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) + health insurance if needed.
Internships normally last 5-6 months. Some teachers may exceptionally accept shorter or longer ones.

GEOMATICS, CIVIL-, ENVIRONMENTAL, BIO-ENGINEERING : pages 1 to 2
IT, COMMUNICATION TECHNOLOGY, MATHEMATICS : pages 3 to 6
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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**

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 systems, for instance by adopting a multi-task learning approach.	**Students with previous knowledge from courses in machine learning, neural networks, 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 biographical study of those two amendments.	**Keywords: WiFi, WLAN, 802.11, protocols, communications.**
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**
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).	**Only students in Computer Science, Bioinformatics or equivalent disciplines, notions of Machine Learning and Python.**

GeoSQL Journey **Prof O. Ertz / J. Ingensand**	Mediamaps is an interdisciplinary team research built of members from MEI and INSIT institutes that work in synergy to bring together knowledge and know-how of GIS and Media technologies. Recently the team has lead a preliminary study and design for a gamified learning experience to introduce (or demystify) geospatial SQL queries - see *https://peerj.com/preprints/27247*.. The project is currently in a first development phase so as to have a prototype to test with different groups of students from universities in Switzerland. Therefore, there are many possibilities to frame subjects of work (i.e. intership, bachelor/master thesis, etc) in relation to this long-term pedagogical innovation project.	**GIS and Media technologies** **pedagogical innovation project**
BioSentiers / BioPocket **Prof O. Ertz / J. Ingensand**	Mediamaps is an interdisciplinary team research built of members from MEI and INSIT institutes that work in synergy to bring together knowledge and know-how of GIS and Media technologies. The following themes are addressed through several research projects: Cartographic representation and visualization (from graphic semiology to augmented reality) Participatory sciences (from VGI to user engagement strategies) Use and development of standards (from Swiss INTERLIS to international OGC standards) UX/UI design and implementation of geospatial applications (from data processing to user interfaces) Since 2017 the Mediamaps team has developed research topics in relation to the use of digital products to raise awareness and actions in favor to biodiversity: BioSentiers is a smartphone/tablet application for young children to discover biodiversity along a virtual outdoor track through augmented reality visualizations. See *https://biosentiers.heig-vd.ch* BioPocket is a smartphone/tablet application for citizens willing to take action in favor of biodiversity without knowing how to start (call it "your biodiversity coach"). See *https://biopocket.ch* Recently, some results around both these called "bio projects" have revealed several interesting ideas that would be relevant to design, develop and experiment. Therefore, there are many possibilities to frame subjects of work (i.e. intership, bachelor/master thesis, etc).	**GIS and Media technologies** **digital products in favor to biodiversity**
Optimization of cryptocurrencies deployment **Prof. S. Robert**	Cryptocurrencies are distributed in digital form and allow a particular community to collect, acquire certain amounts in a cryptographic manner and verify the legitimacy of the transactions carried out. Bitcoin is the best known example. Broadcast messages through the network are generally perceived as anonymous messages. We would like to study how these new currencies will be distributed through an increasingly complex computer network made up of emerging technologies. This project will examine how cryptocurrencies can be implemented on such infrastructures and also explore the best algorithms and methods for their large scale deployment. Page: http://www.stephan-robert.ch/research/projects/blockchain-and-cryptocurrencies/et http://www.stephan-robert.ch/research/projects/active-learning-and-autoencoders-in-banking-fraud-detection/	**Mathematics or Computer Science Students with a strong Mathematical background**
Machine Learning use to help healthcare institutions	The project aims at applying state of the art Machine Learning techniques for the optimization of workflows in healthcare institutions. The final goal is to provide a turnkey solution for customers to optimize the planning at the room, patient and staff level based on historical and live (big) data. The scheduling system will rely on deep learning and deep reinforcement learning	**Computer Science student with good knowledge in**

Prof. S. Robert	on graphs using open source frameworks (Python, Tensorflow). Page: http://www.stephan-robert.ch/research/projects/operate/	**Python**

