Applications (CV + Transcript of records + Desired period to begin) must be sent to international@heig-vd.ch
Interns will receive free housing + payment of their basic expenses (400.-/month).
Internships normally last between 5 and 6 months. Some teachers may exceptionally accept shorter or longer ones.

CIVIL, ENVIRONMENTAL, BIO- ENGINEERING AND GEOMATICS		
Recycling in urban construction fields **Prof M. Viviani**	Urban mining is the process of reclaiming raw materials from wastes and exhausted industrial products. In the construction industry the concept of urban mining has been implemented mostly by deconstructing the buildings and reprocessing the separated materials in order to use them as a raw material in new constructions. Recycled concrete and recycled bitumen are two well-known examples. Although the recycling of the construction wastes have reached the imposing rate of 80% of the total, this figure is stable since many years. Furthermore, the excavated soil is often not included in the statistics of construction wastes and byproducts event thought its disposal is becoming increasingly difficult and costly. Aim of this project is to study the projects and the documents of two construction fields and determine how all the materials that have been disposed could have been valorized. A second aim of the project is to clarify the procedures that applies to each valorization possibility and how an architect/engineer could possibly include these valorization actions when the conception of the building begins. Keywords: urban mining, valorization, construction fields	**Students in Civil engineering and Material sciences with strong interest for lab tests and modelling**
Heat storage systems **Prof. M. Viviani**	The accumulation of heat in soil elements is a popular theme in architecture and engineering. Whereas many studies are available on the heat storage capacity of walls / renderings made of soil, a gap has been found in the literature on the possibility of regularizing the internal temperature of an house by a set of soil masses. The aim of this project is to determine the heat capacity of a specific soil and how much and how fast the heat can be charged in a soil element (mass). The project includes laboratory tests on soils specimens and in heat masses conditioned in laboratory. Keywords: urban mining, soil, heat storage.	**Students in Civil engineering and Material sciences with strong interest for lab tests and modelling**

Effect of biomass ashes in cement pastes and concrete **Prof. M. Viviani**	The number of biomass power plants is increasing since decades. The ashes produced during the burning process have to be disposed unless a valorization is found. Regulations for disposal and utilization of this ashes are very strict due to the presence in many ashes of hazardous substances such as chrome IV and heavy metals. The use of these ashes in concrete is possible but their effect on the hydration process of the cement, on the rheology and on the durability of concrete must be known. The aim of this process is twofold: study the effect of the ashes as they are produced and after a chemical treatment. The project includes laboratory test on cement pastes and mortars with techniques such as isothermal calorimetry and rheolometer. Keywords: valorization of byproducts, cement hydration, rheology of concrete	**Students in Civil engineering and Material sciences with strong interest for lab tests and modelling**
Test and simulation of a new generation of active substation for district heating (DH) **Dr. Alexis Duret**	This internship project will be done in the framework of an applied European research project call PACs-CAD (for "Use of sorption heat pump in substation to improve district heating energy efficiency"). The objective of this project is to develop and test in the laboratory a new generation DH substation integrating a sorption heat pump. This active substation should help to manage better the DH return temperature. This substation will also offer the opportunity to develop new energy services like cooling of buildings during summer. The objectives of this internship/master thesis are the following 1. run laboratory tests of the new generation of DH substation 2. develop a numeric model of the new substation 3. validation of the numeric model using the experimental results of the DH substation laboratory tests 4. evaluation of the economic interests of the new substation concept for different operating modes (reduction of DH return temperature, cooling in summer…)	**Keywords: District Heating, sorption heat pump, substation, building heating and cooling**
Simulations of renovation scenarios for the existing building stock **S. Lasvaux**	This internship will be conducted in the framework of "Robust-LCA" a research project funded by the Swiss National Science Fundation (SNSF). This project will analyze the cost-effectiveness of renovation scenarios of the Swiss residential building stock. This existing stock accounts for a large part of the energy consumption of buildings. Different renovation measures can be considered to minimize its energy consumption, running costs and the related greenhouse gas emissions (e.g., renovation of the building envelope, replacement of heating systems, integration of renewable energy production like PV systems). This project will use reference buildings from different construction periods to assess these different scenarios. The objectives of the internship are the following: 1. Set up of a database of renovation costs and environmental impacts 2. Definition of renovation strategies adapted to each construction period 3. Simulations of reference buildings' energy consumption before/after renovation 4. Assessment of the environmental and economic interests over the building life cycle using LCA and LCC methodologies The internship will work closely with the SNSF project's partners on each of the four points. The simulation procedure will integrate a probabilistic perspective by accounting for the variability of the different parameters used in the energy calculations as well as for the environmental and economic analyses (e.g. variability of renovation costs, climate data, service life of materials, evolution of energy costs).	**Keywords: Existing building stock, envelope, technical systems, Life Cycle Assessment (LCA), Life Cycle Cost (LCC) cost-effectiveness**

