Machine Learning Workshop

CSEM Neuchâtel, February 4th 2016

Dr. Mario El-Khoury

CEO Centre Suisse d'Electronique et Microtechnique (CSEM) SA, Neuchâtel
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52 ans, études d'ingénieur en électricité à l'EPFL et CMU (Carnegie Mellon University – Pittsburgh), titulaire d'un doctorat en automatique de l'EPFL et détenteur d'un MBA depuis 2000.
Dr. Mario El-Khoury a passé l'essentiel de sa carrière dans la recherche appliquée en milieu in-dustriel. Il a rejoint le CSEM en 1994 en tant que responsable du secteur d'activité *Contrôle industriel*. Nommé membre de la direction, il a repris la tête de la division *Ingénierie des Systèmes* en 2003 et a été promu Directeur des Opérations en septembre 2008.
En novembre 2009, M. El-Khoury a été nommé Directeur général du CSEM.
M. El-Khoury a beaucoup contribué à la notoriété et au développement des collaborations entre l'industrie et le CSEM.
Il est auteur et co-auteurs de plusieurs articles scientifiques et brevets. Ses travaux ont été primés à plusieurs reprises.

Welcome from CSEM SA

Dr. Christian Bosshard

Vice-President Thin Film Optics CSEM SA, Muttenz BL
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Dr. Christian Bosshard is managing the Thin Film Optics Division of CSEM in Muttenz. He received his degree in Physics (1986) and his doctorate (1991, Silver medal award) from ETH. Christian Bosshard is a Fellow of the Optical Society of America (OSA), coordinator for CSEM in the Heterogeneous Technology Alliance (HTA), Managing Director and board member of Swissphotonics.

Swissphotonics Welcome and Program

Dr. Amina Chebira

Project Manager at CSEM SA, Neuchâtel
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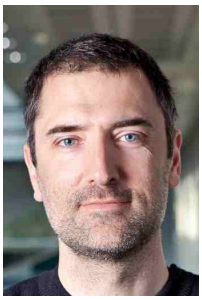
Dr. Amina Chebira is a project manager at the Swiss Center for Electronics and Microtechnology (CSEM) in Neuchâtel. In 1998, she obtained a Bachelor degree in mathematics from University Paris 7 Denis Diderot. She received the B.S. and M.S. degrees in Communication Systems from the EPFL in 2003 and the PhD. degree from the Biomedical Engineering Department, Carnegie Mellon University, Pittsburgh in 2008, for which she received the biomedical engineering research award. She then held a Postdoctoral Researcher position with the Audiovisual Communications Laboratory, EPFL, from 2008 to 2012. Her expertise lies in extracting information and knowledge from data (signal and image) processing, analysis and interpretation (pattern recognition, machine learning), and multiresolution representations.

Chair a.m.



Dr. François Fleuret

Head Computer Vision and Learning group IDIAP Research Institute, Martigny VS
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Dr. François Fleuret got the PhD degree in Mathematics from the University of Paris VI in 2000 and the Habilitation degree in mathematics from the University of Paris XIII in 2006. He is the head of the Computer Vision and Learning group at the Idiap research institute, and adjunct faculty at the EPFL. He is Associate Editor for the Transactions on Pattern Analysis and Machine Intelligence, and serves as Area Chair and in the program committees of top-tier conferences in Computer Vision and Machine Learning. His main research interest is the development of novel machine-learning approaches applied to computer vision, with a particular focus on their computational performance.

Exact Acceleration of Linear Object Detectors
Virtually every existing object detection method relies at its core on the intensive evaluation of large linear filters in a multi-scale sliding-window fashion. This is the case for Boosting and SVM-based detectors, but also for Deformable Part Models or *deep* convolution networks.

We will describe a general and exact method to considerably speed up this core operation. We propose clever implementation strategies to use the Fourier transform and obtain a speedup factor proportional to the filters' sizes. The gain in performance is demonstrated with Deformable Part Models on the standard Pascal VOC benchmark, where we accelerate the speed of said convolutions by an order of magnitude.

