Internship Digest #7 – February 21, 2018

European Career Fair: Saturday, February 24!

This annual event connects MIT students with 100+ European companies, universities, and research institutions. Sign up today! For more information, see their website here: https://ecf.fairsey.com/#!/. Attached is a list of the French organizations that will be attending the fair. Come meet them in person!

Internship Opportunities

Listed below is the table of contents for the internship opportunities. If you are interested in any of these, please let us know immediately at mit-france@mit.edu!

Internship Opportunity	Internship Type	Proposed Internship Length	Location	#
Orange Labs	Industry	3 months – summer	Caen	2
Innovation in Policy Leaders	Research/university	2 months – summer	Toulouse	3
Confluence Summer School	Research/university	5 weeks – summer	Lyon	5
GIANT – deadline approaching!	Research	10 weeks - summer	Grenoble	12
Champollion National University Institute	Research	3 months	Toulouse	36
Airbus	Industry	3-6 months, depending on internship	Toulouse, others	38
ENEA	Industry	6 months	Paris	51
Ecole Polytechnique*	Exchange program*	1 year	Paris	52
ECAM Lyon	Summer school	6 weeks - summer	Lyon	54
ECAM Lyon	Research	6 months	Lyon	56
ILL	Research	3 months or more	Grenoble	58
CEA	Research	3-6 months	Aix-en-Provence	76

*NOTE: In addition to the exchange program, Ecole Polytechnique also has a **summer internship program.** For information on that, please see my email and click on the link for the internship program specifically!

Orange Labs Internship Offer

Location: Caen, France
Dates: Summer, to be determined

Homomorphic encryption, a particular form of encryption that allows to perform computation over encrypted data, currently is a particularly active field of research in cryptography. As a privacy-protecting technology, it allows numerous use-cases : privacy-preserving biometric authentication, processing of encrypted medical files for better medical monitoring,..

However, it suffers from several limitations, and amongst them is the slowness of computation. This is mainly due to a costly operation, namely the bootstrapping phase, that we have to repeatedly perform throughout computation in order to ensure correctness. A line of research [see bibliography below] has taken interest in minimizing the number of bootstrapping required to correctly execute an algorithm over encrypted data. However, these works make a fairly strong hypothesis: bootstrapping takes exactly the same time, independently of when it happens during the computation. Experiments show that this assumption is wrong: the later bootstrapping happens in the process, the more costly it is.

The goal of this internship is to model the "weighted minimizing boostrapping problem" as an optimization problem, and use graphs algorithms or linear programming techniques in order to obtain a solution to this problem.

Bibliography:
Optimization of Bootstrapping in Circuits *, Fabrice Benhamouda and Tancrède Lepoint and Claire Mathieu and Hang Zhou*, in SODA 2017 https://eprint.iacr.org/2016/785
Minimizing the Number of Bootstrappings in Fully Homomorphic Encryption, *Marie Paindavoine and Bastien Vialla***,** in SAC 2015, attached

CAMPUS FRANCE
campusfrance.org

APPLY TO BECOME A MEMBER OF THE 2018 CAMPUS FRANCE INNOVATION IN POLICY LEADERS COHORT

The Innovation in Policy Leaders Program will be launched by Campus France in Toulouse in the summer of 2018. It is designed to inspire a new cohort of policy leaders committed to promoting innovation and change in the public sphere.

Goals

- Learn about local governance in France
- Work in multicultural teams to solve complex problems in short periods of time
- Have a real impact on French policies by initiating and designing a project

Content

The program allows a limited number of students to immerse themselves in French policy making. Participants will attend a five-day seminar in English about French and European policy and intercultural management. They will then participate in an exciting two-day innovation challenge where they will get to solve real policy problems for prominent French institutions. At the end of the competition, they will be placed in the partnering institutions in order to develop their projects during a six-week internship for a real implementation by the institutions. Students will be paired with English-speaking team members. Innovative pluri-disciplinary approaches including nudging and behavioral insights are encouraged. Two international fora will take place in Toulouse in July (ESOF, FAB14). Some of the participants could have the opportunity to present their innovative solutions then.

Topics of the innovation challenge

- How to use behavioral insight to drive change in people's energy consumption habit (with the regional energy agency)
- How to use big data to improve medical research while respecting patients' privacy (with the Public Hospital of Toulouse)
- How to deal with fake news while respecting freedom of speech (with local media)
- How to promote social mobility through education (with Science Po and governmental education agency)
- How to adapt to new forms of youth civic engagement (with the Region Occitanie and the state local representation)
- How to increase employment of young people from socioeconomic minorities (with the state local representation)
- How to improve socio-economic inclusion of young refugees? (with the state local representation)

Seminars at Science Po Toulouse

- Intercultural management by Adrien Pénéranda
- European economic policy and economic integration by Stefano Ugolini
- Innovation and cluster policy in France and Europe by Jérôme Vicente
- A political science analysis of Emmanuel Macron's election by Olivier Baisnée
- An overview of the French political regime and the French administration by Jean-Michel Eymeri-Douzans

Location & Dates

Toulouse, France
June and July 2018

Eligibility criteria

Knowledge of French is encouraged but not required. Applicants must be enrolled in a graduate program or have a graduate degree. This program requires intellectual curiosity and a readiness to engage directly with other cultures. Applicants must demonstrate relevance of the internship to their studies and future career plans.

Compensation

This is an unpaid internship. Participants are responsible for securing funding for the flight and accommodation with their own institutions.

How to apply

Send a resume and a cover letter before March 15th 2018 to michael.vallee@diplomatie.gouv.fr. Pre-selected candidates will be contacted for an interview. The cover letter should include your level of French on a scale from 1 to 5, which topics you are the most excited about (for institutional pairing) and how the program relates to your background and career goals.

Contact

For more information, contact Michael Vallée at michael.vallee@diplomatie.gouv.fr or 774-204-2037

International *Summer School Series*

ARCHITECTURE THINKING FOR TOMOROW

Case Study 1_Lyon (France)

June 11th to July 14th 2018

CONFLUENCE Institute is proud to launch its first edition of a series of International Summer School Program and is glad to invite a group of students for a five week program investigating the future lives of humans in tomorrow's cities

CONF
LUEN
CE
Institute for Innovation and Creative Strategies in Architecture

We believe !

We firmly believe that contemporary developments in science, fabrication or digital culture changes radically the way architecture is envisioned.

How does these changes affect our relationship to technology, nature and the build environment?

We propose to gather a group of international students to work with experts in various fields to form an ephemeral design based think tank. The aim is to envisage future human ways of living through prospective research as well as redefining the architect's role for tomorrow.

What if ?

What if we fully embraced the possibility of pluridisciplinary team by starting the summer program with a 3 days symposium where scientists, demographist, entrepreneurs, engineers, philosophers meet architecture students to discuss and speculate on a real design paradigm shift?

Ideally located in the outskirts of Lyon (France), Le Corbusier's "Couvent de la Tourette" has served for longtime as a research center on architecture and urbanism. It offers perfect condition to host this introductory retreat where students will investigate breakthroughs in biology, epidemiology, astrophysics and geological sciences as well as new technological developments in today's portable or vehicular tools. This prospective research will allow comprehending and anticipating potential transformations of living in the city

The group will then settled in the center of Lyon. A city that has been for many years a pioneer in experimenting new urban systems (smart bikes, autonomous bus, transformation of river banks) and that is building France's biggest ecosystem of startups and entrepreneurs.

Moreover, Lyon has a great history of undertaking major urban projects under the impulse of its successive mayors since the beginning of the XX Century. From the quartier des Gratte-Ciel to the undergoing transformation of the Confluence District, the city strives to test and challenge new urban forms..

Take position !

Students will study these precedents, document the city's rich urban patrimony (roman settlement, Traboules, early modern experiments, Confluence District..) and speculate on the city's major projects: the Confluence District, the transformation of two train stations (Lyon-Perrache, Lyon Part-Dieu), the proposal for an inhabited bridges, the deviation of the highway...

Based at CONFLUENCE Institute's, the group will be encouraged to both critic Lyon's current situation and investigate future ways of living that could trigger new urban transformations. Projects will demonstrate bold polemical interventions and offer a response to the homogeneous urbanization of the world. At the end of the five weeks, the group will edit their work and present it during a closing symposium composed of city officials, urban experts and renowned architects.

PROGRAM

Week 1
- The group will arrive at the La Tourette and follow a 3 days symposium on prospective future
- Introductory courses

Week 2-4
- Visit of Lyon
- Project work and research at CONFLUENCE Institute
- Lecture series by renowned architects and urban planners
- Consultation by city experts and historians
- Intensive seminar on digital tools

Week 5
- Final presentation
- Closing symposium
- Public event with city officials

Confluence Insitute, Studio Odile Decq Lyon, France

Couvent de la Tourette, Le Corbusier Lyon, France

TUTORS

Sir Peter Cook

Sir Peter Cook, founder of ARCHIGRAM, former Director the Institute for Contemporary Art (London) and Bartlett School of Architecture at University College (London). He is the founder and principal of CRAB (London) and has been a pivotal figure within the global architectural world for over half a century. Peter Cook's most recent buildings include the Graz Kunsthaus, Austria, the Vienna Business and Economics University's Law Faculty and the Bond University Soheil Abedian School of Architecture.

Odile Decq

Odile Decq is an internationally renowned French architect and landscape designer. Awarded with the Golden Lion of Architecture at the Venice Biennale in 1996, she has designed several buildings that have marked the contemporary architecture, as the MACRO in Rome. Also very committed in teaching architecture, she launched the Confluence Institute in 2014. In 2017 she was honored with Architizer's Lifetime Achievement Award for her pioneering work as well as her engagement and contribution to the debate on architecture

Antoine Picon

Antoine Picon is Professor of the History of Architecture and Technology and Co-Director of Doctoral Programs (PhD & DDes) at the Harvard Graduate School of Design. He teaches courses in the history and theory of architecture and technology. . Since 2008 he has also been a researcher at the National School of Bridges and Roads. Picon has received a number of awards for his writings, including the Medaille de la Ville de Paris and twice the Prix du Livre d'Architecture de la ville de Briey

WHY CHOOSE CONFLUENCE ?

Settled in the center of Lyon, the school offers perfect conditions for intensive group work, experimentation, prototyping and exhibition. During the five week program, the school will become a place where unpredicted forms and ideas are tested and discussed.

The international summer program is based on the core pedagogy of CONFLUENCE : open, alternative, collaborative and innovative, moving towards a hopeful and forward looking architecture for the 21st century.

Students will experiment how the convergence of different forms of knowledge contribute to the elaboration of an original way of making projects and confront contemporary issues. They will discover how the architectural project is a research activity on its own: to conceive is to undertake research. It is to call up new ways of questioning, experimenting and conceiving.

INFORMATIONS

Entry requirement

- Applicants will need at least a 3 years experience in architecture education
- The workshop is open to all international architecture students
- Language: English
- Participants: 10-15 students

Cost

5 weeks: 2,000 € / 2,500 € (with accommodation)

Registration

Deadline : before April 1st 2018
Payment : before May 1st 2018

Dates

June 11th to July 14th 2018

WHO SHOULD APPLY?

We're looking for architecture students and graduates with an interest in contemporary issues, digital fabrication, prospective attitudes towards the future of cities and the future of living, as well as professionals who would like to further their understanding of architectural thinking. One of the main qualities is the ability of dreaming based on solid historical researches.
At CONFLUENCE, project is understood as a research activity on its own. To conceive a project is to undertake research: it is to call up new ways of questioning, experimenting and conceiving. Students are encouraged to individually design their program and given opportunities to organize symposiums, exhibitions, publications, and seminars

CONTACTS

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GIANT International Internship Programme

SUMMER 2018 RESEARCH PROJECTS OPEN TO MIT STUDENTS

GIANT | DECEMBER 2017

Research projects for international students – summer 2018

Research project 1 – Programming for In-Memory Computing

Laboratory: CEA/DRT/LETI/DACLE/LIALP

Keywords: In-Memory Computing, software programming, Performance Evaluation, LLVM

Project description

In-Memory Computing (IMC) consists in using the native memory computing ability inside its boundary (i.e. without exchanging the data toward others processing units). Thus, it offers significant gain in timing, energy consumption and data transmission security. In previous works, a new software emulation platform has been co-developed by research teams composed of memory and software engineers, to dimension and evaluate a novel IMC architecture. The proposed platform enables to compile software applications on the Low Level Virtual Machine (LLVM), and record the executions traces in order to evaluate the performance in terms of timing, energy consumption and design cost.

The aims of the internship project is to:

- Explore different applications in various fields (security, image/audio/video processing, intensive computation, etc.) starting from the existing software platform
- Use the vector representation of LLVM to implement the IMC features (parallelism, operations with multi-operand selection) and to dynamically configure the data word size
- Evaluate the application performances (timing, energy …)
- Compare the IMC performances to the state-of-the-art systems such as GPUs, dedicated accelerators

Recommended background and skills: programming languages (C, Python…) and computing architecture

Research project 5 – Nuclear control of chloroplast biogenesis by PAPs

Laboratory: CEA/BIG-LPCV

Keywords: Chloroplast biogenesis light signalling PAPs

Project description

The greening of young plants occurs after germination during a developmental program called photomorphogenesis. This program, which supports the acquisition of photo-autotrophy, is induced in Angiosperms by the perception of light. Hence chloroplast biogenesis is triggered and photosynthesis becomes operational. At the molecular level, the formation of chloroplasts requires the activity of a chimeric plastid transcriptional complex (PEP) composed of a prokaryotic core, encoded in the plastid genome, and decorated with 12 eukaryotic proteins (PAP1-12). The PEP complex triggers plastid gene expression for building the photosynthetic apparatus.

In our lab we study the *pap* mutants that develop an albino syndrome with a total carbon heterotrophy. Our work shows that 5 PAPs are localized both in plastids and in the nucleus where they interact. Our aim is to elucidate the intracellular trafficking of PAPs, isolate the nuclear complex and understand its role in chloroplasts biogenesis. We surmise that PAPs participate in the retrograde signal to inform the nucleus of the state of its plastids. Using integrated molecular genetics (functional complementation, chloroplast labeling) as well as biochemistry and large-scale biology, our long-term goal is to elucidate the structure/function of PAP complexes in chloroplasts and the nucleus.

Research project 7 – Growth of SWCNT carpet for 1D confinement of ionic liquid

Laboratory: CEA-Liten/DTNM

Keywords: SWCNT carpet, Ionic liquid, 1D confinement, CNT membrane

Project description

The aim of the project is to grow long (150µm) SWCNT carpet using hot filament CVD system to realize CNT membranes to study the 1D confinement of ionic liquid in such system. In collaboration with other teams we already have realized such membrane with small multiwall [1] and demonstrated a large enhancement of the conduction of ionic liquid confined in 1D system [2]. Up to now the used CNT have a large hollow core as compared with the molecular size of the liquids. We want to shrink the core size and ultimately functionalize the CNT to make highly efficient membranes for batteries [3]. The project consists in the evolution of the CNT growth process we already have to make SWCNT carpet and if successful to go up to the carpet densification.

