance, in terms of both performance and capacity.

Programming Language Abstractions for Big Data

The Swiss National Science Foundation (SNSF) is to fund a project to research ways to better express and export fundamental programming abstractions used in the interfaces between databases and programming languages.

Scala is the programming language of choice for many of the most popular and innovative big data frameworks and is used by hundreds of thousands of developers worldwide. A general trend of increasing confluence of programming and database technologies is currently built on shaky foundations. Interfaces between programming and databases are poorly understood, hard to maintain, and not future proof.

The project, led by Martin Odersky of the Programming Methods Laboratory, will explore three orthogonal research areas. The first concerns projecting data and will involve investigating how generic programming abstractions can best be embedded in Scala. The second focuses on projecting control by embedding easy-to-use yet hard-to-abuse meta-programming techniques. The third area of research concerns distributed programming abstractions.

Awards

Conference Awards

Doctoral student David Kozhaya received the Best Presentation Award at the IEEE International Real-Time System Symposium in Portugal in December 2016. David's presentation was based on his paper "**Right On Time Distributed Shared Memory**", which he co-authored with Rachid Guerraoui – who heads the Distributed Programming Laboratory – and ABB corporate researcher Yvonne-Anne Pignolet-Oswald. The paper explores the construction of a shared memory abstraction as a first step towards satisfying the growing demand for real-time data storage in distributed control systems (DCSs). Real-time DCS guarantees is particularly challenging as more and more sensor and actuator devices are

connected to industrial plants and message loss must be taken into account. Find out more [here](#).

Georgios Chatzopoulos, a student from EPFL's Distributed Programming Laboratory, received the Best Paper Award at the 17th ACM/IFIP/USENIX International Middleware Conference in Italy in December 2016. The winning paper, "**Locking Made Easy**", presents GLS, a middleware designed to simplify and increase the efficiency of lock-based programming, which protects shared data from concurrent accesses. GLS is based on the generic lock algorithm GLK. It offers debugging options for detecting various lock-related issues such as deadlocks. Rachid's team evaluated GLS and GLK on two modern hardware platforms, using several software systems. They demonstrated how GLK improves performances of the systems by an average 23% compared to their default locking strategies.

A two-part paper by Jason Parker from Volkan Cevher's Laboratory for Information and Inference Systems (LIONS) at EPFL has won the 2016 IEEE Signal Processing Society Best Paper Award. The papers, "**Bilinear Generalized Approximate Message Passing – Part I: Derivation**" and "**Bilinear Generalized Approximate Message Passing – Part II: Applications**", were published in IEEE Transactions on Audio, Speech and Language Processing, Volume 62, N° 22 in November 2014. The award ceremony took place at the 2017 IEEE International Conference on Acoustics, Speech, and Signal Processing in New Orleans, USA in March.

Faculty Awards

EcoCloud professor David Atienza received an ERC Consolidator Grant for his research proposal "COMPUSAPIEN: Computing Server Architecture with Joint Power and Cooling Integration at the Nanoscale". COMPUSAPIEN's focus is the design of a three-dimensional computing server inspired by the mammalian brain. The project will involve developing and integrating breakthrough innovations in heterogeneous computing architecture, cooling-power subsystem design, combined microfluidic power delivery and temperature management in computers. The integrated electronic-electrochemical design is expected to result in drastic energy savings and guarantee energy scalability in future server architectures. David Atienza's biography is available [here](#).

EcoCloud professor Volkan Cevher received an ERC Consolidator Grant for his research proposal "Time-Data Trade-Offs in High-Dimensional Statistical Learning

via Convex Optimization". Computational power is growing slowly in relation to data sizes; consequently, large-scale problems require a long time to solve. Volkan's research will explore and build on an emerging perspective that holds that data should be treated as a resource to be traded off with other resources, such as running time. It is the first research project that aims to establish time-data trade-offs while characterizing their optimality. It is expected to change the way data is treated in statistical sciences and promises substantial computational flexibility for data-driven learning. Volkan Cevher's biography is available [here](#).

Martin Jaggi is a recipient of the prestigious 2016 Google Faculty Research Award for his proposal on "A Computational View on Sentence Embedding". Martin and his team will attempt "to improve the quality, the computational performance and the theoretical understanding of learning representations for sequences of words from unsupervised machine training". You can find more information on Martin's work [here](#). The **Google Faculty Research Award** funds "world class technical research in computer science, engineering and related fields".

Student Awards

Baris Kasikci received the **Patrick Denantes Memorial Prize 2016** for his PhD thesis **Techniques for Detection, Root Cause Diagnosis, and Classification of In-Production Concurrency Bugs**. Concurrency bugs are at the heart of some of the worst software bugs. They can slow down software development by weeks or even months, as they are difficult to identify and fix. Baris' thesis introduces techniques to automatically detect concurrency bugs during production and identify the root causes of in-production failures – particularly those caused by concurrency bugs. It also explores a technique that automatically classifies a data race based on its potential consequence. The thesis was developed in EPFL's **Dependable Systems Laboratory** under George Candea. A toolchain built to implement the techniques demonstrated their effectiveness, accuracy and precision.

Publications

Analytics, Control, IoT and Optimization

- **Adaptive-rate Reconstruction of Time-varying Signals with Application in Compressive Foreground Extraction**, João F. C. Mota, et al. IEEE Trans. Signal Processing 2016.