Optimization of energy production from biological waste trough anaerobic digestion **Prof. Dr.** **R. Roethlisberger**	As the world is facing a growing issue with climate change, alternative energy sources are becoming more and more prominent. Among them, anaerobic digestion is a carbon neutral way of converting organic waste into methane, while producing an organic-rich fertilizer. It thus perfectly falls within the concept of a circular economy. The Institute of Thermal Engineering (Institut de Génie Thermique, IGT) is active for several years in this research field. The IGT is particularly active on implementing findings from research laboratories into the field. Within the frame of the program Biosweet of the Swiss Competence Centre for Energy Research (SCCER) we are developing projects that aim: at optimizing pre-treatment of fibrous biomass such as manure (using grinding, organic acid and thermal treatments); at optimizing the digestion process through the usage of novel IR sensors; and at developing new concepts for the biogas upgrade (in combination with ash and/or microalgae). If you want to be integrated in one of these research topic, please feel free to contact us. Minimum duration 4 months, preferentially 6 months.	**Keywords: methanization, anaerobic digestion, pre-treatments, infra-red spectrometry, biogas upgrade** **Students in environmental engineering and/or in biotechnology, with strong interest for laboratory work**

MATHEMATICS, INFORMATION TECHNOLOGY AND COMMUNICATION (TIC)		
Platform applying Intelligent Signal Analysis to Gain Insights to Plant Electrophysiology **Prof. Laura Elena Raileanu**	Plant electrophysiology has been studied for decades but there are still substantial insights to be gained which will flow through to improved agriculture practices. For this industrial project, we developed a multi-channel plant electrophysiology biosensor; it will be used to collect dataset of under stress plants' electrical signal. Your task will be to apply signal-processing techniques on these datasets to extract features and then use intelligent data analysis algorithms on these features in order to predict if the plants are stressed and which kind of external stimuli are applied. The main goal of this project is to use plants as multiple stimuli sensing biological devices.	**Keywords: signal-processing, data analysis, machine learning, plants, electrical signal**
Improvement of user experience in a serious game authoring system and in existing serious games **Prof D. Jaccard**	We have developed a serious game authoring system and many different serious games (www.albasim.ch). Most of them may be improved from the user experience point of view.	**End of Bachelor or Master student in Computer sciences.**
Machine translation at the text level **Prof A. Popescu-Belis**	The goal of this internship is to study the combination of recent, deep learning approaches to machine translation (MT), with other recent approaches for coreference resolution, i.e. finding the words or phrases in a text that refer to the same entity. Knowledge of coreference is potentially useful for translating more coherently the referring expressions, but is hard to combine with neural MT. This internship will be devoted to the combination of the two architectures, based on existing	**Students with previous knowledge from courses in machine learning, neural networks,**

	systems, for instance by adopting a multi-task learning approach.	**human language technology or artificial intelligence**
Task-oriented chatbots using neural networks **Prof A. Popescu-Belis**	Recent neural network approaches to the design of chatbots have resulted in realistic conversational agents - using written, or sometimes spoken language. However, while these agents are trainable through conversations, it is difficult to connect these agents to knowledge bases, so that they perform useful tasks, such as question answering or database transactions. The internship will focus on a hybrid chatbot, which can switch between a conversational, NN-based model for the social aspects of an interaction, and a traditional, knowledge-based model for the task-oriented aspects. The second model could, for instance, perform community question answering, i.e. use existing answers to popular questions to answer new ones, assuming they are variants of existing ones.	**Students with previous knowledge from courses in machine learning, neural networks, human language technology or artificial intelligence**
Design and implementation of a physical object search application **Prof M. Rubinstein**	We are used to searching for infotmation using Google's, Yahoo's and other portals. In this project, the student will implement a demonstrator of a physical-world search engine using Open CV libraries or similar software. The prototype will return the physical location of an object whose name and/or characteristics are given to the search engine.	**Students with background in programming languages**
Study of 802.11ac and 802.11ad **Prof M. Rubinstein**	Wireless local area networks are based on the IEEE 802.11 standard and its amendments. Two recent amendments, 802.11ac and 802.11ad, increase the speeds up to the Gigabit/s range. In this project, the student will perform an experimental and bibliographical study of those two amendments.	**Keywords: WiFi, WLAN, 802.11, protocols, communications.**
Triggering System for Lightning Measurements **Prof M. Rubinstein**	A system to measure different parameters of lightning striking a tower in Switzerland has been in operation for 10 years. The system measured the lightning curret, it takes high-speed video of the lightning events, it measures the electric fields and even X-Rays from the lightning channel. In this project, the student will study the current system used to initiate all the measurements simultaneously when there is a lightning strike to the tower and he/she will propose solutions to improve its reliability and its cybersecurity performance.	**For students with a background in telecommunications . Experience with Raspberry Pi and electronics is a plus.**
Medical drug dosage adaptation software **Prof. Yann Thoma**	Tucuxi (http://www.tucuxi.ch) is a software that has been developed with the aim of helping the pharmacologists with the adaptation of medical drug dosages. The current system supports drugs with single analytes, but some medical drugs require multi-analytes models. The computing engine has been developed in C++, and the GUI in C++, with QML. The goal of this project is to adapt the current GUI to multi-analytes models, with a specific emphasis on the reliability of the system.	**Computer science or c. engineering students: C++ software development, expert system.**