[1] Berrod, Q. *et al.* Enhanced ionic liquid mobility induced by confinement in 1D CNT membranes. *Nanoscale* **8,** 7845–7848 (2016).

[2] Ionic liquids confined in 1D CNT membranes: gigantic ionic conductivity Q. Berrod, P. Judeinstein, Y. Fu, V.S Battaglia, A. Fournier, J. Dijon, J.-M Zanotti, Energy and environmental Science, under review. arXiv:1710.06020

[3] Patent WO 2016151142 A1 Porous electrolyte membrane, manufacturing process thereof and electrochemical devices comprising same https://www.google.com/patents/WO2016151142A1?cl=en

Recommended background and skills:

The used tools will be the CVD reactor, SEM, and Raman spectroscopy for SWCNT characterization. The student must be interested in the experiments if possible with a background around materials, he will be coached by the team members.

Research project 8 – Implementation of the Phase Space Method to simulating synchrotron beamlines

Laboratory: ESRF-ISDD

Keywords: python, PSA, oasys

Project description

The calculation of the properties of x-ray beams and their transport along synchrotron beamlines is essential for designing and optimizing new beamlines. Different simulation methods like geometrical optics (ray-tracing), matrix-based approaches (phase space analysis), or physical optics (wavefront propagation) are adopted to this effect. Oasys [1] is an Open Source software putting together tools to simulate a complete optical system, like a synchrotron beamline, interconnecting different methods. The goal of this trainee work is to complete the development of an existing Python library [2] that carries out phase space analysis of a beamline and implements it in Oasys [3].

This software will be used for simulations of the beam optics for different beamlines at the EBS (Extreme Brilliant Source), the forthcoming ESRF upgraded source.

Main objectives:

1. Get familiar with phase space for beam optics theory. Learn how to integrate python packages in Oasys.
2. Develop further on the phase space library [2].
3. Integration into the Oasys environment, documentation, testing and deployment.

References

[1] OASYS http://www.elettra.eu/oasys.html http://dx.doi.org/10.1117/12.2061834
[2] https://github.com/Evenity/py_psa (and references therein)

Required background and skills:

Good background in Physics, interest in Optics, interest in computer simulations, programming skills in object oriented programming in a high level language (python, etc…)

Research project 9 – Machine Learning for building a Meta-Model of the Prospective Outlook for Long Term Energy System

Laboratory: CNRS/LPSC - Groupe Physique des Réacteurs

Keywords: Energy prospective, Energy Economics, Meta-Model, Big Data, clustering, sensitivity study

Project description

Help us to build a real-time "meta-model" of the Global energy prospective program POLES (Prospective Outlook for Long Term Energy System). This models have tens of thousands of input parameters. Each run may take as long as ten minutes and produce files whose size is in dozens of Megabytes. If those detailed models are adapted for research on the efficiency of climate policies, the general public cannot use them.

The Carnot Institute "Energies du Futur", who develops research on energy technology, would like to understand better how key economic parameters such as CO2 taxes, or improved characteristics of energy technology (efficiency, cyclability) could have on their development. Furthermore, the Carnot Institute, would like to have a tool, open to the general public to present its own « Vision » of energy prospective.

The objective of the internship is to demonstrate the feasibility of a simplified real-time model, which could reproduce the behavior of the complex POLES model over a limited sub-space of input variables. Such a tool would be based on big data and machine learning methodologies. The technical objectives of the internship are to:

- Classify the input parameters through sensitivity analysis and if possible classify trajectories or scenario types, using clustering algorithms
- Help with the visualization of the diversity of the trajectories and of their sensitivity to parameters.
- Demonstrate the feasibility of the real-time meta modeling by selecting machine learning algorithm and smart modeling tools adapted to do this kind of time-depend models.

Research project 10 – Targeting the skin microcirculation to enhance wound healing

Laboratory: UGA/ HP2, Inserm & Univ Grenoble Alpes UMR 1042; https://hp2.univ-grenoble-alpes.fr

Keywords: hypoxia; wound healing; skin microcirculation

Project description

Chronic ulcers are common and associated with important morbidity. Despite available treatments, they are responsible for an amputation every 30 seconds somewhere in the world. The skin microcirculation, by maintaining perfusion and delivering oxygen and nutrients, has a key role in tissue survival. Structural and functional abnormalities of the cutaneous microcirculation in patients at risk patients (e.g. with diabetes) support its critical role in the pathophysiology of chronic ulcers However, the detailed mechanisms underlying such dysfunction remain largely unexplored. Our research consists in the exploration of different regulators of endothelial function and neurovascular function in the skin of patients with non-healing ulcers. We further aim at targeting the cutaneous microcirculation, by using innovative pharmacological approaches to locally deliver drugs with an effect of microvascular function. This translational research is conducted in animal models of chronic wounds, in 3D bioengineered skin, and in patients.

Recommended background and skills: Background in medicine, pharmacy or (medical) biology is recommended.

Research project 11 – Integrate Learning Analytics Approach and AI in immersive learning spaces "REAL WORLD LABS":

exploring the utility for experiential learning approach and stakeholders (students, teacher, etc.)

Laboratory: GEM/Plexus, Direction de l'Innovation

Keywords: AI, learning spaces

Project description

Plexus Platform proposes connected workspaces in which the GEM students are going to be brought to develop manager's skills of tomorrow. Indeed, the GEM students work in connected and phygital (physical and virtual) spaces. In their forthcoming professional context, they will have to manage teams distributed in various spaces, to pilot communities of project: work in collaboration, communicate, use and produce resources, create and bring to the foreground new knowledge, etc. In connected spaces Plexus, the students of GEM can build their culture and digital skills necessary for the manager of tomorrow. In order to enhance this process of learning, these connected spaces should be able to make go back up tracks of activities of production, search, interaction, and emotions during learning session in experiential learning approach, in real-world labs (shop connected, immersive labs...)

The object of the stage is to study how immersive and phygital training spaces like real-world labs could integrate IA and Learning Analytics approach and generate a flow of data in real time (sounds, pictures, etc.) for exploring the impact of experiential learning and the dedicated real-world labs (shop connected, escape game….) on the stakeholders (students, tutor, teacher).

A second aim is to propose a processing of data exploitation (dashboard…) for helping teachers to adapt their learning scenario or to improve the Learning Design engineering in these real-world labs.

Several themes would be explored (consumer behaviour, technology adoption) with partners of our close ecosystem (CEA, Bouygues…).

The subject could be achieved by 1 or 2 students.

Research project 12 – Cascade Catalytic Reactions for Amine Containing Pharmaceutical Active Compounds

Laboratory: CEA/BIG

Keywords: sustainable chemistry, homogeneous catalysis

Project description

The research proposal will be carry out in the Physicochemistry of Metals in Biology (PMB) team. The host PMB team associates expertises in molecular and structural biology, organic, inorganic and physical chemistry and in magnetic resonance spectroscopies to contribute to understand how metalloproteins, molecular model complexes and more generally catalysts operate.

The aim of this research is to release environmentally benign and atom-economical methodologies catalyzed by sustainable molecular complexes to access valuable compounds, in particular amines containing pharmaceutical compounds. With respect to atom and step-economy ideals, the multicatalytic one-pot process appears as one of the most promising methods. In this context, multifunctional molecular catalysts have proven their efficiency to produce valuable compounds such as amines with sustainable substrates, e.g alcohols. In recent years, due to the significance of C–N bonds formation, several efficient homogeneous catalysts based on nonprecious, earth abundant metals such as Fe, Mn or Co have been developed. However, these examples remain scarce in comparison to noble catalysts and the reactions conditions remain often harsh (high temperature, pressure). Our objective is to provide a fundamental understanding of the catalytic mechanism and structure-dependent catalytic properties of molecular catalysts based on sustainable metals involved in N-alkylation of amines with alcohols. The results will form a foundation for knowledge-based rational design of multifunctional catalysts for this synthetic process.

Recommended background and skills:

This project offers the student the opportunity to gain expertise in complementary domains (organic and inorganic synthesis, catalysis, spectroscopic characterizations) and can be emphasized towards one or more areas depending on the student's skills and wishes. If you are interested in working:

- on a competitive chemistry research project,
- using a huge panel of techniques,
- within a dynamic and enthusiastic team,
- surrounded by the French Alps mountains,

… we will be glad to welcome you!

Research project 13 – Superfuidity of light in a 2D periodic potential

Laboratory: CNRS/Institut Néel

Keywords: Driven-dissipative quantum fluids, semiconductor nanostructures, exciton-polaritons, photonic crystals

Project description

Exciton-polaritons are quasi-particles of hybrid light and electron-hole pair (i.e. "exciton") nature. They are laboratory objects that exists only in optoelectronic semiconductor nanostructure designed for this purpose. Their most striking characteristic is the fact that they constitute a unique experimental realization of a nonequilibrium quantum fluid, in which novel driven-dissipative versions of Bose-Einstein condensation and superfluidity have been reported and extensively studied over the last ten years, we have been profiting from the impressive progresses in the domain of semiconductor nanotechnology, to take control over the spatial environment of polaritons. In this project, our aim is to investigate the polaritonic superfluid state when it is experiencing a periodic potential. In this situation, new states of superfluidity are expected, that simulate non-trivial analogs of phenomena mixing up quantum fluids and general relativity.

Recommended background and skills:

The candidate must have a very good track record in quantum optics, and/or optoelectronics properties of semiconductor nanostructures, and/or ultra-cold atom physics. He/She is to carry out quantum optics experiments, data analysis, and participate in physical discussion with the support of his/her supervisor.

Research project 14 – Implementation of a non-linear equations solver with an application to « smart grids »

Laboratory: UGA-INP-CNRS/LJK & G2ELab

Keywords: mathematical modelling, numerical computation, nonlinear equations, nonlinear optimization

Project description

The LIG (Grenoble Informatics Laboratory), LJK (Jean Kuntzmann Laboratory for Applied Mathematics) and G2Elab (Grenoble Electrical Engineering Laboratory) laboratories, in partnership with several companies of the electrical sector, are jointly developing a simulation software for "smart" electricity distribution networks. The intern will contribute to the development of this software by taking responsibility for an important feature: solving the non-linear equations that result from the modeling of lines, transformers and loads.

Recommended background and skills:

- Student in Applied Mathematics with software engineering knowledge, or Computer Science student with a pronounced taste for modelling and numerical computation.
- Interest in the field of energy, smart grids and the energy transition.
- Experience with C++, Python and Git.
- No prior knowledge of electrical engineering is necessary.

Research project 15 – Computational Caching Algorithms for Joint Proactive C3: Communication, Computing, Caching

Laboratory: CEA-Leti/DSYS

Keywords: Telecommunications, mathematics: 5G, networks, mobile edge cloud, wireless communications, caching, computational caching, graph-based learning

Project description

The future of mobile communications will be characterized by ubiquitous connection availability, very dense networks in terms of number of users and access points, ultra-low latency, very high bandwidth, and energetic efficiency. The exchange of data and information over the network will be extremely fast, copious, and secure, radically improving users' quality of experience and introducing new business models for service providers and stakeholders. The 5G network revolution will be enabled by cutting-edge technological innovations, concerning millimeter-wave radio communications, baseband and RF architecture, resources virtualization, and much more. Further, a vertical reorganization of the roles of the network components will be necessary. A game-changing idea consists in empowering the mobile edge of the network with data elaboration and storage capabilities, thus bringing cloud support the closest possible to the user. This paradigm is called *Mobile Edge Cloud (MEC)* [1]-[4].

In the proposed internship work, we consider MEC empowered by small cell access points, endowed with hardware and software resources adapted to handling the three main pillars of modern networks: *communication, computing, and caching (C^3)*.

Research agenda and goals:

The research will target the design of solutions for *joint allocation* of the C^3 resources [5]-[9]. Classically, distributed caching involves storing "popular" content at the network edge, making it quickly retrievable for users [10]-[13]. With this work, instead, we intend to explore the very recently-proposed and innovative concept of *computational caching* [14], [15]: reducing latency and optimizing precious computational resources by reusing the same processing results for different users. In other words, computational caching consists in *storing popular computation results instead of content*, thereby preventing recurrent elaboration of the same tasks and minimizing redundant processing. Among the many advantages, this technique guarantees much faster service delays, an increased availability of computation resources, and power consumption reduction at the MEC side.

To this end, the candidate will investigate and propose new caching policies and algorithms for computational caching. This phase of the investigation will assume a one-to-one match between users' computation requests and retrievable processing results. The work's goal will be to design algorithms for a proactive and dynamic implementation of computational caching, targeting an efficient joint allocation of the C^3 resources. Further, the candidate will study backhaul costs [16], caching policies adapted to ad hoc small cells clustering and sparsification [17], and learning strategies for the analysis of computations popularity.

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Research project 16 – Graph-based Learning Techniques for Tasks Popularity and Similarity in Proactive Computional Caching

Laboratory: CEA-Leti/DSYS

Keywords: Telecommunications, mathematics: 5G, networks, mobile edge cloud, wireless communications, caching, computational caching, graph-based learning

Project description

The future of mobile communications will be characterized by ubiquitous connection availability, very dense networks in terms of number of users and access points, ultra-low latency, very high bandwidth, and energetic efficiency. The exchange of data and information over the network will be extremely fast, copious, and secure, radically improving users' quality of experience and introducing new business models for service providers and stakeholders. The 5G network revolution will be enabled by cutting-edge technological innovations, concerning millimeter-wave radio communications, baseband and RF architecture, resources virtualization, and much more. Further, a vertical reorganization of the roles of the network components will be necessary. A game-changing idea consists in empowering the mobile edge of the network with data elaboration and storage capabilities, thus bringing cloud support the closest possible to the user. This paradigm is called *Mobile Edge Cloud (MEC)* [1]-[4].

In the proposed internship work, we consider MEC empowered by small cell access points, endowed with hardware and software resources adapted to handling the three main pillars of modern networks: *communication, computing, and caching (C^3)*.

Research agenda and goals:

The research will target the design of solutions for *joint allocation* of the C^3 resources [5]-[9]. Classically, distributed caching involves storing "popular" content at the network edge, making it quickly retrievable for users [10]-[13]. With this work, instead, we intend to explore the very recently-proposed and innovative concept of *computational caching* [14], [15]: reducing latency and optimizing precious computational resources by reusing the same processing results for different users. In other words, computational caching consists in *storing popular computation results instead of content*, thereby preventing recurrent elaboration of the same tasks and minimizing redundant processing. Among the many advantages, this technique guarantees much faster service delays, an increased availability of computation resources, and power consumption reduction at the MEC side.