Prof. Dr. Marco Zaffalon

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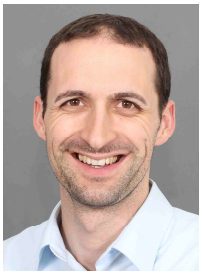
Prof. Marco Zaffalon is a professor at IDSIA where he leads the group on data mining and probabilistic methods. The group has hundreds of publications in the subject of algorithms for data mining, probability and statistics, filtering and control, and several applications of these methods to real-world problems (e.g., bioinformatics, decision support, business intelligence, finance, web and the news).

Innovation through algorithms that learn
This talk will first discuss what it means for a computer to learn from data or other sources of information. Then it will overview the research carried out at IDSIA (Dalle Molle Institute for Artificial Intelligence - Lugano) in the related fields of data mining/big data, image processing and decision support. After a brief description of the methods (e.g., probabilistic graphical models, neural nets, etc.), the talk will concentrate on their real-world significance by illustrating a number of applications IDSIA has made in collaboration with companies.



Dipl. Ing. FH Philipp Schmid

Section Head Robotics & Automation CSEM SA, Alpnach Dorf OW
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Philipp Schmid is Application Manager for Automation & Robotics at CSEM. He holds an engineering degree in Microtechnology (Dipl. Ing. FH) focused in Mechatronics, Automation and Robotics. Before joining the CSEM in 2006 he worked in several industrial automation companies and spent one year as research fellow at the ICT Robotics group (QCAT/CSIRO) in Australia. From his experience as Senior R&D engineer he gained a profound expertise in delivery of advanced solutions in robotics and automation to industry. Now he manages the research, development and industrialization of new technologies for automation applications.

Industrial Approach: Automated Fault Detection with 1-Dimensional Sensory Signals for Quality Inspection
Automated decision making in industrial processes is an important tool for reliable online inspection, quality assurance and early failure detection for predictive maintenance. CSEM developed a new automated fault detection method based on Deep Belief Networks (DBN) for 1-dimensional sensory signals (e.g. vibration, acoustic, analog measurements). Being a very popular research topic in machine learning society, the DBN generative nature enables itself a strong feature learning ability. Treating the fault detection as an anomaly detection problem the new approach allows learning sensory signals only from good samples, without any failure catalogue. The industrial approach is shown using the example of vibration inspection of electromotor. This method is beyond the state-of-art and has demonstrated clear improvements and advantages over standard accelerometer signal analysis techniques.

Dr. Christoph Harder

President Swissphotonics, Wollerau SZ
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Dr. Christoph S. Harder received the ETH Diploma in 1979 and the Master and PhD in EE in 1980 and 1983 from Caltech, Pasadena, USA. He is cofounder of the IBM Zurich Laser Diode Enterprise which pioneered the first 980nm high power pump laser for telecom optical amplifiers and laser diodes for industrial and consumer applications with ultrahigh reliability. He is the recipient of a Fulbright scholarship and the OSA Fellow recognition.
Christoph is now heading a consulting company and is cofounder of Swissphotonics and has been its president for the last few years.
He has published more than 100 papers and 20 patents and has held a variety of staff and management positions at ETH, Caltech, IBM, Uniphase, JDS Uniphase, Nortel and Bookham and has volunteered on society boards and committees.

Chair p.m.

Virginie Moser

Expert Vision Embedded Systems CSEM SA, Neuchâtel
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Virginie Moser was born in Switzerland in 1980. She studied computer science at EPFL from 2000 to 2005. She worked three years in the industry for a company that develops numeric commands for machines tools. Then she joined CSEM in 2008 where she worked three years on the development of a low power DSP processor. In addition to developing the instruction set simulator of the processor, she ported and parallelized many algorithms on it, for example FFT or denoising algorithms.
Since 2013 she is expert in vision system and she works mostly on vision algorithms and machine learning. She especially tries to improve those algorithms so that they can be implemented on small and low power platforms and thus bring vision to places where it was not possible before.

Vision algorithms on embedded platforms
Vision applications often require lots of computing needs. On the other hand, there are places where a vision application would be desired, but the computing means are limited. For example, if a detection algorithm has to be embedded on drones, the system must be cheap and small. A vision application could be deployed in a place where the access is difficult or where there is no power supply and thus must work on batteries. The system must therefore be low power.
This workshop presents different techniques for the implementation of detection algorithms on a very small platform. It will show how the speed and memory usage of different algorithms like Support Vector Machine (SVM) or Convolutionnal Neural Network (CNN) can be improved to be embedded on a small platforms.
This improvement will be illustrated through an application for cars and pedestrians detection that runs on CSEM's Vision In Package (VIP), the world's smallest vision system.