Medical drug dosage adaptation server **Prof. Yann Thoma**	Tucuxi (http://www.tucuxi.ch) is a software that has been developed with the aim of helping the pharmacologists with the adaptation of medical drug dosages. The current system is composed of a computing backend and a GUI. The goal of the current project is to develop a server version. This REST server shall be able to answer questions a pharmacologist would have, such as : is this drug concentration measurement likely to be correct, what dosage should I propose for this specific patient, ... It will use the existing computing backend and add a layer of expert system on top of it. The development will be done in C++ with a specific emphasis on the reliability of the system.	**Computer science or computer engineering students: C++ software development, expert system**
Diverse projects on machine learning applied to life sciences **Prof C. Peña**	Our group, Computational Intelligence for Computational Biology (CI4CB), applies machine-learning methods to solve hard data-driven problems in life sciences (e.g., diagnostic decision, biomarker discovery, personalized health). Different projects are available that address this specific kind of applications. The exact subject would be discussed and defined with the interested student prior to the beginning of the training period. Keywords: Machine learning, Software development, Data analysis and modelling.	**Only students in Computer Science, Bioinformatics or equivalent disciplines, notions of Machine Learning and Python.**
RULE-DEEP-EXTRACTION: Extraction of Rules from Deep Neural Networks **Prof C. Peña**	The proposed project is developed in the frame of D-Rex (Deep Rule EXtraction), an exploratory research project in which we intend to develop, implement, and evaluate a novel method for extracting rules from Deep Neural Networks. The method(s) will be able: (1) to extract knowledge in the form of hierarchical rule representations to explain how Deep Neural Networks make their predictions while (2) preserving, as much as possible, the prediction accuracy of the neural network. The specific goal of the student's project will be to investigate, implement, and test an approach for extracting rules from a specific architecture of Deep Neural Networks (e.g., convolutional or recurrent). Keywords: Machine learning, Deep learning	**Only students in Computer Science, Bioinformatics or equivalent disciplines, notions of Machine Learning and Python.**
Deep Learning for robotic vision **Prof A. Perez-Uribe**	Deep neural networks have shown to be very good at image classification and object recognition tasks. The objective of this project is to train a custom system to recognize particular objects in an indoor environment and to embedded such a system on a humanoid robot. To achieve this, we will take advantage of pretrained models provided by the major actors in the domain and proceed to fine-tune them with our own data. For more information: http://iict-space.heig-vd.ch/ape	**Keywords: Deep Neural Networks, image processing, Machine Learning**
Personal mobile coach **Prof A. Perez-Uribe**	The increasing availability of wearable sensors embedded in smartphones, watches and physical activity trackers has open the door to original applications, mainly in health and wellness improvement. One typically collects data by means of sensors like GPS, accelerometers, gyroscopes, barometers, microphones, cameras, depth sensors, etc. To make sense of these data, Machine learning algorithms can be used to establish correlations among the variables under investigation, and as in every attempt to understand high-dimensional data, visualization and dimensionality reduction techniques can suggest new knowledge about the aspects of the person's life being monitored.	**Keywords: wearable sensors, smartphones, smartwatches, time-series, Machine Learning, health, sports**