The state of the art on computational caching assumes a one-to-one match between users' computation requests and retrievable processing results. The candidate will investigate extension of the problem to the case of *approximate task retrieval*, for which even partial and not necessarily complete computation results can be cached and retrieved to speed up users' tasks elaboration. This investigation will require the use of advanced signal processing and mathematical tools known as graph-based machine learning, exploiting approximate computing principles. Graph-based learning

will be adapted (and, if necessary, redesigned) to our specific context and exploited to define several "similarity" policies to match computation requests and retrievable information in distributed caches. The main goal of the internship is to mathematically formalize the concept of approximate task retrieval and understand how similarities and correlation among tasks can be efficiently measured and exploited for computational caching.

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Research project 17 – Deep learning-based techniques for new 3D medical imaging systems

Laboratory: CEA-Leti/DTBS/LDET

Keywords: deep learning, X-ray tomography, multi-energy, medical imaging

Project description

The CEA-LETI Detector Laboratory has a long experience in the development and use of innovative CdTe semi-conductor detectors. Advancement in photon counting detectors show great promise for the emergence of a new type of medical imaging technology with many potential applications such reducing dose or quantitative contrast agent imaging. The feasibility of spectral computed tomography systems is demonstrated but the current performance of photon counting detectors is still far from being perfect. In practice, different physical effects degrade the detector response and require a method to compensate for spectral distortion.

The aim of the internship is to develop deep learning based techniques (convolutional neural network) to address spectral distortion of photon counting detectors. A comparison with existing methods will then be performed on simulated and experimental data acquired using simulation tools and experimental benches of the lab. In order to carry out this study, the student will benefit from the expertise of the members of the lab which associate skills in physics, modelling simulation and information processing.

Recommended background and skills:

The candidate must have a strong background in deep learning and signal / image processing. Programming skills: python and C (optional)

Research project 19 – Study of enzyme complexes involved in Heparan sulfate biosynthesis

Laboratory: CEA/CNRS/UGA-Institut de Biologie Structurale

Keywords: Purification of enzyme complexes, involved in heparin sulfate biosynthesis and endogenously expressed by HeLa cells, for Identification and characterization by mass spectrometry

Project description

Heparan sulfate (HS) is a complex polysaccharide of the glycosaminoglycan (GAG) family, ubiquitously present on cell surfaces and within extracellular matrices. HS influences embryonic development as well as adult physiology through interactions with various proteins.

Similar interactions also implicate HS in various pathophysiological settings, including cancer, amyloid diseases, infectious diseases, and inflammation.

These interactions depend on HS structure, which is largely determined during biosynthesis by Golgi enzymes. HS is synthesized in the Golgi network through complex, concerted action of several distinct enzymes, and how these enzymes organize this machinery is far from fully understood.

Our goal is to characterize the nature and the organization of these enzyme complexes by the combination of affinity purification and mass spectrometry (MS). The objective will be to determine the best strategies to prepare enzymes or enzymes complex samples for MS analysis. This work could decipher the supramolecular organization of enzyme complexes involved in biosynthesis of HS.

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Recommended background and skills: Cell culture, co-immunoprecipitation, Cross-linking, Western blot

Research project 20 – Automatic Configuration of Location Privacy Protection Mechanisms

Laboratory: CNRS/Grenoble INP/UGA – Gipsa-Lab

Keywords: control for cyber-physical systems, privacy preserving, anonymity

Project description

Location Based Services such as navigation or recommendation applications (Google Maps, Facebook, TripAdvisor) have been widely adopted by people using mobile devices due to their user-friendly behaviour, increase in productivity, time saving. Although location-aware systems have improved the quality of many services, such systems rise important concerns about privacy. To overcome this Protection Mechanisms have been proposed but without considering data utility. This can be problematic because data with a very low utility can degrade the accuracy of further analysis or even produce wrong conclusions. The real challenge is to dynamically anonymize data such that meaningful analysis can still be performed on it while ensure the privacy of users who contributed.

Here we focus on geographic data such as GPS position and location paths and our purpose is to build algorithms that automatically guarantee user privacy and data utility. To do this we build mathematical models describing privacy/utility variation and use optimisation theory or predictive algorithms to guarantee this. Test are first done in simulation with Matlab and on collected data from smartphones.

Recommended background and skills:

High motivation is essential. Knowledge in optimisation or control theory is needed. Help for implementing the developed algorithms will be assured by Sophie CERF, PhD student at GIPSA-lab or from our partners in IBM Zurich.

Research project 21 – Control of Systems in the presence of Cloud Environment Constraints

Laboratory: CNRS/Grenoble INP/UGA – Gipsa-Lab

Keywords: disturbance rejection, nonlinear control systems, control for computers, cloud computing

Project description

Recent technological developments have led to a sharp rise of the amount of data used in every day application. For this purpose Google developed MapReduce, a tool for analyzing large amount of unstructured data. Although to some extent its use is already wide-spread in industrial settings, ensuring performance and availability constraints for such a complex system poses great challenges. During our previous work, we addressed many of the challenges affecting MapReduce. Specifically, by pursuing a control theoretical approach, we provided several closed-loop strategies to simultaneously ensure performance and dependability constraints of a multi-user MapReduce workload.

The main objective here consists of relaxing some of the assumptions related to the effect of resources saturation. When saturation comes into play, the resulting closed-loop system is nonlinear and this can lead to very complex behaviors whose analytic characterization is far from trivial. To overcome this problem, the candidate will build on robust control tools based on semidefinite programming. All this is to be done by optimizing the number of utilized resources. The approach will be fist validated in Matlab on the experimental set-up constructed here at GIPSA-lab and then online in the Grid 5000 cluster.

Recommended background and skills:

Knowledge in optimisation or control theory is needed. Help for implementing the developed algorithms and testing in Grid5000 will be assured by a PhD student here at GIPSA.

Research project 22 – Magnetic Control of attitude dynamics for CubeSat

Laboratory: CNRS/Grenoble INP/UGA – Gipsa-Lab

Keywords: Control Engineering and Systems, Filtering and Estimation, Aerospace Dynamics

Project description

Controlling the satellite attitude requires sensors to measure its orientation, actuators to apply the torques needed to re-orient the satellite to a desired attitude and algorithms to control the actuators based on: (1) sensor measurements of the current attitude and (2) specification of a desired attitude.

Pointing, acquisition and tracking of a targeted optical ground station with the specified small FOV of the detector is probably the most critical part. In this project we are interested to the attitude control problem for Cubesat. Multiple actuators are used in the Attitude Determination and Control System (ADCS) such as reaction wheels and magnetotorquers. For (very) accurate missions the jitter of reaction wheels may be dominant in the performance of the payload. For that reason it could be better to only use magnetotorquers. A known attitude control algorithm for magnetic control (especially for detumbling) is the B-dot control. This control algorithm could be the basis for a robust control for a smallsat/cubesat. Magnetic control nevertheless has limitations, as it has singularities in the control. Still, it is desired to have a fast control to stabilize the spinning (detumbling) of the satellite, while also being able to have very fine control.

The internship subject will focus on the development of a scalable algorithm for the attitude control based on magnetorquers. The outcome of the internship will be a functional algorithm and design guidelines for the control range of the magnetorquers, based on the required fine accuracy, speed of stabilization and available power.

Research project 23 – Thermal runaway propagation study in Li-ion module

Laboratory: CEA-Liten/DETH/LPM

Keywords: Li-ion batteries, thermal runaway modeling, heat transfer, Comsol Multiphysics

Project description

The safety issues of lithium ion batteries, especially those associated with thermal runaway (TR), have generated much attention these last years. Once the TR is triggered within a single cell, cell-to-cell thermal runaway propagation can result in catastrophic hazards.

A 3D thermal runaway model was developed at the module level with Comsol Multiphysics. The model is based on energy balance equation at cell level, and includes the different heat transfer modes at the module level. This numerical approach will be validated by an experimental study, in which the thermal runaway propagation on an assembled mini module in specific abuse conditions is performed.

As part of this work, you will first aggregate, analyze and mine the experimental data. Next, you will use the existing model to analyze its accuracy by comparing simulated data with the experimental results. Thus, you will contribute to the improvement of the modeling development, understanding of propagation thermal runaway mechanisms within a module. Finally, through this work you will be able to formulate recommendations for the design of safer modules.

Recommended background and skills:

- Basic knowledge of Comsol Multiphysics
- Knowledge of heat transfer modes
- Understanding of operating principles of Li-ion batteries is a plus
- Available for 12 weeks

Research project 24 – MEMS based on carbon nanomembranes for large band ultrasound device

Keywords: MEMS, Nanomembrane, Acoustic, c-MUT, modelling, microresonators, characterisation

Project description

Amorphous carbon synthesized in layers of nanometric thicknesses has demonstrated such mechanical properties of elasticity and toughness that new concepts of pressure transducers with unprecedented performance in sensitivity and bandwidth can be envisaged. Sensors or actuators made with such an ultrafine membrane have very large amplitudes of deformation, from the very low frequencies, and up to the resonance frequency. The project proposes to explore the potential of integrated ultrafine amorphous carbon membranes as a vibrating element of ultrasonic transducers.

The student will be involved in the achievement of the proof of concept. He will be in charge of modelling pressure transduction mechanisms when ultrathin membrane are involved, in order to depict the resulting ultrasonic wave characteristics. The available modelling tools are analytic (Matlab) or finite elements (Comsol). Within the safety clearance, he (she) will also participate in the various technical aspects, realization of the devices (simple micro technological operations), physical characterizations (SEM, AFM) and in the electrical and acoustic characterizations (laboratory equipment), so he (she) can get a comprehensive approach of the technical challenges addressed in this applied research upstream.

Recommended background and skills:

Knowledge in solid mechanics and acoustics are required, together with interest in modelling, practical work and characterization.

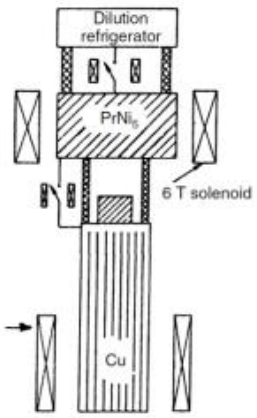
Research project 41 – Development of a Demagnetization Stage for Sub-mK cooling

Laboratory: CNRS / Institut Néel

Keywords: low temperature physics, condensed matter physics

Project description

The Grenoble Ultra-Low Temperatures group cools condensed matter samples to sub-mK temperatures to probe fundamental questions in quantum mechanics. These samples include NEMS (nanoelectromechanical systems) and quantum fluids. Refrigeration by Adiabatic Demagnetization of Cu or PrNi5 nuclei is the most common way to achieve this temperature range [1]. Such a cooler uses a ~10 mK pre-cooling stage provided by a dilution refrigerator. In the present development, we plan to use a He free « dry » dilution refrigerator similarly to previous works [2, 3] but with the goal of providing continuous cooling below 1 mK, which hasn't been achieved so far.



Double-stage nuclear demagnetization refrigerator

As heat switches (HS) are of major importance in the final performance of the system, a first step will consist in characterizing existing HS and improving their performance, in particular the thermal contacts. In parallel, the overall system shall be designed taking into account all the thermal constraints (parasitic loads, thermal resistances, heat capacities, etc) but also the magnetic field aspects (available space in the dilution refrigerator, shielding, etc).

Recommended background and skills:

- Ability to work in autonomy
- Good competencies in low temperature physics and, more generally, in condensed matter physics
- Good skills for experimental work
- English (fluent)

Institut National
Universitaire
Champollion

Internship

academic year 2017-2018

Indoor localisation in Non-Line Of Sight situations

Context and project summary

IoT is not only appealing to companies but also to researchers for several reasons : we expect large numbers of innovative applications to be implemented relying on services such as localization. Localization aims at determining a mobile device position. While the GPS system fulfills this task outdoors, a prevalent solution has yet to be developped for indoor environments. Ultra-Wide Band (UWB) - based solutions are generally considered as suitable thanks to their precision, but some key issues are to be addressed. The main task of this internship is to tackle one of these challenges : a reliable localisation when Non- Line Of Sight communication links are involved.

Research will be conducted as part of the IRT team of the IRIT lab. Situated in the city of Toulouse, Southern France, this Information technologies lab has been contribution to the advancement of the networking field, with a special interest in the Device Layer of the Internet of Things. To this end, a UWB-based testbed has been deployed in the lab and an aggressive radio environment known as the Blagnac intelligent home will be made available to the intern.

https://www.irit.fr/~Adrien.Van-Den-Bossche/projects-decaduino.php

Required skills

- Protocol engineering
- Programming and versioning : Python, C/C++, familiar with Arduino and/or RaspeberryPi environments, Git Electronics (basic skills)
- Must know his/her way around technical documents
- Enthusiasm

Institut National Universitaire Champollion

Internship

academic year 2017-2018

Information Systems & Health

Context and project summary

The core mission of Castres graduate engineering school is to participate in the evolution from a healing to a preventive health care system by training graduate engineers specialized in information systems dedicated to healthcare. This mission is supported by strong relationships with the professional field more specifically the pharmaceutical industry and the elderly home care system, EHPAD. One such establishment, EHPAD AGIR of Castres, positioned itself as a training playground for student projects with various relevant themes : data processing, connected devices...

These projects are typically tutored by professors and senior lecturers who are also members of IRIT (www.irit.fr), a key research facility located in Toulouse.

An EHPAD typically involves elderly patients and healthcare personel. When the former encounter a problem, they can require help from the latter via a dedicated system which relies on buttons placed in the patients' rooms and a local telephony system using radio signals. Although this system works, it could be enhanced to target specific members of the staff : this would in turn enable innovative services and a optimization of the provided care.

The internship consists in the development of a proof of concept: after conducting a feasibility analysis through the analysis of the existing system (messages exchanged between the subsystems, technologies involved, possibilities for configuration…), the intern will propose a middleware enabling both systems to interact in a flexible way.