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**
Design a multi-layer electronic board containing a SoC-FPGA Cyclone V coupled with 2 or 4 sampling channels with fast ADCs and DACs. **Prof G. Courret**	Design a multi-layer electronic board containing a SoC-FPGA Cyclone V coupled with 2 or 4 sampling channels with fast ADCs and DACs. The goal is to reduce the form factor of an actual setup based on evaluation and custom-made boards. - The first step would be to redraw a schematic containing all the required components by reusing some part of existing schematics as a model. - The second step is naturally to achieve the layout part (place and route process). - Then proceeding to the fabrication output files in order to produce the PCB. - Meanwhile, producing a complete components list ordered to be ready for the assembly - As a final point, testing the board, the power supplies, the clocking network, the firmware and boot of the FPGA as well as the ADC and DAC channels. - Produce a full report with all the relevant files and the test results. Having some knowledges on FPGA design is not mandatory but good to have. It is more important to have some experience or knowledge on fast signal routing and layout considerations, like traces geometry, ground plane, stack-up, impedance control, etc. Autonomy and initiative is welcome.	**Students should be comfortable with CAO tools, essentially Altium, but Kickad would be a plus.**

Spectral Analysis and Signal Generation on FPGA-SoC Embedded System **Prof G. Courret**	The goal of this internship is to develop a software and firmware dedicated to real time spectral analysis with streaming FFT. Knowledge of acoustic and vibration engineering (turbojet engines, roll bearings) is potentially useful for defining the algorithm of analysis. This internship will be devoted to the design of spectral detection methods.	**Students with previous knowledge from courses in mechanical engineering, signal processing engineering, digital electronics (FPGA-SoC), VHDL and Matlab 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 3 months, preferentially 4-6 months.	**Keywords: surface coating, surface functionalisation, wear, lubricants, nano- and microtribology, nanocomposite coatings, self-assembly**
Nanocomposite fiber fabrication **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 conducting fibers and membranes using different techniques and machines of the laboratory and to develop application demonstrators. 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 3 months, preferentially 4-6 months.	**Keywords: conductive polymer nanocomposites, adavanced processing techniques, nano- and microfibers, testing & validation**
Atmospheric pressure plasma for industrial applications **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 industrial relevant materials for the application field .of advanced materials printing and coating 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 3 months, preferentially 4-6 months.	**Keywords: Atmospheric pressure plasma, surface treatment of materials, experimental study on industrially relevant surfaces**

Flexible transparent conductive 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. The candidate will perform experimental work on thin film polymer 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 3 months, preferentially 4-6 months.	**Keywords: transparent conducting materials, UV-vis-IR characterization, electrical thins film characterization, printing and coating**
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 3 months, preferentially 4-6 months.	**Keywords: ink formulation, testing and characterization, nanocomposite materials, printing and coating processes, surface functionalisation, surface analysis**
Resins and surface treatments for wood protection **Prof. Dr. S. Schintke**	The research unit COMATEC-LANS (Laboratory of Applied NanoSciences, www.comatec-lans.ch) is active in the field of advanced materials and coatings. Within the study project, the candidate will participate in running research activities of the COMATEC-LANS. The goal of the project is to develop and test the effect of different resine coatings and surface treatment methods for wood protection. The candidate will perform experimental work, formulate resins, prepare coatings, and evaluate wood aging under UV exposure, as well as under moisture, and heat. Coating and testing procedures shall be optimized for rapid material screening and database generation. Adapted procedures will be developed during the project. The project is best suitable for master students in chemical engineering, material or surface science, applied physic, as well as for students in industrial process technologies. Minimum duration 3 months, preferentially 4-6 months.	**Keywords: resin formulation, testing and characterization, nanocomposite materials, coating processes, aging tests, wood protection**
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	**Keywords: AM High dynamics machines, Additive manufacturing, structural**

	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.	**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**