	The objective of this project is to deal with diverse application domains including self-tracking of physical activity, self-tracking and characterization of style and performance in sport (e.g., racket sports, running), daily-life logging , or 24/7 self-monitoring as a means to enhace our wellbeing. For more information: http://iict-space.heig-vd.ch/ape	
Human-humanoid interaction **Prof A. Perez-Uribe**	The current availability of the first humanoid robots at moderate prices opens up a wide range of applications. The objective of this project is to program a humanoid robot or a human-humanoid interface using Kinect cameras or smart glasses. Potential applications include the programming of appropriate behaviors that makes the interaction with such robots more human-like with the aim of increasing our trust in them. For more information: http://iict-space.heig-vd.ch/ape	**Keywords: Humanoid robots, human-humanoid interfaces, Kinect, image processing, Machine Learning**
Smart rehabilitation **Prof A. Perez-Uribe**	Werable sensors open the door to monitoring patients at home. This can provide very valuable data to doctors, that nowadays rely on the observation of their patients when they go to the hospital and on the subjective information provided by the patients themselves or their relatives. Within this project, we will use wearable sensors and egocentric cameras to identify and evaluate the quality of movement of persons suffering from upper-limb neurological disorders. To identify particular movements, we will use machine learning algorithms to exploit both, the video captured by the camera and the time-series captured by the wearable sensors. For more information: http://iict-space.heig-vd.ch/ape	**Keywords: wearable sensors, Machine Learning, rehabilitation**
GeoSQL Journey **Prof O. Ertz / J. Ingensand**	GeoSQL Journey is a project led by the Media Engineering Institute and the Institute of Territorial Engineering (see https://peerj.com/preprints/27247). The purpose is to motivate and help students to learn geospatial SQL with a fun software. It is to guide students through pedagogical objectives on the base of a game world and story combining mechanisms related to gamification. The proposed work will be based on the results of preliminary game design. It will be about the development of a proof of concept platform that implements some ideas of GeoSQL Journey to learn geospatial SQL with fun using actual web technologies. The work will follow three main phases: (1) take in the web technologies through tutorials and documentation, (2) follow an agile process to implement a first release with the web technologies studied during the first phase and (3) deploy and test with multiple students in order to improve and validate the concept.	**background in software engineering and development and/or in geographical sciences, with interest in education technology (EdTech).**
BioSentiers augmented reality and occlusion techniques	BioSentiers is a project lead by the Media Engineering Institute and the Institute of Territorial Engineering. The purpose is to offer a way to discover biodiversity through a location-based augmented reality mobile application (see biosentiers.heig-vd.ch). That means, given a predefined pathway marked all along its length with points of biodiversity interest, citizens of	**background in software engineering and**

Prof O. Ertz / J. Ingensand	Yverdon-les-Bains have the possibility to observe them and virtually interact with nature by getting extra multimedia content about various flora and tree species. The proposed work is about a new feature for the front-office AR application to allow object occlusion while exploring the area around the user. In other words, the purpose is to find a solution to avoid the display in the AR scene of points of biodiversity interest which may be hidden by a building in the real environment. The swissTLM3D large-scale topographic landscape model and swissBUILDINGS3D vector based dataset which describes buildings as 3D models may be useful to implement such a feature. The work will follow three phases (1) carry out a state of the art to draw up a panorama of knowledge and techniques on this theme (2) specify, design and develop a proof of concept of the intended feature (3) integrate the occlusion solution so as to release a new version of the AR front-office BioSentiers application.	**development with interest in augmented reality or in geographical sciences with focus on interactive mapping techniques**
BioSentiers augmented reality authoring system **Prof O. Ertz / J. Ingensand**	BioSentiers is a project lead by the Media Engineering Institute and the Institute of Territorial Engineering. The purpose is to offer a way to discover biodiversity through a location-based augmented reality mobile application (see biosentiers.heig-vd.ch). That means, given a pathway marked all along its length with points of biodiversity interest, citizens of Yverdon-les-Bains have the possibility to observe them and virtually interact with nature by getting extra multimedia content about various flora and tree species. Currently the pathway and the points of biodiversity interest are predefined. There is a back-office that allows only to customize a visit of the pathway by choosing the sections of the pathway to explore and the species to observe. The proposed work is about the development of a full featured authoring back-office that allows a content manager to define new pathways, collect/insert new points of biodiversity interest, associate media content (photos, sounds, ...) to them and finally publish everything to be displayed through the front-office AR application. The work will follow three phases (1) carry out a state of the art to draw up a panorama of knowledge and techniques on this theme and identify existing toolset, framework and system (e.g. headless-CMS, etc) that may be useful to consider (2) iteratively specify, design and develop the intended back-office (3) adapt the the AR front-office BioSentiers application to use the features served by the back-office.	**background in software engineering and development with interest in augmented reality or in geographical sciences with focus on interactive mapping techniques**
Machine Learning to study the spread of highly contagious diseases **Prof. S. Robert**	The project aims at applying state of the art Machine Learning techniques to study the spead of highly contagious diseases, the Novel Coronavirus (Covid-19) for example. This virus is identified as the cause of a pandemia/outbreak of respiratory illness, first detected in Wuhan, China. Early on, many of the patients in the outbreak in Wuhan, China reportedly had some link to a large seafood and animal market, suggesting animal-to-person spread. However, a growing number of patients reportedly have not had exposure to animal markets, indicating person-to-person spread is occurring. We have datasets from Kaggle that has daily level information on the number of affected cases, deaths and recovery from 2019 novel coronavirus. The aim is to study the spread of highly contagious diseases in general with Machine learning on graphs techniques (based on Python, Tensorflow) and apply them to the Covid-19. Page: http://www.stephan-robert.ch/research/	**Mathematics or computer science students with data science skills**