Required Skills

- Programming : Python, C/C++, familiar with Arduino and/or RaspeberryPi environments,
- Git Electronics (basic skills)
- Must know his/her way around technical documents
- Enthusiasm

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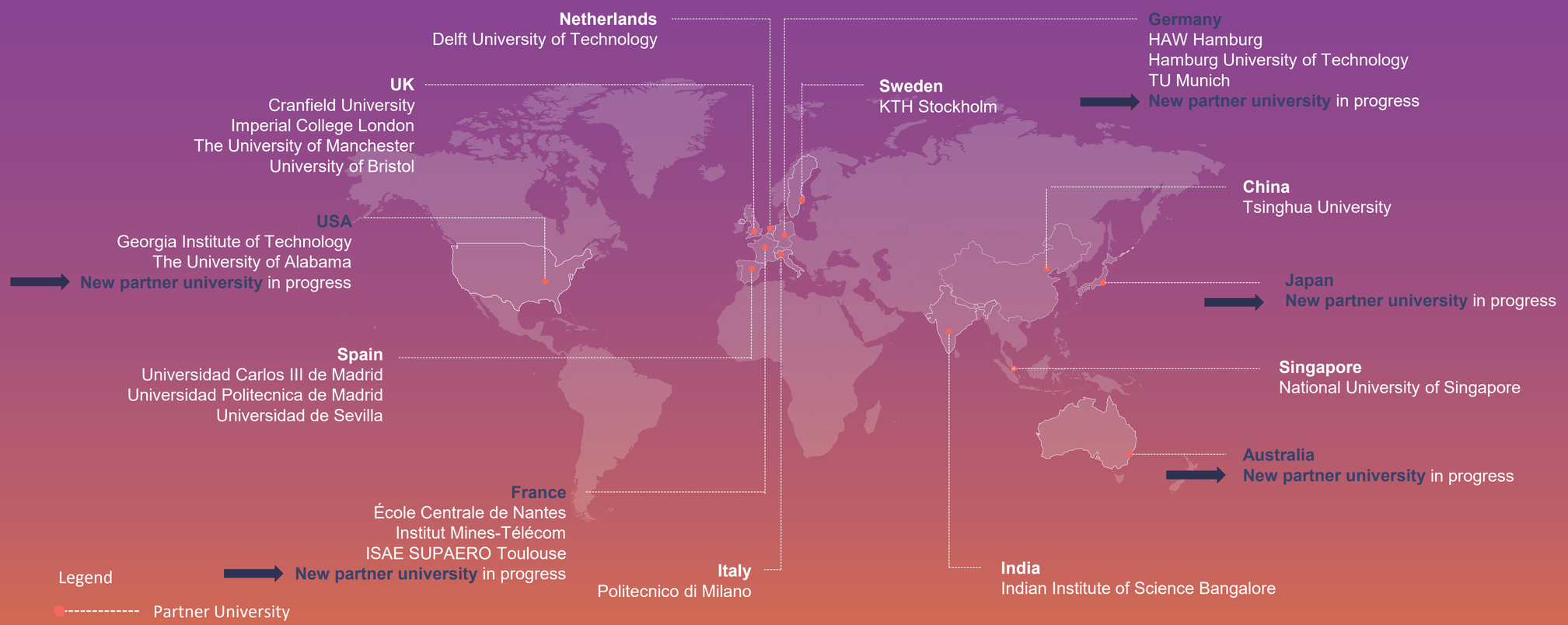
AIRBUS GLOBAL UNIVERSITY PARTNER PROGRAMME WORLD MAP



AIRBUS

CF3D - Carbon Fiber 3D Printer

APPLY NOW >

- Project based in Madrid Spain
- From May onwards (flexible start date) for minimum 3 months length
- **3 positions available**

JOB DESCRIPTION

The goal of the project is to develop a carbon fiber 3D printer in the AIRBUS Getafe ProtoSpace.
This project is part of a wider one in collaboration with FIDAMC (research center in composites materials that belongs to Airbus as a foundation). The aim of this study is to research the additive layer manufacturing using carbon fiber as input material and a first prototype of a 3D printer has been manufactured in FIDAMC facilities already.
The team of interns will develop a 3D printer based on the existing one but taking into account the lessons learned and future improvements recommendations.
Final challenge for AIRBUS will be to print a real aircraft part and test it.

TASKS & ACCOUNTABILITIES

- Extract several lessons learnt from the first 3D Printer prototype made.
- Assemble Hardware and material provided by AIRBUS ProtoSpace to build the Carbon Fiber 3D Printer.
- Program and test the device to optimize results and make changes accordingly.

REQUIRED SKILLS

Different and complementary profiles are desirable so they could learn from each other and work together from different perspectives but under the same objective.
Bachelor or Master degree students from Mechanical Engineering, Electronics (ARDUINOS) y Composite Material fields.

- Very good communication and negotiation skills.
- Dynamic, autonomous and ability to work as a team.
- English fluent.

AIRBUS

AIR – AIRBUS Artificial Intelligence Resources Center

APPLY NOW >

- Project based in Toulouse France
- From May onwards (flexible start date) for minimum 3 months length
- **5 positions available**

JOB DESCRIPTION

The goal of the project is to setup a place able to speed up Artificial Intelligence (AI) dissemination within AIRBUS and where all required resources and support are available to make AIRBUS a leading company in this domain. This goes through the centralization and capitalization of:

- datasets (audio, video, flight records) to train and benchmark AI systems.
- AI software libraries and frameworks to setup and develop quickly proofs of concepts and applications.
- computing and hardware devices to implement solutions.

This place would be supported by a team of AI skilled people to elaborate fast and adequate solutions to any employees' ideas.

TASKS & ACCOUNTABILITIES

The goal of the international internship project is to participate to the development of AIR.

- Benchmarking AI initiatives outside and inside Airbus with partners, universities, start-ups and identify priorities of areas to explore.
- Energize the Airbus ecosystem by the organization of an IdeaSpace campaign, and create a community to communicate around AI.
- Kick-off prototyping related to identified use cases during the campaign.
- Identify missing resources (dataset, SW,…) within Airbus needed for this technology. Propose a way forward, a physical and organizational architecture to boost AI usage for Airbus application.

REQUIRED SKILLS

Bachelor or Master degree students from Artificial Intelligence, Data Management, Engineering, Computer Science , Robotics fields.

- General knowledge of Aerospace is a plus but not fully mandatory.
- Very good communication and negotiation skills, global thinking, achiever and pragmatic mindset, dynamic & autonomous.
- English fluent.

AIRBUS

Aircraft Health Monitoring in Scheduled Maintenance

APPLY NOW >

- Project based in Hamburg Germany and Toulouse France
- From May onwards (flexible start date) for 12 weeks length
- **5 positions available, 3 based in Toulouse and 2 based in Hamburg**

JOB DESCRIPTION

The development of Aircraft Health Monitoring technologies is considered as a major opportunity to improve existing aircraft scheduled maintenance programs in the near future, by providing alternative means of compliance. Associated with Airbus in-service data collection latest improvement, it allows development of new maintenance solutions to maximise Aircraft availabilities.

TASKS & ACCOUNTABILITIES

- Identify candidate Systems that could benefit from Health Monitoring technologies to improve existing maintenance programme.
- Determine what are the necessary in service data to collect and ensure their availability within Airbus data collection systems.
- Inventory the reporting operators and the means they use to report scheduled maintenance data.
- Analyse according to the Maintenance Information System used by operators the technical improvements that can be envisaged to ease and automatize the data reporting.
- Prepare communication to operators in order to propose them the identified way of improvements.
- Develop algorithms that ensure alternative means of compliance to existing schedule maintenance programme.
- Benchmark Maintenance costs & Aircraft availability versus existing Scheduled maintenance programme.

REQUIRED SKILLS

The project necessitates a collaborative behaviour from the students with different profiles.

- Bachelor or Master degree students from Aerospace, Aircraft systems, Data Science, Computer Science fields.
- English fluent.

AIRBUS

Future Engineering OpenLab

APPLY NOW >

- Project based in Toulouse France
- From May onwards (flexible start date) for 6 months length
- **5 positions available**

JOB DESCRIPTION

Going from idea to virtual product and finally to real product takes a very long time, costly, is hard to visualize and understand interdependencies in design of complex systems and access to crowd-source type expertise is limited due to complex/tribal and disconnected types of design environments. Today in the gaming world we begin to see a trend and opportunity for applying new thinking and technology to make a disruptive step in the engineering design space.

This project aims to create an Engineering environment where “Ideas” are directly created as “digital products”; opening up the ideation space to a much broader population.

TASKS & ACCOUNTABILITIES

- Product conception through “Serious Gaming and/or Game with a Purpose GWAP” where Engineers are directly assembling components coming from “Enterprise/gamified Model Repository” and/or GWAP techniques to optimize solutions (Examples: Nanocrafter, Foldit, Scrap Mechanic, Minecraft, Eve Online).
- Enable a new and more interactive design environment “User experience” through an immersive environment 4D or plus (AR/VR, Hologram, 3D print.
- Idea materialized as “Digital Product” is the starting point for “Digital Twin” and could be reused as a prototype.
- Create an “OpenLab” where students, start-ups and maybe any other people can “propose”, “Test”, “collaborate” and “share” new ideas as “digital drafts” and or “modules” like building blocks (including different games for different levels of problem) + a tiered platform approach for integrating multiple/different games and or scenarios into a final product construct.

REQUIRED SKILLS

Bachelor or Master degree students with fluent English, in total we are looking for 5 different profiles:

- User Experience Designer (Low fidelity mockup tools such as Balsamiq, UXPin, Mockingbird,Gliffy).
- Serious games (Unity 3D, Unreal Engine, Gpure, Blender).
- AR/VR expert (tools: Unity 3D, Unreal Engine, Gpure, Blender).
- System Engineer (SysML, system architecture tools: Cameo or Rhapsody, engineering tools: Matlab Simulink, 3DExperience, Modelica, Amesim).
- Software Developer (Python, Java, Javascript, C, C++).

AIRBUS

Airbus Holographic Academy

APPLY NOW >

- Project based in Toulouse France
- From May onwards (flexible start date) for 12 weeks length
- **3 positions available**

JOB DESCRIPTION

The project is to integrate the Airbus Holographic Academy to research and develop AR/VR technologies that could disrupt current business applications. It aims also to raise awareness of business owners by introducing the technology and researching on the field new business application (UX). Finally, AIRBUS is expecting to build interfaces that makes the technology transparent to the user, according to the most appropriate technology selected for the application.

TASKS & ACCOUNTABILITIES

- To analyse and guide business owners to the most appropriate technology according to their needs.
- Master cutting edge technologies and build good-enough application to make them commonalities.
- To research and understand very rare technologies and project their impact to build the future of the company.

REQUIRED SKILLS

Bachelor or Master degree students with fluent English, in total we are looking for 3 different profiles:

- 3D developer (3D Unity).
- Technical artist (link between 3D developer and UX Designer, technical knowledge in ·3D Unity and 3Ds Max will be valued).
- UX designer (3Ds Max – Blender).

Positive and constructive person, who listen other people and can explicit complex ideas with simple wording and schematics.

AIRBUS

Tool To Visualize Primary Flight Control System Parameters

APPLY NOW >

- Project based in Toulouse France
- From May onwards (flexible start date) for 6 months length
- **2 positions available**

JOB DESCRIPTION

In the frame of e-rudder development, the objective of the internship would be to develop a tool enabling to visualize on Aircraft (in Final Assembly Line or in-Flight Line) all the parameters associated to the status of the ATA27 Primary Flight Control System. In a context of industrial ramp-up of the Single Aisle production this project is a key enabler to improve the performance of our industrial capacity.

TASKS & ACCOUNTABILITIES

- Collection of needs, requirements specification.
- Architecture definition (Hardware and Software).
- PC laptop tool development:
  - Collection of parameters / Processing of ARINC frames emitted by system.
  - Visualization tool of these parameters.
  - Possibilities to test some function through this tool to be assessed (servoloop of one ServoControl).
- Use inputs from similar tools developed on A380 & A350 to support the study.

REQUIRED SKILLS

- Bachelor or Master degree students with fluent English.
- Input processing, electronics, Real-Time.
- Software development (C,C++, Python…).
- HW/SW architecture.

AIRBUS

Airline Sciences

APPLY NOW >

- Project based in Toulouse France
- From May onwards (flexible start date) for 6 months length
- **5 positions available**

JOB DESCRIPTION

Airline Sciences team is a melting pot of newcomers and senior experts from all around the world, organized in Agile way and strongly dedicated to the establishment of new standards in aircraft evaluation. Airline Sciences is about combining tool kits from Marketing, Design and Airlines Operations Support Services to:
Ensure the delivery of reliable aircraft economics, to design the right aircraft for our customers to maximize Airbus' profitability, and finally to provide the ability to play out airline scenarios to explore new markets and/or yields.

TASKS & ACCOUNTABILITIES

- Ensuring a continuum in aircraft representation, adjusted through operations feedbacks enabling airline tactical gains.
- Designing aircraft and engine using actual airline operations.
- Combining market forecasts and airline simulations.
- More generally speaking, Fuel Policy, consumption, traffic, revenue, maintenance... are as much parameters considered by Airline Sciences team.

REQUIRED SKILLS

Bachelor or Master degree students with fluent English, in total we are looking for 5 different profiles:

- Maintenance/Cost.
- Revenue/Network optimization.
- Traffic/Airport/ATC.
- Flight Performance/Fuel Policy.
- Engine Performance/modeling.

Following knowledge or expertise will be valued: Applied mathematics, Aerospace Engineering,
Object oriented programming (Java, C++, Python), Data Science toolkit (numpy, scikit learn pandas, tensorflow).

AIRBUS

HR4HR Developing Learning Solution

APPLY NOW >

- Project based in Toulouse France and Hamburg Germany
- From May onwards (flexible start date) for 5 months length
- **3 positions available,** 2 based in Toulouse and 1 based in Hamburg

JOB DESCRIPTION

HR4HR, a transnational & cross-divisional team spread across 8 sites acting as Human Business Partner for HR and developing learning solutions for HR. The mission of the interns' team will be to develop HR one step forward with a new portfolio in the catalogue of alternative learning solutions.

- Analysis of the current portfolio between e-learning, classroom trainings and alternative learning solutions and the H competences addressed, gap analysis versus the H competence strategy, competence analysis of the H population.
- Proposal of alternative learning solutions that can answer competences not addresses through current offer and not yet largely developed.
- Design of alternative innovative learning solution not yet addressed in the portfolio (e.g. learning expedition or videogame).
- Conduction of pilot to test the solution proposed.

TASKS & ACCOUNTABILITIES

- Work as a transnational team in different locations.
- Conduction of a project from A-Z, starting by analysis and ending by implementation.
- Evolve and look for informat8ion in a complex environment (CKL J).

REQUIRED SKILLS

- Ability to work in a team.
- Fluent level of English required.
- International experience will be valued.
- Student from Engineering or Business and Administration fields.

AIRBUS

Collective team goals and collective Reward

APPLY NOW >

- Project based in Toulouse France
- From May onwards (flexible start date) for 6 months length
- **3 positions available**

JOB DESCRIPTION

Out of several feedbacks from the business we recognize a rising interest to connect collective goals with collective reward. There are some pitfalls with respect to mind-set / culture, national / legal binding rules, implementation within a changing environment.