Dr. Reto Wyss

CTO and co-founder, ViDi Systems SA, Villaz-St-Pierre FR
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Dr. Wyss is CTO and co-founder of ViDi Systems SA. After studying physics at EPFL and ETH, he got his PhD from the Institute of Neuroinformatics (ETH/UNIZ) for the investigation of models about sensory and motor coding in biological system. After a PostDoc at Caltech he joined the CSEM in Alpnach in 2006, where he developed the visual inspection technology that was transferred in 2012 into the newly founded startup ViDi Systems.

Deep-Learning for real world inspection problems
Visual inspection is omnipresent in today's society. Be it for the visual examination of finished products in a manufacturing plant, the assessment of X-ray images in hospitals or the analysis of videos from security cameras. All of these inspection tasks have in common that it is often not clearly defined what needs to be found. Often the inspector is looking for some or multiple types of anomalies. Therefore, he is forced to look at many aspects at the same time, tolerate large - yet unimportant - variations in visual appearance and often faces borderline decisions because the anomaly is difficult to quantify and/or to compare to the acceptance criteria in place. As a consequence, this type of qualitative inspection is not very accurate when done by humans but at the same time sufficiently difficult to rule out automatic inspection with today's state-of-the-art machine vision technology. Building on recent advances in deep-learning and high performance computing, ViDi's inspection technology is filling this gap providing human like visual inspection abilities combined with the reliability and consistency of automated visual inspection systems.

Dr. Boris Ecker

Imaging Solutions Engineer Edmund Optics GmbH, Karlsruhe DE
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Edmund Optics has announced the addition of Dr. Boris Ecker, who, with the support of Edmund Optics' global team of imaging experts, will directly service the growing imaging and machine vision application needs of customers in Europe.
Ecker, who will serve as Imaging Solutions Engineer, is fluent in German and English, and holds a Ph.D. in physics, obtained for his work on high-energy lasers and plasma physics at the University of Mainz, Germany and the *GSI Helmholtzzentrum für Schwerionenforschung* in Darmstadt, Germany. Ecker has also worked as an optical designer in process analytics (NIR and Raman spectroscopy), having been responsible for creating optic designs, as well as managing the application requirements of domestic and international customer projects.
At Edmund Optics, Ecker will provide support and expertise to customers and partners regarding technical questions as well as assist with the implementation of vision projects. His primary focus will be to consult and recommend the selection of the appropriate optics, to provide detailed product specifications, and to create application-specific Zemax simulations as well as to conduct feasibility studies and product testing, according to Edmund Optics.
Boris Ecker joined the Edmund Optics Imaging team, headed by Greg Hollows in the corporate headquarters in Barrington, New Jersey, in the US, in January of 2015.

New Trends in Optics: Overcoming Depth of Field Limitations
The presentation will provide an overview of two exciting optical technologies and highlight their relevance to specific applications.
Electrically tunable lenses are a powerful tool for any application that deals with varying distances between the vision system and the objects under inspection. In Europe, there are two prominent companies whose products have proven that liquid lenses have matured and are suitable for industrial environments. Varioptic (France) is relying on electrowetting, whereas Optotune AG (Switzerland), uses tunable polymer lenses. In the presentation, both technologies and the respective products are introduced, followed by an overview of applications that benefit from their advantages and concluding with a quick glimpse on future developments.
Light Field Imaging (LFI) allows for capturing calibrated 3D images with a single shot of a single camera at video frame rates. The technology is based on positioning a micro lens array between the camera sensor and the imaging lens and relies on efficient algorithms to post-process the resulting image to extract the 3D information. This second part of the presentation focuses on the optical aspects of this technology and discusses applications that already today benefit from the possibilities granted by LFI.

Simon Gray

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Simon Gray joined CSEM in 2008 and is Head of Business Development in CSEM's Integrated and Wireless Systems Division.
Prior to joining CSEM he held senior positions in technical, marketing and general management roles in the semiconductor industry for companies including Philips, Xemics and Semtech.
He has a BSc in Physics from Nottingham University and an MBA from Open University.

CSEM Showroom Vist

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