Heterogeneous System Infrastructure **Prof. Alberto Dassatti**	The end of the Moore's law imposes new specialized hardware solutions to serve the increasing computing demand. System composed by several domain specific accelerators are available, but from the system integration and programming point of view they rely on custom solutions. The idea of this project is exploring the state of the art in compiler infrastructure for heterogeneous hardware and implement a prototype to measure real benefit and compromises of these solutions. Several research project have already been carried out in our laboratory on this subject.	**Compiler, heterogeneous systems, accelerator, runtime.** **Requirements: computer architecture, C/C++ programming, basic FPGA knowledge a plus.**
Data Center accelerators **Prof. Alberto Dassatti**	Data centres demand more and more computation efficiency. Standard CPU are unable to cope with the demand and GPU can only serve specific computation patterns. FPGAs are an attractive technology in this field, but its integration in the data center infrastructure is not trivial. In this work we will explore the opportunities and limits of abusing the nvme protocol to support a scalable model of integration of FPGA accelerators.	**Keywords: Linux, nvme, file system** **Requirements: computer architecture, C/C++ programming, basic FPGA knowledge a plus, Operating systems**
DVBS2x LDPC decoder **Prof. Alberto Dassatti**	LDPC are powerful error correction codes adopted by many modern communication standards. In satellite communication, for instance, DVBS2x use a specific LDPC to protect video transmission from and to space. In our lab we have a complete Software Defined Radio system implementing the system in software, but the performance of the LDPC decoder are unable to cope with the required data rate for a real-time system. In this project we will develop a FPGA based LDPC decoder and we will test it in a complete radio communication chain.	**Keywords: LDPC, SDR** **Requirements: C/C++ programming, FPGA design experience**
FPGA compression for stereo RGBd Stream **Prof. R. Mosqueron**	Goals : Due to the large amount of data providing by the images sensors, the goal of this project must be to send a compressed stream for storage and for processing. Images come from a RGBd sensor which is a stereo camera plus a depth sensor. This kind of sensor is very useful to manage a 3D environment illustrating the virtual rehabilitation environment. The bandwidth is very high (10Gbps per sensor) and medium capacity is limited. In this case, USB3 is used and the bandwidth is close to 5Gbps (10 for USB3.1). Then, capacity of the medium for uncompressed is not sufficient.	**Video analysis** **Student with a good knowledge in compression**