- The aim of the mission is to design, test and implement new idea how to foster team goals and especially how to link those team goals towards collective reward using a test environment (POC).
- The team will have to setup a project management plan, KPI's and start the design by getting the most relevant stakeholders view on board.
- Design the process and if necessary the means (tooling) to support collective goals and reward. The main deliverable will be the proof of concept - implementation in a smaller environment.

TASKS & ACCOUNTABILITIES

- Work as a transnational team in different locations.
- Conduction of a project from A-Z, starting by analysis and ending by implementation.
- Evolve and look for information in a complex environment.

REQUIRED SKILLS

Bachelor or Master degree students with fluent English (French would be valued).
To get the most out of it and to embark diverse cultural and technical skill (IT, HR, business, legal) we aim at an international team of students from diverse areas not necessarily HR only. The team should have a strong focus on delivery and implementation.

- IT/Data driven.
- Knowledge of Project management.
- General Business skills.

AIRBUS

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www.airbus.com

AIRBUS

JOB OFFER – INTERN – JUNIOR CONSULTANT

ENEA is a consulting firm that works with large multinationals (e.g. TOTAL, ENGIE, BNP Paribas, Danone) and institutions (e.g World Bank, UN, the French government) on their energy transition strategies. Our 60 team members are based in our offices in Paris, Hong Kong and Melbourne and we are growing fast.

ENEA are currently looking for an intern, for 6 months starting July 2018 with a strong interest in the energy transition. The candidate should be finishing their bachelor or a master degree at a top university, and looking to make an impact in the shift to a decarbonised, decentralised and digitalized energy system.

We are looking for someone eager to convince global clients of the importance of energy and climate challenges; someone ready to support them in their energy and environment transition, in order to develop sustainable, long-term business.

As well as exciting projects, we also offer a great social experience, with weekly yoga classes, weekly staff breakfasts, and regular team discussions on the energy transition. Our office is situated in the heart of Paris, surrounded by great restaurants and cafes.

Are you in?

As an intern, you will:

- Contribute to projects by:
  - Preparing quantitative and qualitative analyses.
  - Providing recommendations/solutions, under the supervision of an experienced consultant or a manager
  - Attending and participating in client meetings to present your findings and recommendations.

Main skills:

- "Technical skills": strong analytical skills, MS Excel and PowerPoint. Coding skills (Python, VBA) a plus.
- "Functional skills": good oral and written communication, synthesis capabilities, good time management, intellectual honesty and rigor, curiosity, open mindedness, empathy and team spirit.
- Languages: Fluent in both French and English – able to present results and to interact with customers during meetings
- Previous experience in consulting will be highly valued.

Consulting projects at ENEA:

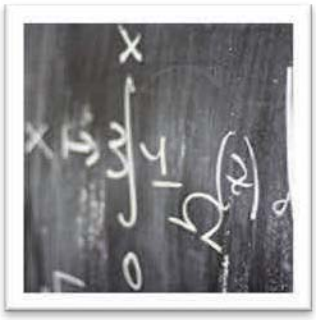
Typically, projects include the following elements:

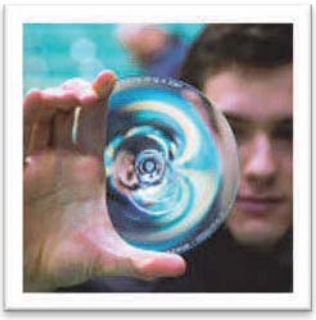
- **Clients**: Oil & gas firms (TOTAL, ENGIE, Statoil), industrial companies (Danone, Vinci, Heineken), investors (BNP Paribas, PE funds), public institutions (World Bank, UN) and startups. We work with actors from the world's largest energy companies, to SMEs.
- **Topics:** Many topics on the energy transition – renewable energy in industry, biogas, hydrogen, smart grids, clean cooking, distributed energy, storage, power-to-gas, energy finance, and our favourite topic: micro-algae
- **Project duration**: from 10 days to 12 months
- **Project team size**: 2 to 6 people
- Projects are mostly carried out in ENEA's central Paris office, but with frequent interaction with clients

INTERNATIONAL ACADEMIC EXCHANGE PROGRAM

General information about the Program

Address	École Polytechnique Direction du Marketing et des Relations Internationales Route de Saclay 91128 Palaiseau Cedex – France
Contact	Ms. Eglantine Jastrabsky Exchange-international@polytechnique.fr
Website	www.polytechnique.edu
Further information on the International Academic Exchange Program	https://portail.polytechnique.edu/admissions/en/non-diplomants/international-academic-exchange-program
Erasmus code	F PALAISE01





Admission

L'École Polytechnique welcomes exchange students willing to follow courses for one or two semesters. If you wish to study as an exchange student at l'École Polytechnique, you should first contact the Exchange coordinator at your home university.

Be sure that your school is on l'École Polytechnique's list of worldwide partner institutions. **L'École Polytechnique will only process applications that have been nominated by their home institution.**

The International Academic Exchange Program is open to students at the following levels:

- **Undergraduate: Bachelor's students in their 3rd or 4th year**
- **Graduate: Master's students in their 1st year**

Course registration and Academic information

In this exchange program students enroll directly in courses in the 2nd or in 3rd years of the *Ingénieur Polytechnicien* curriculum and take classes together with regular students.

Semester dates (2nd year)	Courses start on late August **Fall Semester:** August to December **Spring Semester:** January to June Company internship is not open to Exchange students.
Semester dates (3rd year)	Courses start on early September **Fall Semester:** September to February **Spring Semester (research internship):** March to August The scientific research internship is open to Exchange students under certain

	conditions and can be carried out in one of l'École Polytechnique laboratories.
List of Departments	http://www.polytechnique.edu/en/departments
Course Catalogue	https://moodle.polytechnique.fr/?langue=EN
Language Proficiency	As most of the courses are taught in French and as exams are to be taken in most case in French, applicants must prove a good knowledge of the French language to be admitted. A B1 level in French is required at minimal. For courses taught in English, a B1 level in English is required at minimal. A2 level in French is fully recommended.
Semester workload	20-30 credits or ECTS suggested.
Academic Transcripts	Request for Official *transcripts* of Academic Records can be made in July each year. The Official *transcripts* of Academic Records will be sent to the student and his or her Exchange coordinator/ Contact person by email.

Application deadline

Only ONE session of application

Start of the Application session: February 1st, 2018
Deadline to apply for the Program: April 20, 2018
Start of courses: late August or mid-September 2018

Application Process

Nominations should be made by the university exchange coordinator by email to the contact person above containing **the students' name, level of study at his or her home university, gender, date of birth, nationality and email address.**

Application from the Students: student must apply and send by email only the required documents listed on our website. **To find out more on the application process**

Other Useful Information

L'École Polytechnique has a specific office to support international students' stay in France and assist them through mandatory formalities such as immigration visa, health insurance, accommodation and all sorts of administrative matters. The office is called International Student Support & Services Office (in French BASIX). Once admitted, each student will receive an email with all information to prepare his or her arrival on campus.

L'École Polytechnique provides an orientation program, a few days before starting of the courses designed to help students find their way on the campus and give them tools for a successful exchange period with us!

Fees & Estimated costs of living on campus

Tuition fees for exchange students admitted into the International Academic Exchange program are of 2.500€ per semester. No tuition fees are charged for students admitted in the framework of a partnership between their home university and École Polytechnique.

800 euros per month is the estimated amount required to cover all major living costs including accommodation, food, health insurance, study material, transport and other personal expenses. The application for the International Academic Exchange Program includes an offer for an individual room on campus at the rate of 450 euros/month. **Further information** is available on-line.

Visa

All applicants who are not EU citizen need a visa to study in France. In order to get a visa, you must apply for one with the original certificate of admission issued by l'École Polytechnique at the French Embassy or Consulate in your home country.

IPL Summer School 2018

Science & Engineering program

A multidisciplinary approach to the subject of Energy and Sustainability.

Most of the largest challenges we will face in the future (global warming, increasing scarcity of fossil fuels, the impact of production methods and materials, etc.) are related to how we produce and use energy and the consequences of those actions. The course aims to teach future engineers the industrial and regulatory context, the technical concepts and tools needed to comprehend these challenges, and explore the solutions of tomorrow.

Drawing from ECAM Lyon's expertise in the areas of energy, electrical and mechanical engineering, as well as materials science, this program is composed of a series of lectures and practical courses that will include case studies, labs and individual work on the themes covered. Students will also be asked to work on a team project that will be presented at the end of the course.

For program and application details, go to: http://www.iplsummerschool.com/index.php

Total credits: 6 ECTS[1], European Transfer System

Hours: 54

	Session - Course content [2]	Instructor	Hours
1	**Regulatory context of sustainable energies**	Dominique Seguy, Consultant in Operational Management in the energy sector	4
- Laws and regulations: European and National regulatory context; post COP 21-COP22 - Institutional support to promote and encourage sustainable energies - Industrial sector of HVAC in France and Europe - Perspectives for bioenergy and biomass in France			
2	**Circular Economy and the energy sector**	Dominique Seguy, Consultant in Operational Management	4
- Circular economy: what is it and how does it apply to the sector of sustainable energies? - Wood industry - Biogas plants and industry; waste energy - Bioenergy & Biomass: organization of the sector - Focus on District Heating			
3	**Visit of boiler plant in district heating with double energy production**	Dominique Seguy, Consultant in Operational Management	4
4	**Production of Electrical Energy 1: Nuclear power plant & Power grid**	Prof. Thierry Bailles &, Professor-Researcher in the Energy Department	3
- Operating principle of a nuclear reactor, fission chain reaction, schematic diagram of a nuclear power plant with electro-mechanic-thermal conversion, performances - Three-phase and one-phase power grid, currents and power calculation - Electrical test with a transformer and some receivers			
5	**Production of Electrical Energy 2: Photovoltaic, Wind turbine**	Prof. Thierry Bailles, Professor-Researcher in the Energy Department	3
- Operating principle of a photovoltaic cell, main characteristics, performance of a solar panel installation, examples of applications - Test of a solar panel - Operating principle of a wind turbine, main characteristics, conversion of mechanical energy to electrical energy with or without coupling network, with synchronous or induction generator, schemes of associated electronic convertor, installation examples. - Test bench of the coupling network of a synchronous alternator			

[1] Equivalent to 3 or 4 US credits.

[2] The school reserves the right to modify the course modules and/or their content for updating or improvement purposes.

6	**Production of Electrical Energy 3: Fuel Cells**	Prof. Christophe Jouve, Head of the Automation & IT Department	3
- Operating principle of a fuel cell, main characteristics, performance, hydrogen generation and stocking means, applications examples (e.g. electric vehicles) - Test bench of a 500W fuel cell			
7	**Efficiency and Control System**	Prof. Christophe Jouve	3
- Presentation of an industrial programmable logic controller PLC, performances and industrial applications. Drivers & controllers of actuators. Rules of regulation. - Test bench of a device with on-off inputs and outputs and of a small process control, small controller programming and analysis of the system response.			
8	**Energy: From primary sources to sustainability I**	Prof. Alexandre Vaudrey, Professor-Researcher in the Energy Department	3
- A short reminder of the two laws of thermodynamics and their consequences on the management of energy and environment: why we must take energy from somewhere, but it cannot come from anywhere. - What we need and what we have: what are the primary energy sources (PES), energy carriers (EC) and final energy (FE)? Why do we always need to convert, to transport and to store energy? - How to assess all energy systems: is it better to talk about efficiency or effectiveness? What are the other typical performance criteria and when are they used? How should the environment be taken into account in our calculations?			
9	**Energy: From primary sources to sustainability II**	Prof. Alexandre Vaudrey	3
- Current state of our world: what are our actual primary sources and how are we using them? - The problem: what is the Energy Transition and why must we care about sustainability? - The future: what are the possible solutions for tomorrow? What are the critical parameters to take into account before adopting a new technology? How to stay hopeful.			
10	**Heat Ventilation and Air Conditioning (HVAC) systems and energy consumption of buildings**	Prof. Alexandre Vaudrey	3
- Thermal comfort and acceptable indoor air quality in buildings. - The concept of humid air: importance of temperature and humidity. - How does an HVAC system works. - Energy balance and efficiency of HVAC systems. - Laboratory work: practical use of a real HVAC equipment with case studies.			
11	**Structures: Materials Science**	Prof. Atilla Atli, Prof. Philippe Jacquet, Professor-Researchers, Materials and Structures Department	3
- Classification of Materials and their common properties. - Materials in photovoltaic solar panels. Methods for their characterization in our laboratory from the point of view of material science - Laboratory work: characterization of a photovoltaic solar cell by different techniques			
12	**Group Project**	ECAM Lyon instructors	5 x 3h sessions
- Research project related to one of the subjects covered during the course - Students work in teams; regular contact with supervising professors			
13	**Final evaluation + oral presentation**	ECAM Lyon instructors	3
- Final exam covering the taught classes and laboratory work - 20-minute oral presentation of the group project followed by questions from the panel of professors			

Numerical Investigation of Windage Power Losses in a Planetary Gear Set

Yann MARCHESSE – Christophe CHANGENET
LabECAM / ECAM LYON

In high-speed gear units, the power loss generated by the rotation of parts in air/oil mist can become predominant. In the case of a planetary gear set (Figure 1), the planets, the sun and the ring gears may all contribute to these power losses that are mainly called windage power losses (WPL). It is then crucial to investigate the effect of operating conditions and design features on these losses for improving the performance of gears. A number of investigations have been therefore carried out to understand the relevant physical phenomena and quantify these losses. As an example computational fluid dynamics (CFD) method has been previously employed successfully when estimating WPL considering spur [1] or helical [2] gears (Figure 2).

As previously mentioned, three sets of gears usually compose the most basic form of planetary gearing: the planets, the sun and the ring. The trajectory of the axes centers of each rotating planet gears is circular around the sun that spins in place, and a ring binds the planet. The relative movements of these gears depend on the type of transmission.