- **A Distributed Mining Framework for Influence in Evolving Entities**, Tian Guo, Karl Aberer. EDBT 2016.
- **A Parametric Nonconvex Decomposition Algorithm for Real-time and Distributed NMPC**, J.-H. Hours and C. N. Jones. In IEEE Transactions On Automatic Control 2016.
- **A Single-phase, Proximal Path-following Framework**, Quoc Tran-Dinh, Anastasios Kyrillidis, Volkan Cevher. CoRR 2016.
- **Binary Sparse Coding of Convolutive Mixtures for Sound Localization and Separation via Spatialization**, Afsaneh Asaei, et al. IEEE Trans. Signal Processing 2016.
- **Computational Methods for Underdetermined Convolutive Speech Localization and Separation via Model-based Sparse Component Analysis**, Afsaneh Asaei, et al. Speech Communication 2016.
- **Contextualized Ranking of Entity Types Based on Knowledge Graphs**, Alberto Tonon, et al. J. Web Sem. 2016.
- **Controller Design and Value Function Approximation for Non-linear Dynamical Systems**, M. Korda, D. Henrion and C. Jones. Automatica 2016.
- **Converse Bounds for Noisy Group Testing with Arbitrary Measurement Matrices**, Jonathan Scarlett, Volkan Cevher. ISIT 2016.
- **Convex Block-sparse Linear Regression with Expanders – Provably**, Anastasios Kyrillidis, et al. AISTATS 2016.
- **Detection of Hypoglycemic Events through Wearable Sensors**, Jean-Eudes Ranvier, et al. SEMPER@ESWC 2016.
- **Distributed Synthesis and Stability of Cooperative Distributed Model Predictive Control for Linear Systems**, C. Conte, C. Jones, M. Morari and M. N. Zeilinger. Automatica 2016.
- **Energy vs. Reliability Trade-offs Exploration in Biomedical Ultra-low Power Devices**, Loris Duch, et al. DATE 2016.
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- **Learning-based Compressive Subsampling**, Luca Baldassarre, et al. J. Sel. Topics Signal Processing 2016.
- **Learning Data Triage: Linear Decoding Works for Compressive MRI**, Yen-Huan Li, Volkan Cevher. ICASSP 2016.

- **Limits on Sparse Support Recovery via Linear Sketching with Random Expander Matrices**, Jonathan Scarlett, Volkan Cevher. AISTATS 2016.
- **Lower Bounds on Active Learning for Graphical Model Selection**, Jonathan Scarlett, Volkan Cevher. CoRR 2016.
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- **Phase Transitions in Group Testing**, Jonathan Scarlett, Volkan Cevher. SODA 2016.
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- **Time-varying Gaussian Process Bandit Optimization**, Ilija Bogunovic, Jonathan Scarlett, Volkan Cevher. AISTATS 2016.
- **Touch-based System for Beat-to-beat Impedance Cardiogram Acquisition and Hemodynamic Parameters Estimation**, Dionisije Sopic, et al. DATE 2016.
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- **Wearable System for Real-time Screening of Obstructive Sleep Apnea**, G. Surrel, F. J. Rincon Vallejos, S. Murali and D. Atienza Alonso. Low-Power IEEE Computer Society Annual Symposium on VLSI 2016.

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- **Cheap Data Analytics Using Cold Storage Devices**, Renata Borovica-Gajic, Raja Appuswamy, Anastasia Ailamaki. PVLDB 2016.
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- **More than a Network: Distributed OLTP on Clusters of Hardware Islands**, Danica Porobic, Pinar Tözün, Raja Appuswamy, Anastasia Ailamaki. DaMoN 2016.
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- **OLTP on a Server-grade ARM: Power, Throughput and Latency Comparison**, Utku Sirin, Raja Appuswamy, Anastasia Ailamaki. DaMoN 2016.
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- **Space Odyssey: Efficient Exploration of Scientific Data**, Mirjana Pavlovic, et al. ExploreDB@SIGMOD/PODS 2016.
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Programming Models & Scalability

- **The Essence of Dependent Object Types**, Nada Amin, et al. A List of Successes That Can Change the World 2016.

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- **Exploiting CPU-load and Data Correlations in Multi-objective VM Placement for Geo-distributed Data Centers**, Ali Pahlevan, Pablo Garcia Del Valle, David Atienza. DATE 2016.
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- **Introduction to the Special Issue on PPOPP'14**, James R. Larus, Sandhya Dwarkadas, José E. Moreira, Andrew Lumsdaine. TOPC 2016.
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Security & Privacy

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- **Managing Identities Using Blockchains and CoSi**, L. Kokoris-Kogias, L. Gasser, I. Khoffi, P. Jovanovic and N. Gailly et al. HotPETs 2016.
- **Open, Privacy-preserving Protocols for Lawful Surveillance**, Aaron Segal, Joan Feigenbaum, Bryan Ford. CoRR 2016.
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- **Riffle: An Efficient Communication System with Strong Anonymity**, Albert Kwon, David Lazar, Srinivas Devadas, Bryan Ford. PoPETs 2016.

- **The Curious Case of the PDF Converter that Likes Mozart: Dissecting and Mitigating the Privacy Risk of Personal Cloud Apps**, Hamza Harkous, CoRR 2016.