	The solution is to use compression. Compression for stereoscopic field could be specific. Either the stereo compression is done in a smart system before sending the stream or two separate compressions are done. Some compression can be used with strict constraint of latency. The latency (Glass to glass) must be less than 40 ms. It means that most of the standard cannot be used.	
IoT counting people **Prof. R. Mosqueron**	The project aims at designing an entire IoT system which will be based on the following scenario: We have a closed room with a certain number of windows. We have an embedded system whichmeasures at regular intervals the temperature, humidity and CO2. The data is uploaded by usingcellular connectivity to a public cloud (Azure, AWS or Swisscom Cloud). The date (time series) will besubsequently analyzed and based on the parameters, a basic data processing will be made in order todetect the number of persons which are in the room (CO2 should vary linearly with the number ofpersons in the room). This way an indirect person counter will be implemented. The CO2 variationwill tell also the user when the window should be opened, before the values will become dangerous.Sensors will be installed also on the windows to detect when it is opened.From a hardware point of view, the system will consist in an embedded system (RPi or Arduino typeor both) together with a cellular modem and the sensors.The cloud architecture consists in a virtual machine with a nonSQL database which ingests the data.A dashboard will be also put in place so that the user can check the actual status.All the hardware and cloud client will be provided by Swisscom. Also several resources andknowledge about the cellular connectivity will be shared along the project	**Signal processing and network** **Student with good knowledge in network and signal analysis**
Elastic edge-to-cloud resource management techniques **Prof. M. Zapater**	The popularization of artificial intellengence is bringing deep learning to a myriad of novel applications. Image analytics, video surveillance, self-driving card or real-time population monitoring are among the novel killer applications that require efficient management between edge and cloud. To maximize performance and minimize the energy consumption of both edge devices and cloud platforms, there is a need to develop efficient resource management techniques able to take workload allocation decisions, on when and where to execute the workload, in the edge to cloud continuum in an elastic way. To exploit elasticity, these techniques need to be aware of the underlying hardware and software stack, which often consist on a lightweight virtualization (like containers) deployed on ARM or RISC-V based edge devices. This project proposes the design of heuristic and meta-heuristic based workload managemet techniques and tools to adequately allocate deep learning workloads in edge and cloud devices. To test the proposed techniques in a large-scale scenario of hundreds of nodes, we will use an efficient in-house open source simulator tool that will be extended with novel features to ensure scalability.	**Computer Science and Computer Architcture** **Student with good knowledge of C/C++.** **Basic ML knowledge would be a plus.**
In-memory computing techniques to accelerate deep neural networks **Prof. M. Zapater**	In-memory computing techniques have emerged as a promising technique to reduce the processor-to-memory traffic and increase the performance in the execution of deep neural networks. The specific technique that is more suitable for each type of network depends on the network size (amount of layers, parameters and weights) and on the nature of the network itself. In this project we will evaluate in-memory computing techniques, in particular the suitability of both in-SRAM (in-cache) and in-DRAM (main memory) computing for a set of different networks. For this porpuse we will use the gem5 architectural simulator, which enables us to extend an ARM 64-bit architecture with novel architectural enhancements.	**Strong background on computer architecture.** **Student with knowledge on C/C++.**

INDUSTRIAL ENGINEERING (TIN)		
New Smartgrid lab : Development and test of power converters interface software using LabVIEW programming based on Compact RIO and industrial PC **Prof. M. Carpita**	The Institute of Energy and Electrical Systems provides expertise in the field of electrical energy in the broadest sense of the term with special focus on energy systems with an electrical component. The institute implements a new Intelligent Networks laboratory involving new data acquisition hardware and software. One of the major topic is a system that produces two feeder distributions in low voltage, totally reconfigurable, with several different generation systems. Two different measurement acquisition and signal processing systems have been planned as well. The interface software system is based on Compact RIO and industrial PC. The developing environment is Labview. The objective of this diploma thesis is the development and test of power converters interface software system. The power converters are part of the laboratory. The diploma thesis will be performed in collaboration with the Intelligent Networks Laboratory development team.	**Basic competences in power electronics and power systems**
Self-adaptive sampling rate data acquisition system **Prof G. Courret**	The goal of this internship is to develop a self-adaptive sampling rate data acquisition system designed for larg band signals. A software and firmware dedicated to signal processing and real time analysis will be developed. This internship will also be devoted to the design of the algorithm of data analysis. Knowledge of acoustic and vibration engineering as well as signal processing for spatial engineering is potentially useful.	**Students with previous knowledge from courses in signal processing engineering, digital electronics (FPGA-SoC), VHDL and Matlab or Octave languages**

Nanotribology **Prof. Dr. S. Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in research on surface coatings. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. Nano- and microtribology properties are of importance for the development and characterization of performant lubrifiants coatings, as well as for functional ink and coating developments. In this project several measurement techniques are studied and evaluated, tested and anaylsed in view of applications and developments for different fields (biomedical applications, nano- and microtechnology, and/ or printing & coating technologies). The project is best suitable for master or PhD students in chemical engineering, material or surface science, as well as for students in industrial process technologies. Minimum duration master students 3 months, preferentially 4-6 months; PhD interns 6-12 months.	**Keywords: surface coating, surface functionalisation, wear, lubricants, nano- and microtribology, nanocomposite coatings, self-assembly, applied nanosciences**
Flexible Electrodes for outdoor signal monitoring **Prof. Dr. S. Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in the field of nano- and microfiber composite materials. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. The project aims at the development of flexible electrodes for outdoor signal monitoring. Conducting fibers and membranes will be produced using different techniques and machines of the laboratory. The project involves process and materials development, characterization, as well as testing of the materials and electrodes for outdoor applications . The project is suitable for master or PhD students in chemical engineering, materials or surface science, applied physics, as well as for students in industrial process technologies. Minimum duration master students 3 months, preferentially 4-6 months; PhD interns 6-12 months.	**Keywords: conductive polymer nanocomposites, adavanced processing techniques, nano- and microfibers, testing & validation, applied nanosciences**
Surface structuring by atmospheric pressure plasma **Prof. Dr. S. Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in the field of atmospheric pressure plasma treatment of surfaces. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. The aim of the project is to run series of experiments for surface modification on various industrially relevant materials.. The influence of process parameters will be studied at the nano- and microscale by analysis of the treated and untreated material surfaces using various surface analysis techniques. The project is best suitable for master or PhD students in chemical engineering, material or surface science, applied physics, metrology, photonics, as well as for students in industrial process technologies. Minimum duration for master students 3 months, preferentially 4-6 months; PhD interns 6-12 months	**Keywords: Atmospheric pressure plasma, surface treatment of materials, experimental study on industrially relevant surfaces, applied nanosciences**