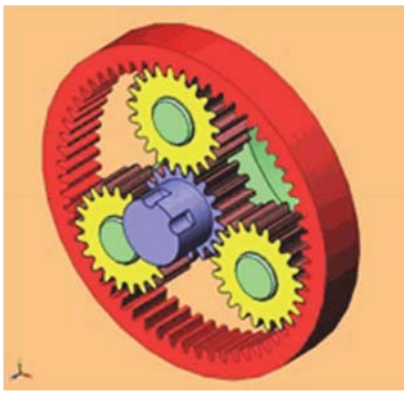
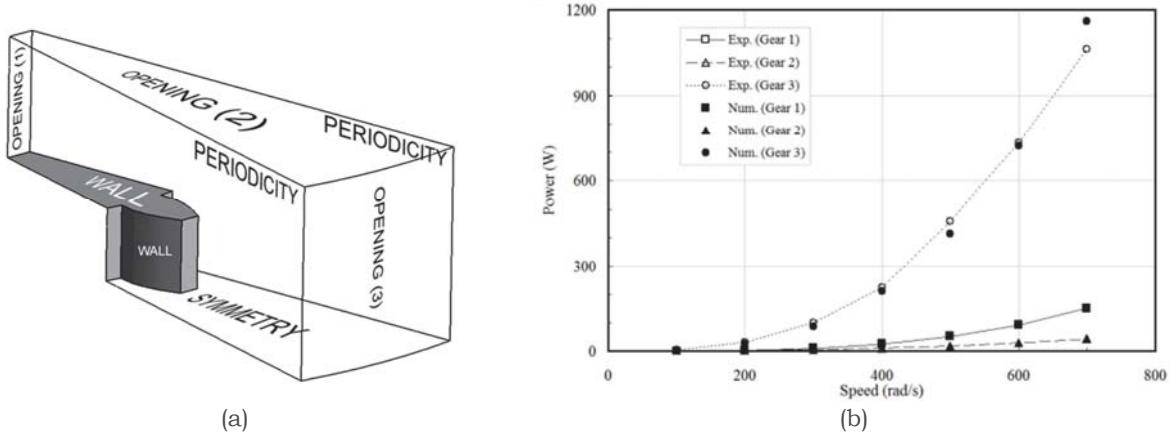


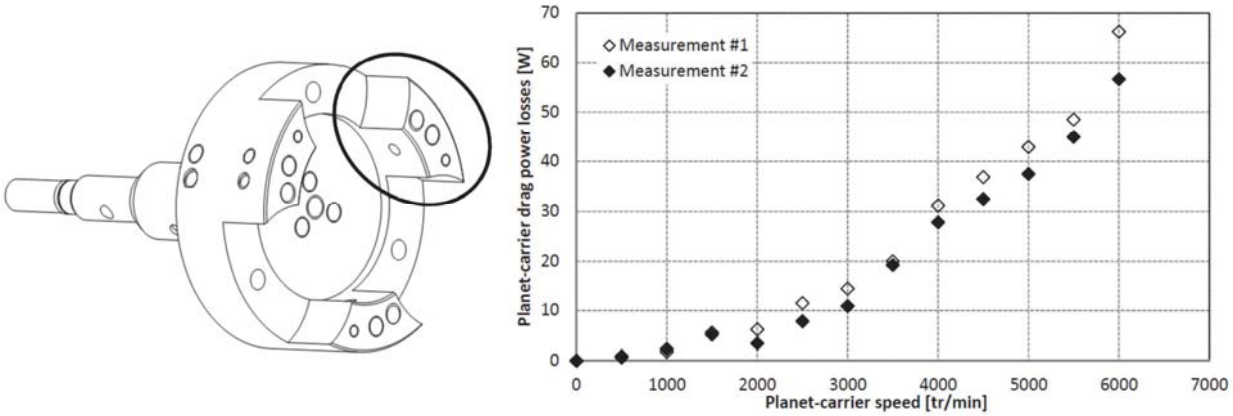
Figure 1: planetary gear set.

The purpose of the project is to study the windage power losses only when both the planet- carrier and the ring are present. In a first configuration the planet- carrier will move near a stationary ring while a second configuration will consider a moving ring in front of a stationary planet-carrier. For that a CFD method will be used in order to predict the fluid motion on both cases. The numerical prediction of WPL will be then compared with experimental data obtained from a test rig (which is located at ECAM Lyon) when the first configuration is considered (Figure 3).



(a) (b)

Figure 2: a, sketch of the computational domain and presentation of the boundary conditions imposed at external surfaces; b, windage power losses estimated experimentally and predicted from numerical approach (from ref. [1]).



(a) (b)

Figure 3: a, planet-carrier; b, measured planet-carrier drag power losses (from ref. [3]).

[1] S. Pallas, Y. Marchesse, C. Changenet, F. Ville & P. Velex, « *Application and validation of a simplified numerical approach for the estimation of windage power losses in spur gears*, » 2013, Computers and Fluids, 84, pp. 39-45.

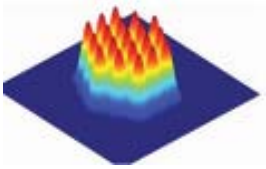
[2] N. Voeltzel, Y. Marchesse, C. Changenet, F. Ville & P. Velex, « *On the influence of helix angle and face width on gear windage losses*, » 2016, J. of Mech. Eng. Sc., Proc. of the Inst. of Mech. Engineers Part C, 230(7-8), pp. 1101-1112.

[3] J. Durand de Gevigney, C. Changenet, F. Ville, P. Velex & S. Becquerelle, « Experimental investigation on no-load dependent power losses in a planetary gear set, » 2013, Int. Conf. on Gears, Garching (Munich - Germany), Oct. 7-9, 2013.

ILL WORK PLACEMENT OPPORTUNITIES 2018

The Institut Laue-Langevin (ILL, www.ill.eu), situated in Grenoble, is an international research centre at the leading edge of neutron science and technology. As the world's flagship centre for neutron science, the ILL makes its facilities and expertise available to visiting scientists from all over the world.

Every year we offer a large variety of highly interesting placement subjects allowing students to:



- Contribute to the development of scientific research
- Participate in the implementation of advanced technology projects
- Work in an international context while living in an area of outstanding beauty**...(**tourist info, photos**)**

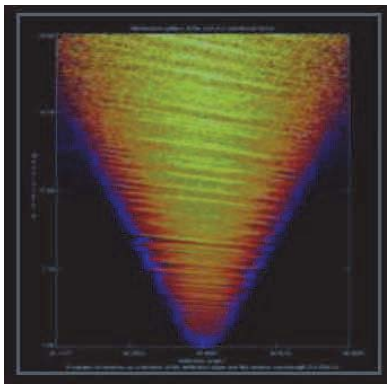
Whilst most of the placements are scientific in content, there are also opportunities in other fields (computing, technical).

Please find our placement topics on the following pages and also on our internet site

ILL Work placement opportunities

OVERVIEW

INTERNSHIP (REF. NPP_1) **STUDY OF SURFACE POTENTIALS USING NEUTRON WHISPERING GALLERY**



Gravitational and whispering-gallery quantum states were discovered at the ILL, Grenoble, in experiments with slow neutrons. These phenomena provide a unique example of the so-called quantum bouncing of particles of matter on a surface. On the one hand, they allow us to constrain/explore fundamental physics phenomena beyond the Standard Model of particle physics. On the other hand, they are extremely sensitive to changes to surface potentials and, thus, provide an excellent tool for materials science.
A recent textbook [1] explains the whole of quantum mechanics using this single phenomenon and justifies why it should be the subject of precision studies. It describes in detail the phenomena involved and the experimental methods used.
In short, the neutron whispering gallery is a quantum phenomenon which may appear, for instance, when a neutron with a velocity of ~10^3 m/s moves near a concave cylindrical mirror with a radius of a few cm at a distance of ~10^1-10^2 nm. It can be explored by simultaneously measuring, under certain conditions, the longitudinal and tangential neutron velocities. The figure shows a typical interference pattern. Even minor changes to the mirror surface potential (thin surface films, gas adsorption, etc.) would affect some features of such an interference pattern.

[1] V.V. Nesvizhevsky and A.Yu. Voronin, Surprising Quantum Bouncing, Imperial College Press, UK, 2015

Activities of the trainee:
This Master's thesis internship proposal consists of measuring such interference patterns for various mirror surfaces, treating the data, and analysing them with a view to evaluating the surface potentials. We have obtained cylindrical mirrors of sufficient quality and investigated them experimentally. The student will apply surface coatings to the mirrors, study the mirrors with/without the coatings using neutron reflectometers (D17), treat the data using standard programs and analyse them using existing theoretical formalism. Such an analysis is relatively complex when a high precision is required. It might therefore be associated with further development of the software. This makes the work interesting and challenging. Furthermore, the results expected from this project will provide an unprecedented insight into sensitivity to surface phenomena.

Key words: neutron whispering gallery; cold neutrons; neutron reflection; surface potentials; thin films; extreme sensitivity
Level required: 5th year university studies in physics
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF. NPP_2) **OCTUPOLE EXCITATIONS IN EXOTIC NUCLEI: LIFETIME MEASUREMENTS IN FISSION FRAGMENTS USING THE FIPPS ARRAY**

All along the chart of nuclei, different structures are observed that are manifestations of the underlying nucleon-nucleon interaction. Important nuclear information can be extracted from the measurement of the gamma radiation emitted by excited nuclear states. In particular, the transition probabilities, one of the most stringent tests of nuclear models, can be determined from lifetime measurements of nuclear levels.
The first negative parity state of spin J=3 in the doubly magic 132Sn nucleus is considered to be one of the best examples of octupole vibrations in nuclei. However, to date the strength of the gamma transition from this state to the ground state has never been measured. The structure of nuclei around 132Sn is important not only for testing theoretical models but also for understanding the r-process nucleosynthesis.
This lifetime can be measured at the FIPPS spectrometer at the ILL by producing nuclei in this mass region through neutron-induced fission. From the Doppler broadening of the gamma line in the energy spectrum emitted while the

fission fragments are slowing down in the target/support material, the lifetime can be determined and thus the octupole vibration nature of the nuclear state possibly demonstrated.

Activities of the trainee:
The trainee will participate in the fission measurements planned for next year at the FIPPS instrument. He/she will analyse the data and run Monte Carlo simulations for the slowing-down of the emitting nuclei and emission of gamma rays in order to determine the lifetimes of nuclear states around 132Sn.

Key words: octupole vibrations; nuclear structure; doubly magic nuclei; transition probabilities
Level required: 5th year university studies in physics
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF. NPP_3) DETERMINING SPIN AND PARITY OF NUCLEAR STATES USING FIPPS:TEST MEASUREMENTS AND SIMULATIONS

The detection of gamma rays emitted by excited nuclear states using a symmetric system of Ge detectors such as the FIPPS array at the ILL makes it possible to determine the spin and parities of the states through angular correlation measurements. This information is used to benchmark the theoretical models describing the structure of nuclei. FIPPS is a new instrument and ran its first experimental campaign at the beginning of 2017. A systematic study of source/in-beam data and Monte Carlo simulations are needed in order to determine the geometry factors to be used to account for the finite dimensions of the detectors and the variation of the detector response as a function of energy.

Activities of the trainee:
The trainee will learn how to measure angular correlations between coincident gamma rays. He/she will analyse source/in-beam data from the first FIPPS experimental campaign. He/she will conduct a systematic study of such correlations as a function of gamma-ray energy and develop the part of the Monte Carlo simulation code for establishing the geometrical corrections to the experimental data.

Level required: 3rd year university studies in physics
Notes: This post is an internship with a maximum duration of 3 months

INTERNSHIP (REF. NPP_4) CROSS-TALK PROPERTIES OF A FIPPS CLOVER DETECTOR

High-resolution nuclear structure studies rely on the sensitivity of germanium detectors. The co-axial geometry is commonly used for gamma-ray spectroscopy studies at accelerator and neutron beam facilities. In detector arrays such as FIPPS at the ILL, 4 co-axial germanium crystals share the same cryostat in the so-called “clover” configuration. The energy deposited in the different crystals of the same clover by Compton-scattered gamma rays is “added-back” in order to recover the full energy of the gamma rays. This procedure dramatically improves the peak-over-background and efficiency of such devices.
In order to preserve resolution and adequate energy calibration in the energy spectra after add-back, the *cross-talk* among the different detectors of the same clover has to be taken into account. Due to this effect, when multiple crystals in a clover are hit at the same time, the measured energy in each crystal is less than the actual energy. This is due, on the one hand, to the presence of transient signals induced in neighbouring crystals and, on the other hand, to a capacitance effect in the signal readout electronics circuit. The cross-talk effect must be corrected in order to guarantee the energy resolution needed for spectroscopic studies. A systematic study as a function of gamma-ray energy is needed as well as a modelling of the effect by analysing the shapes of digitized signals.

Activities of the trainee:
The trainee will analyse FIPPS source and in-beam data in order to study the cross-talk effect of FIPPS clovers. He/she will use analysis programs already developed at FIPPS and improve them on the basis of his/her own investigation. He/she will analyse raw waveforms in order to model the effect.

Level required: 3rd year university studies in physics

Notes: This post is an internship with a maximum duration of 3 months

INTERNSHIP (REF. NPP_5) GAMMA-RAY IMAGING:CHARACTERISATION OF A SEGMENTED GERMANIUM DETECTOR

Nuclear structure studies through gamma-ray spectroscopy as well as many applications rely on a knowledge of the position of the gamma-ray emitting source. With standard germanium detectors (such as the ones of the FIPPS array at the ILL), the backtracking of the gamma-ray emitting source is limited by the finite size of the detectors. New-generation arrays (such as AGATA, the result of the efforts of a European collaboration) are made up of segmented germanium detectors and pulse-shape analysis techniques are used to reconstruct the gamma interaction points in the germanium medium with a precision down to 5mm.
One of these detectors is available at the ILL, and, once put in operation and tested, could be used for reconstructing the gamma-ray source position at FIPPS. If this technique were successful, this would pave the way for a new ancillary system at FIPPS that would help to suppress the gamma background (by identifying the gamma rays that are not coming from the source) as well as for applications requiring the localisation of the source of gamma rays.

Such a detector can also be used for neutron scattering experiments. The tracing of gamma rays described above will make it possible to identify the neutrons that are captured by the sample, which are not usually taken into account. At the same time, the gamma-ray signal would provide information on the chemical/isotopical composition of the sample as it is irradiated by the neutron beam of the scattering experiment. A similar technique, but with a simple Ge detector, has already been used in reflectometry experiments (D17, Figaro). From these experiments, it is clear that the ability to distinguish gamma rays from the sample and the background would boost sensitivity enormously.

Activities of the trainee:
The trainee will become familiar with segmented HPGe technology both from a theoretical and an operational point of view. He/she will deal with the cooling of the detector and the testing of the different channels. He/she will test the electronic chain for treatment of the signals and storage of the raw traces. He/she will determine the cross-talk properties of the detector and perform Pulse-Shape Analysis of source data. He/she will develop his/her own imaging code for source position reconstruction.

Level required: 3rd year university studies in physics
Notes: This post is an internship with a maximum duration of 3 months

NTERNSHIP (REF. SPECT_1) HYDROGEN DIFFUSION IN NOVEL CATALYST MATERIALS

Hydrogen is an important energy carrier in connection with carbon-free energy production. Unfortunately, hydrogen reactions in fuel cells and water electrolysers require the use of catalysts, which generally contain substantial amounts of expensive noble metals such as platinum. To reduce the need for platinum and to lower catalyser costs, several materials are being studied, among which our group - in collaboration with research groups from Germany – is concentrating on molybdenum disulphide (MoS_2). In fact, MoS_2 is a promising candidate for the cathode of polymer electrolyte membrane (PEM) electrolysers, but it is not clear how hydrogen moves in MoS_2 and at which sites of the material the catalytic activity is located. We have already performed diffraction, diffusion and spectroscopy experiments on this system and further experiments are planned for 2018. The data obtained has

given us an insight into the location and motion of hydrogen from Å to micrometre length scales. Based on this data and using computational modelling, we aim to find out how MoS_2 catalysts can be optimised.