Printable flexible transparent heaters **Prof. Dr. S. Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in the field of transparent electrodes. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. The goal of the project is the design and characterization of transparent flexible heater and sensor materials based on conductive polymers nanocomposites. The candidate will perform experimental work on thin film polymer nanocomposite deposition (coating and printing), thin film and thin wire characterization (interferomentry, profilometry), electrical characterization of materials and devices, optical UV-vis-IR characterizations of the materials and devices. Set-up of a demonstration of a transparent heater system, perform aging tests. The project is best suitable for master or PhD students in chemical engineering, material or surface science, applied physic, metrology, photonics, as well as for students in industrial process technologies. Minimum duration for master students 3 months, preferentially 4-6 months; PhD interns 6-12 months.	**Keywords: transparent conducting materials, UV-vis-IR characterization, electrical thins film characterization, printing and coating, applied nanosciences**
Nanocomposite inks for printing and additive manufacturing **Prof. Dr. S. Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in the field of nanocomposite ink formulations. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. The goal of the project is the design and characterization of conductive nanocomposite inks for flexible printable micro-tag, heater and sensor devices. The candidate will perform experimental work (ink formulations, coating and printing), thin film and thin wire characterization (interferomentry, profilometry), electrical characterization of materials, printed structures, and devices. Suitable inks will be characterised by optical UV-vis-IR spectroscopy, as well as DLS. Various printing methods will be used for the experimental work, covering a broad range of complementary techniques and ink parameters. The ink formulations shall lead to scratch resistant functional prints and coatings for functional surface decoration and additive manufacturing. The project is best suitable for master or PhD students in chemical engineering, material or surface science, applied physic, metrology, as well as for students in industrial process technologies. Minimum duration for master students 3 months, preferentially 4-6 months; PhD interns 6-12 months.	**Keywords: ink formulation, testing and characterization, nanocomposite materials, printing and coating processes, surface functionalisation, surface analysis, applied nanosciences**
Nanoparticle and nanostructure generation by pulsed laser machining **Prof. Dr. S. Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in the field of nanoparticle and nano- and microstructure generation by laser machining. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. Laser assisted processes, printing- and machining techniques are used for nanoparticle synthesis, as well as for surface nanostructure generation. The candidate will investigate laser-assisted nanoparticle generation processes, as well as laser-assisted surface structuring and printing techniques. Synthesised nanoparticles will be characterized for particle sizes and concentrations using modulated 3D cross-correlation dynamic light scattering and UV-vis-NIR spectroscopy. The generated materials and surface structures upon laser treatment will be analysed using optical microscopy as well as atomic force microscopy, optical spectroscopy. Semi-automated data analysis combined with modelling will be used for gaining understanding in the underlying process as needed for parameter adjustements in industrial processes. The project is best suitable for master or PhD students in chemical engineering, material or surface science, applied physic, metrology, as well as for students in industrial process technologies. Minimum duration for master students 3 months, preferentially 4-6 months; PhD interns 6-12 months.	**Keywords: laser machining, nanoparticle generation, dynamic light scattering, surface topography, wettability, laser assisted printing technologies, applied nanosciences**

Flexible supercapacitors based on polymercomposite nanofibers **Prof. Dr. Silvia Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in the field of flexible electrodes for energy and sensor applications. Within this project electrodes and solid electrolytes will be developed and tested for the design of flexible supercapacitors and flexible sensor. The candidate will work on the topic of flexible supercapacitors, using nanofiber and coating techniques for electrode and solid electrolyte fabrication. Electrode characterizations will be performed using electrical 4 point probing (I-V), cyclo-voltammetry, as well as impedance spectroscopy. The project is best suitable for master or PhD students in chemical engineering, material or surface science, applied physic, metrology, as well as for students in industrial process technologies. Minimum duration for master students 3 months, preferentially 4-6 months; PhD interns 6-12 months.	**Keywords: electrospinning, polymer nanocomposites, energy, supercapacitors, sensors, cyclovoltammetry, impedance spectroscopy, applied nanosciences**
AM for high dynamics structures **Prof. Alain Schorderet**	The Machine and Design Applied Research Group is active in high dynamics systems, additive manufacturing and composite structures research fields. Using a strong dual numerical-experimental approach, the Group has developed mechanical design solutions for the high performance machine-tool field. A holistic system approach has been created within the mecatronYx interdisciplinary platform, in tight association with the automatic control group. They produced patented dynamic optimization algorithms that allow very significant quality and/or productivity improvements when implemented on high-end milling machines (5 times quicker milling speeds). The goal of the proposed project is to use metal additive manufacturing solutions to design and realize very high dynamic components using intensive design for AM, FEA, topological and parametric optimization.	**Keywords: AM High dynamics machines, Additive manufacturing, structural optimization**
Micro-milling quality criterion **Prof. Alain Schorderet**	The Machine and Design Applied Research Group is active in high dynamics systems, additive manufacturing and composite structures research fields. Using a strong dual numerical-experimental approach, the Group has developed mechanical design solutions for the high performance machine-tool field. A holistic system approach has been created within the mecatronYx interdisciplinary platform, in tight association with the automatic control group. They produced patented dynamic optimization algorithms that allow very significant quality and/or productivity improvements when implemented on high-end milling machines (5 times quicker milling speeds). The goal of the proposed project is to use intelligent data analysis of specific sensors data (force, vibration, acoustic emission) and available machine signals (position, current, …) to define a sensitive micro-milling process quality criterion. If available, this criterion could be used to implement a very novel process control loop able to guarantee manufactured parts accuracy, and surface quality.	**Keywords: micro-milling, process quality, sensors, intelligent data analysis**
UHS spindles **Prof. Alain Schorderet**	The Machine and Design Applied Research Group is active in high dynamics systems, additive manufacturing and composite structures research fields. UHS rotors and spindles were developed by the group for various applications : micro-drilling (600'000tpm PCB drilling), micro-energetics, laser micro-machining and micro-milling. The goal of the proposed projet is to push the spindles performances (speed, stability, stiffness, load capacity, …) and characterize the process capability of the spindles.	**Keywords: ultra-high speed rotors, micro milling, laser milling**

Nanostructured pressure sensor **Dr. L. Gravier**	In the frame of the Industry 4.0 research program, a new generation of sensors is needed, to be integrated in micromachines or devices. The project aim at the design and fabrication of a small scale pressure sensor using nanostructured thin film, using nanotechnology techniques mastered in the lab. A test bench will be developed to characterize this sensor, which will be integrated in a technology demonstrator by 3D print techniques.	**Keywords: microtechniques, nanotechnology, sensors, 3D print**
Nanostructured Infrared light sensor **Dr. L. Gravier**	In the frame of the Industry 4.0 research program, a new generation of sensors is needed, to be integrated in micromachines or devices. The project aim at the design and fabrication of a small scale infrared light sensor using thermoelectric properties of a nanostructured thin film, using the nanotechnology techniques mastered in the lab. The light will be detected by thermoelectric effect combined to lock-in amplifier technique. A test bench will be developed to characterize the sensitivity and response time of this sensor, which will be integrated in a technology demonstrator.	**Keywords: microtechniques, nanotechnology, lock-in detection, IR light sensors**
Optimization of industrial and collaborative robots **Prof. Marc Kunze**	The robotic laboratory is active in the field of industrial and collaborative robotics. In this field the following topics are studied: Bin picking: in the case of small production batches it is interesting to be able to perform bin picking instead of using vibratory bowl feeders. However, the time to setup up the bin picking task is often too long. Different technics to reduce this time are studied. Collaborative robot: nowadays collaborative robots are more and more used in the industry. Thus, humans need to interact with this kind of robot. Interaction can be in terms of task teaching by demonstration, robot path adaptation function of the environment, robot – human interaction. 3D printing with a robotic arm: 3D printing is often done with a cartesian robot. In this project, the idea is to perform this task using a robotic arm which offers several advantages (non-planar trajectories, different orientation of the head, increased stiffness…). For all these developments we are using ROS (Robot Operating System) middleware.	**Keywords: industrial robot, collaborative robot, bin picking, robot – human interaction, 3D printing, ROS**