Activities of the trainee:
The trainee will take part in a new project on hydrogen catalyst materials that has been started in collaboration with research groups from Germany. The trainee will perform classical molecular dynamics simulations as well as density functional theory calculations of hydrogen in MoS_2. He/she will also analyse neutron spectroscopy data and, provided the internship takes place during reactor operations, will have the opportunity to participate in a neutron scattering experiment. The internship will provide an opportunity to gain an inside view of the power and limitations of present theoretical and experimental techniques for the study of energy materials via the study of molecular dynamics.

Key words: self-assembly; surfactants; small-angle scattering
Level required: 3rd year university studies in chemistry or physics with some computing background
Notes: This post is an internship with a maximum duration of 3 months

NTERNSHIP (REF. SPECT_2) MEASUREMENTS OF TEMPERATURE INHOMOGENEITIES IN CRYSTAL OPTICS COMPONENTS FOR NEUTRON SPECTROSCOPY

The recently commissioned GaAs prototype for the backscattering spectrometer IN16B has achieved a world record in energy resolution. Nevertheless, the measured resolution was larger than estimated. A probable deteriorating factor is the presence of temperature inhomogeneities over the surface of the monochromator, which need to be investigated.

In addition, more GaAs crystals have been ordered for the next stage in the construction of the monochromator. Neutron measurements using an established test setup need to be conducted on a sample of crystals to determine the structural quality as well as variations of the lattice parameter.

Activities of the trainee:

- Measurement and quantitative evaluation of temperature maps of the GaAs monochromator for IN16B under different conditions.
- Neutron diffraction measurements of GaAs crystals.

Level required: 3rd year university studies in physics, chemistry or mechanical engineering with some computing background
Notes: This post is an internship with a maximum duration of 2 months

INTERNSHIP (REF. SPECT_5) DESIGN STUDY OF A TIME-OF-FLIGHT SPECTROMETER FOR EXTREME-CONDITION EXPERIMENTS WITH MONTECARLO METHODS

The growing scientific interest in the physical properties of matter in extreme conditions such as very high pressure and temperature calls for dedicated and optimized experimental tools. Time-of-Flight (ToF) spectrometers are in principle the instruments of choice to meet the scientific interests and quality standards required for extreme-condition experiments. However, the ToF instruments currently available have not been optimized for such studies. We are planning to perform a design study of a hybrid ToF spectrometer, i.e. a ToF instrument equipped with a monochromator and chopper system, for optimum performance in extreme conditions and with small samples. This design study will be based on Monte Carlo simulation techniques (McStas) developed and optimized for neutron ray-tracing computation. The necessary software packages are available at the ILL and can be run in a standard operation mode. Expertise in, and hardware components for, running the software packages are present. Preliminary design studies of an instrument called RAMSES (RApid Measurement and Special Environment time-of-flight Spectrometer) have been already performed. For these reasons, we believe it will be possible to complete the optimization work within four months, a period well suited to a student internship.

Activities of the trainee:
The trainee's activities will primarily involve computer simulations, together with a few analytical analyses, for the design of the hybrid time-of-flight instrument located at the end position of a dedicated cold-neutron guide:

- Definition of a dedicated guide (new H15) for the hybrid ToF instrument RAMSES III (McStas calculations)
- Optimization of guide components for best performance in terms of flux and divergence (McStas calculations)
- Identification of central components of the primary spectrometer and their geometry for best performance in the time-focusing mode
- Optimization of the primary spectrometer components for best performance for experiments on mm^3-sized samples.

Key words: computer simulation; ray tracing calculation; neutron spectroscopy
Level required: 4th year university studies in physics
Notes: This post is an internship with a maximum duration of 4 months

INTERNSHIP (REF. SPECT_7) EFFECT OF CHEMICAL OR STRUCTURAL DISORDER ON THE LATTICE DYNAMICS OF THE BROWNMILLERITE IONIC CONDUCTORS $SR_{1-x}CA_xFEO_{2.5}$ AND SR_2SCGAO_5. AN AB-INITIO STUDY

Oxygen ion conductors at low temperatures are materials of major interest for a host of applications, such as fuel cells, battery electrodes and sensors. The discovery of oxygen reversible intercalation into Brownmillerite-type structures down to moderate temperatures is considered of paramount importance. Despite this, SrFeO2.5 has been shown to be a good conductor down to RT, while the iso-structural CaFeO2.5 material only conducts oxygen at high temperatures (over 1000 K). Inelastic neutron scattering (INS) studies on solid solutions of Sr1-xCaxFeO2.5 (chemical disorder) have revealed dramatic differences in the low energy part of vibrational DOS (density of states). At the same time, Raman spectra on end members are also drastically different. Similarly, Sr2ScGaO5 shows good ionic conduction at moderate temperatures, but the Brownmillerite-type structure, with ordered SC, Ga and vacancy sites, and the cubic-related structure, with random Sc Ga and vacancy positions, differ in the onset temperature of conduction and conduction mechanism. This is reflected again in the difference observed in the low energy part of vibrational DOS and Raman spectra.
To understand the microscopic origin of these differences, detailed DFT (density functional theory) calculations on several solid solutions of Sr1-xCaxFeO2.5 and random vacancy supercells of Sr2ScGaO5 are necessary. The experiments will allow us to validate the calculations and the calculations can then be used to gain a better understanding of the material's properties.
The results will shed light on the way that chemical or structural (other than oxygen) disorder affects the ionic conduction properties of this material, helping us to gain a deeper understanding of the factors which promote or hinder ionic conduction.

Activities of the trainee:
The trainee will run advanced level simulations (solid solutions and random vacancy supercells) with the CRYSTAL code, extract useful electronic and vibrational properties (band structure, vibrational DOS, Raman spectra), compare the data obtained with existing experimental data, and critically interpret the results. He/she will correlate all the experimental and simulated data to establish trends in electronic/vibrational properties. If the results of this work prove to be interesting, the trainee will take an active part in writing articles.

Key words: ionic conductors; chemical or structural disorder; ab-initio simulations; comparison with INS and Raman spectra
Level required: 5th year university studies in physics or theoretical chemistry
Notes: This post is an internship with a maximum duration of 5 months

NTERNSHIP (REF. SPECT_8) ADSORPTION ENERGY AND GEOMETRY OF DIHYDROGEN ON A PT-SUBSTITUTED UIO-67 MOF

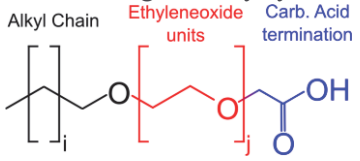
Microporous materials have proven to be highly valuable materials for industrial applications such as petrochemistry, catalysis, selective separation and gas storage. In this regard, metal-organic frameworks (MOFs) open up new possibilities for the design of both the geometrical shape and chemical properties of the internal surface, enabling very high pore volumes and surface areas. Moreover, they are in principle able to display novel functionalities, potentially exploitable for a number of applications in catalysis, as sensors, in gas separation, and/or storage.
The synthesis of a Pt-functionalised UiO-67 MOF creates exposed metal species from the PtCl2 functionalisation that are considered to induce enhanced adsorption properties during gas dosing. For this reason, the evolution of the rotational transition of H2 molecules (15 meV) during hydrogen uptake has been investigated by inelastic neutron scattering up to 25 bar pressure.
Simulations of the bare UiO-67 have been performed and the matching with experimental vibrational DOS (density of states) is remarkable, opening the way for a reliable and detailed study of the adsorption of H2 on the different adsorption sites. The calculation of the adsorption energies and geometries will make it possible to assign with consistency the features detected during the INS experiment.

Activities of the trainee:
The trainee will run advanced level simulations (adsorption of molecules on surfaces) with the CRYSTAL code, extract useful electronic and vibrational properties (band structure, vibrational DOS, Raman spectra, adsorption energies), compare the data obtained with existing experimental data, and critically interpret the results. If the results of this work prove to be interesting, the trainee will take an active part in writing articles.

Key words: metal-organic framework; UiO-67; H_2 adsorption; ab-initio simulations; comparison with INS spectra
Level required: 5th year university studies in physics or theoretical chemistry
Notes: This post is an internship with a maximum duration of 3 months

INTERNSHIP (REF. SMSS_1) USING CYCLODEXTRIN TO CONTROL THE AGGREGATION OF ALKYL ETHYLENEOXIDE CARBOXYLIC ACID SURFACTANTS

The development of smart materials from renewable resources based on supramolecular interactions is attracting the interest of scientists and industry. A multidisciplinary approach is vital in order to determine the preparation route for complex materials based on the self-assembly of small molecules into functional supramolecular aggregates. Fatty ethoxylated carboxylic acids (see figure below) are biocompatible surfactants with temperature/pH responsive features [1-3]. These systems have been shown to assemble into hierarchal, complex structures with strongly responsive properties. The properties of surfactants can be further controlled by the addition of cyclodextrins, which are cyclic oligosaccharides [4]. The hydrophobic cavity of cyclodextrins can selectively thread the hydrophilic or hydrophobic part of the surfactant, thus breaking up or altering the self-assembling properties. This feature can be exploited in pollutant removal as well as drug delivery systems.



Activities of the trainee:
The trainee will deal with the preparation and characterization of supramolecular complexes formed by a temperature/pH-sensitive surfactant and cyclodextrins. In particular, cyclodextrins with different cavity sizes can be investigated (α-, β- and γ-cyclodextrins). As regards the surfactant (CiEjCOOH), the role of alkyl chain length (C12 and C18) together with the ethoxylated block length (from 2 to 10 units) will be studied. The project can be subdivided into three main parts: 1) the determination of the phase behaviour, 2) the quantitative determination of the binding constants, and 3) the structural characterization of the supramolecular structures. In detail:
1) Optical inspection and turbidity measurements make it possible to determine the stability of the cyclodextrin/surfactant complexes. Temperature, pH and composition of the system will be varied systematically.
2) Densitometric experiments make it possible to determine the equilibrium constant and the stoichiometry of the complexation reaction. In combination with calorimetric measurements, this will allow the thermodynamic origin of the binding processes to be determined. 3) Static and dynamic light scattering, electrophoretic mobility, and possibly small-angle neutron scattering will allow investigation of the structural behaviour of the surfactant-cyclodextrin mixtures on various length scales.

The information obtained will be combined, leading to a complete picture of these binary systems. The correlation between the thermodynamic driving forces for the self-assembly process and the resulting structure and functionality will allow us to understand these systems and to fine tailor them for specific purposes. In summary, the trainee will encounter the major characterization techniques used for soft-matter systems. He/she will learn how to perform the experiments, analyse the data, and combine the information in order to produce a comprehensive picture.

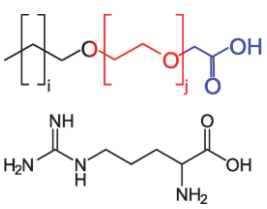
References:
[1] Chiappisi, L.; Prevost, S.; Grillo, I.; Gradzielski, M. Langmuir 2014, 30, 1778-1787, [2] Schwarze, M.; Chiappisi, L.; Prévost, S.; Gradzielski, M. J. Colloid Interface Sci. 2014, 421, 184–190., [3] Chiappisi, L. Adv. Colloid Interf. Sci. 2107,doi:10.1016/j.cis.2017.10.001, [4] Lazzara, G.; Milioto, S. J. Phys. Chem. B 2008, 112 (38), 11887–11895.

Key words: supramolecular self-assembly; surfactants; small-angle neutron scattering; thermodynamics
Level required: 4th year university studies in chemistry/physics
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF. SMSS_2) ENVIRONMENTALLY FRIENDLY COUNTERIONS FOR CONTROLLING SURFACTANT SELF-ASSEMBLY PROPERTIES

Surfactants are among the most versatile compounds in the colloidal playground. The properties of their aqueous solutions do not depend only on the molecular structure of the hydrophilic and hydrophobic groups, but also on experimental parameters such as temperature, ionic strength, pH, etc. A further key element which determines the properties of ionic surfactants is the nature of the counterion. In particular, the use of bulky, cationic counterions, such as choline, guanidine, arginine or lysine, have been shown to greatly affect the behaviour of anionic surfactants,

in particular of fatty acids [1-2]. The main aim of this internship is to characterize aqueous solutions of fatty ethoxylated carboxylic acids (see figure below) with arginine and choline as counterions. Fatty ethoxylated carboxylic acids are extremely interesting surfactants, showing both temperature and pH-responsive behaviour. They self-assemble into globular micelles, wormlike micelles or vesicles, depending on the pH and size of the blocks. Moreover, these surfactants are mild and low-toxic and can be used extensively in large-scale applications [3]. Further control of their properties through the addition of environmentally friendly counterions, such as arginine or choline, can further widen their field of use.



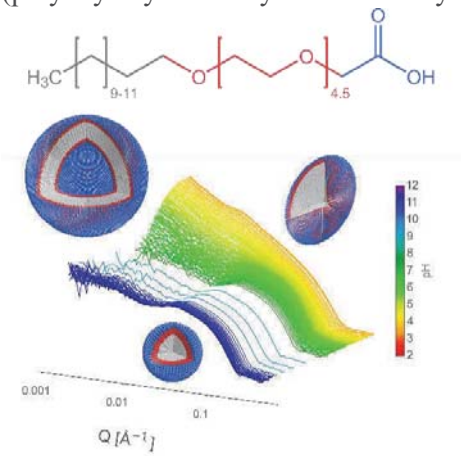
Activities of the trainee:
The trainee will deal with the preparation and characterization of choline and arginine fatty ethoxylated carboxylates. Surfactants based on oleic acid and a variable number of ethylene oxide units will be employed. The project can be subdivided into three main parts: 1) the determination of the phase behaviour, 2) the quantitative determination of the surfactant self-assembly properties, and 3) the structural characterization of the self-assembled structures. In detail:
1) The phase behaviour of fatty acid salts will be investigated as a function of pH and surfactant concentration. In particular, complex behaviour is expected for the arginine salts, as both the surfactant and the counterion exhibit pH-dependent behaviour.
2) The physico-chemical properties of the salts, such as critical micelle concentration, cloud and Krafft point, will be determined.
3) Static and dynamic light scattering, electrophoretic mobility, and possibly small-angle neutron scattering will shed light on the size and shape of the self-assembled aggregates.
The information obtained will be combined, leading to a complete overview of the behaviour of these environmentally friendly surfactants with a large potential for practical applications. The trainee will encounter the major characterization techniques used for surfactant systems. He/she will learn how to perform the experiments, analyse the data, and combine the information in order to produce a comprehensive picture.

References [1] Wolfrum, S.; Marcus, J.; Touraud, D.; Kunz, W. Adv. Colloid Interface Sci. **2016**, 236, 28–42., [2] Klein, R.; Kellermeier, M.; Touraud, D.; Mueller, E.; Kunz, W. J. Colloid Interface Sci. **2013,** 392 (1), 274–280., [3] Chiappisi, L.; **2107**, Adv. Colloid Interface Sci. 2107, doi:10.1016/j.cis.2017.10.001

Key words: self-assembly; surfactants; small-angle scattering
Level required: 4th year university studies in chemistry/physics
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF. SMSS_3) SHINING A LIGHT ONTO THE STRANGE ENERGY LANDSCAPE OF SURFACTANT SELF-ASSEMBLY

Over the past 20 years, many of the tremendous advances in the field of soft nanotechnology, from drug delivery to oil extraction, can be ascribed to a combination of two factors: progress in the chemical synthesis of macromolecules and, perhaps more importantly, a better understanding of the structure-function relationship in self-assembled materials. This understanding gives us the power to design self-assembling building blocks and control morphology on the nanometre scale. An interesting example of this is the surfactant AKYPO 45CA (polyoxyethylene lauryl ether carboxylic acid), which is composed of hydrophobic, hydrophilic and ionic components. This structure gives rise to a wide range of spontaneously self-assembled aggregates in solution ranging from large vesicles and thin discs through to smaller ellipsoidal micelles where the geometry depends on the degree of ionisation of the head-group, which can be controlled by adjusting the pH of the solution. During a recent small-angle neutron scattering experiment to investigate the pH dependence of the self-assembled structures, it was observed that the form of the aggregates also depends on the addition rate and concentration of the NaOH used to adjust the pH of the solution. This is a highly surprising result: as the self-assembled structures are dynamic and the exchange kinetics are fast, the presence of more than one final state would indicate a complex free energy landscape with deep local minima. For such an ostensibly simple molecule, this complex behaviour cannot be easily explained with currently available models. The aim of this project is therefore to determine how the preparation conditions affect the self-assembly. This will be done by observing the phase behaviour under various preparation conditions and comparing the behaviour of a commercial surfactant with that of a purified surfactant with a known number of ethylene oxide units. With sufficient data, we will hopefully be able to shed some light on this complex energy landscape.



Activities of the trainee:
The trainee's activities will be conducted along two lines. The main task will be to explore the parameter space consisting of base concentrations, base addition rates, salt concentrations and temperatures to determine the effect of each parameter on the self-assembly behaviour of the surfactant. This will be done predominantly via turbidity and light scattering measurements with the possibility of small-angle X-ray and neutron scattering, if the opportunity arises. The second parallel line of investigation will be to purify the surfactant via distillation, fractionation or size exclusion chromatography and repeat some self-assembly experiments in order to probe the origins of the observed anomalous behaviour. The trainee will gain experience in solution self-assembly and learn to conduct static and dynamic light scattering (SLS and DLS, respectively) and small-angle scattering experiments. He/she will also learn to analyse and interpret the experimental data, which will then be used to steer the direction of the project.

Level required: 2nd year university studies in chemistry or physical chemistry
Notes: This post is an internship with a maximum duration of 3 months
Benefits: You will receive a monthly allowance of between 435 € and 1 050 €, depending on the duration of your internship and your profile.

INTERNSHIP (REF. LSS_1) REGULATING FAT DIGESTION BY ENGINEERING LIPID EMULSIONS

The intake of dietary fats (lipids) and its effects on health have become a major focus of our modern societies since, over the past few years, changes in both lifestyle and eating habits have resulted in an increase of obesity levels. Consequently, developing solutions that may have beneficial impacts on health is urgently needed. Controlling the digestion of fats is key to addressing this ongoing health crisis but also to controlling the absorption of drugs in oral lipid-based formulations. The overall aim of this broad project is to develop a formulation strategy that slows down and thus reduces lipid absorption.

Bile salts (BS) are biosurfactants produced in the liver and released into the small intestine (duodenum) which play a key role in lipid digestion and absorption. BS facilitate the adsorption of the lipase/co-lipase complex to fat

droplet interfaces, thus promoting enzyme-catalysed lipolysis, and they also desorb from the interface and shuttle insoluble lipolysis products to the gut mucosa in mixed micelles, to facilitate their absorption. Therefore, given that BS are a key player in lipolysis, the strategy will consist in using appropriate emulsifiers that compete with BS for adsorption at the water/fat droplet interface and thus slow down lipase adsorption. Our work focuses on a candidate widely used in both the food and pharmaceutical industries: methylcellulose ethers (MC). Although MC have demonstrated potential as dietary fibres (reducing fat absorption), there is still a staggering lack of mechanistic understanding of the competitive interfacial processes leading to lipase inhibition, slower lipid digestion and the associated health benefits.

Activities of the trainee:
The specific project proposed will focus on characterising MC and studying their ability to inhibit BS activity, and thus enzyme activity, both at the interface and in solution. For this purpose, the interfacial properties of MC and their interaction with BS will be investigated at the air/water interface using different interfacial techniques, such as the Langmuir trough, tensiometer, Brewster angle microscope and ellipsometer. These measurements are a first step towards moving onto the more physiologically relevant oil/water interface studies, with the sessile drop method. In parallel, the impact of BS on the self-assembly, thermodynamic and rheological properties of both MC and MC-stabilised emulsions will be assessed using the techniques of dynamic light scattering (DLS), microcalorimetry and rheology. These studies will allow us to improve our understanding of the mechanisms leading to BS inhibition. These preliminary data will be of considerable interest since they will provide a basis for further neutron reflectivity (NR) and small-angle neutron scattering (SANS) experiments.

Key words: methylcellulose ethers; bile salts; interfacial studies; self-assembly, thermodynamic and rheological properties
Level required: 5th year university studies in physical chemistry / formulation
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF. LSS_4) AN EFFICIENT AND VERSATILE MICROFLUID SYSTEM FOR ELECTROPHYSIOLOGY MEASUREMENTS

Electrophysiology is a technique involving the measurement of the flow of ions across a lipid membrane, with the aim of assessing the membrane's permeability or of studying the proteins specifically devoted to the transport of the ions, including at the single molecule scale. This method is particularly challenging and requires special equipment capable of measuring electric current in pico amps. We use the technique on artificial membranes, created at the interface between two droplets surrounded by a lipid monolayer.
Through the use of microfabrication techniques, we would like to improve our experimental setup in order to reduce the volume of reagents required and increase its sensitivity and the quality of the signal recorded.

Activities of the trainee:
After familiarising yourself with the equipment in the laboratory, you will design and produce milli/micro-fluidic devices by 3D printing and PDMS moulding, and then evaluate their efficiency:
- formation and characterisation of the artificial membrane,
- comparison with the current device, in terms of sample quantity, signal quality and ease of use
- estimation of the limits of the new device: membrane size, possibility of multiplexing, etc.

Key words: microfluids; 3D printing; electrophysiology
Level required: Equivalent of 1st year university studies in a general technical field (covering instrumentation and measurement techniques)
Notes: This post is an internship with a maximum duration of 2 months

INTERNSHIP (REF. LSS_5) STIMULI-RESPONSIVE MICROCAPSULES MADE OF PNIPAM PARTICLES

Soft capsules with shells made of environmentally sensitive materials are receiving a lot of attention as a novel type of carrier for delivery or microreactors. They have unique and desirable properties such as controllable size or permeability. These can be triggered by changes to an ambient stimulus, for example involving pH, ionic strength, or temperature.
Poly N-Isopropyl Acrylamide (PNIPAM) microgels are stimuli-responsive colloids, changing size with pH or temperature. They do this because of a delicate balance of conformational entropy and hydrophobic interactions. This also plays a key role in their affinity for fluid interfaces (e.g. water/air, water/oil), enabling their adsorption properties to be tuned. This fact makes them suitable candidates for controlling the stability of fluid-fluid dispersions (an example of what some people call "smart fluids"). Self-assembled PNIPAM particles at fluid interfaces are also building blocks for creating hollow microcapsules — also known as polymerosomes — whose size, permeability and mechanical strength can thus be controlled.
Hollow capsules with shells made of PNIPAM particles will be produced – by using a co-flow microfluidic chip – from oil/water emulsions. The capsules will be exposed to different external stimuli (T, pH and ionic strength) in order to correlate the behaviour found with the properties of the interfacial PNIPAM layers. To achieve our goal, we will use surface methods (pendant drop and Langmuir trough tensiometry) and imaging techniques (confocal and fluorescence microscopy).

Activities of the trainee:
-Preparation of ligand-coated PNIPAM particles and adsorption at fluid interfaces. Characterization by surface methods (pendant drop tensiometry, Langmuir trough tensiometry and interfacial shear rheology) and imaging techniques, such as fluorescence microscopy and AFM.
-Production of hollow capsules by a co-flow microfluidic chip. Further characterization by imaging (fluorescence) and rheology.

Key words: soft and biological matter; microfluidics; rheology; fluorescence microscopy; AFM; tensiometry
Level required: 4th year university studies in Physics, Chemistry or Physical-Chemistry
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF. LSS_6) ENDOCYTOSIS ACROSS SCALES

Transport across a cell membrane is a key aspect of cellular biology. Clathrin-mediated endocytosis is a crucial mechanism, whereby cargo and proteins located at the plasma membrane are controllably incorporated into the cell. This is an example of a controlled multiscale choreography, in which several molecular players (proteins such as clathrin, clathrin adaptors and cargo, together with specific lipid molecules associated with the membrane) join forces in a cooperative effort to overcome the curvature energy of the membrane and make possible the invagination of a clathrin-coated vesicle (a supra-molecular assembly) in which cargo proteins are incorporated. The presence of different length-scales – from the molecule (10's Å) to the vesicle (100s nm) – and hence different processes coupled together, have so far prevented a full understanding of this process.
What is proposed in this project involves a challenging bottom-up approach, focusing on the self-assembly, mechanics and rheology of precisely formulated in-vitro conditions. State-of-the-art surface methods – Langmuir trough tensiometry, rheology and particle tracking – and imaging techniques will be used. Starting from planar lipid monolayers and moving to supported lipid bilayers and giant unilamellar vesicles, the self-assembly of clathrin molecules on lipid monolayers and the role of adaptor proteins will be investigated.

Activities of the trainee:

- Sample preparation: Langmuir lipid monolayers, supported lipid bilayers and giant unilamellar vesicles (GUVs) by electroformation.
- Characterization of protein samples with the support of our collaborators at the Cambridge Institute for Medical Research CIMR.
- Characterization of the lipid-protein interactions by surface methods (Langmuir trough tensiometry and interfacial shear rheology) and imaging techniques such as fluorescence microscopy and AFM.

Key words: soft and biological matter; lipid-protein interactions; rheology; fluorescence microscopy; AFM; tensiometry
Level required: 4th year university studies in Physics, Chemistry or Physical-Chemistry
Notes: This post is an internship with a maximum duration of 5 months

NTERNSHIP (REF. LSS_7) BIO-INSPIRED EMULSIONS AND MICROEMULSIONS WITH CHOLESTERYL ESTERS AS MODEL SYSTEMS FOR LDL/HDL PARTICLES

Low-density lipoproteins (LDL) and high-density lipoproteins (HDL), commonly referred to as "bad" and "good" cholesterol, are biological assemblies of phospholipids and cholesterol, apolipoproteins and triglycerides. Their main role is to transport fat in the extracellular fluid of organisms. The role of HDL and LDL in common diseases is well known, the main distinction between the two being simply their size, i.e. the number of fatty molecules they transport: HDL particles are small (containing around 100 lipids and as many proteins), LDL particles are large (containing up to 1000s of lipids and far fewer proteins), while even larger particles exist. LDL have a low stability and therefore increase the risk of atherosclerosis (artery wall thickening) by deposition, while HDL take away these deposits as a hydrophobic cargo. The stability of these assemblies and therefore the associated risk of cardiovascular disease is, however, poorly understood.
HDL is in fact a microemulsion in soft matter terms (stable at equilibrium), while LDL is an emulsion (unstable at equilibrium). In between, a miniemulsion domain should be present (presenting long-term stability).
Using simple models based on conventional phospholipids for the stabilizing shell, and various triglycerides and cholesteryl esters for the hydrophobic core, we aim to elucidate, in particular by Small-Angle Neutron Scattering (SANS), the lipoproteins (shape, size, size distribution), including the composition and organisation of their shell and core. Phase diagrams where the composition is varied will help us determine the loading thresholds in triglycerides between microemulsion, miniemulsion and emulsion, based on the choice of triglyceride, for a given composition in phospholipids and amount of cholesteryl esters. Finally, the influence of apolipoproteins (decorating the lipoprotein's outer surface) on the phase diagram will be evaluated by the trainee.

Activities of the trainee:
Bibliography, sample preparation, phase diagrams from visual observations, Differential Scanning Calorimetry (melting of the triglyceride/cholesteryl ester core), Isothermal Titration Calorimetry (for the addition of apolipoprotein), Dynamic and Static Light Scattering (determination of overall dimensions), Zetametry (determination of surface charge), Small-Angle Neutron and X-ray Scattering (structural characterization).

Key words: small-angle neutron scattering; emulsions and microemulsions; high-density lipoproteins and low-density lipoproteins (HDL and LDL); cholesterol esters; model HDL/LDL particles
Level required: 5th year university studies in physical chemistry
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF. THEO_1) DYNAMICAL TRANSITION OF PROTEINS, AS A FUNCTION OF SPATIO-TEMPORAL SCALE

By dynamical transition we mean the deviation from linear behaviour of the variation in mean-square displacements of atoms, as a function of temperature. Several experiments have shown the existence of a dynamical transition in hydrated protein systems around 180 – 200 K. This transition reveals an activated change in the conformational states of the protein, as a function of temperature. We have a simple view of the dynamical transition as that of at least two conformational states corresponding to potential wells separated by a potential barrier. As, at low temperatures, the (harmonic) motion of the protein atoms is situated around the minimum of the conformational states of lower energies, the mean-square displacements rise linearly with temperature. At high temperatures the amplitude of the (anharmonic) motion increases, to the point that it crosses the barrier from low-energy conformational states to those of high energies. The result is a non-linear rise in mean-square displacements. A dynamical transition can therefore be summed up as the transition from harmonic motions to anharmonic motions, following the crossing of a potential barrier.

In practice, if we want to study dynamical transition in incoherent neutron scattering experiments, for example, we would classically use the mean-square displacement of the (hydrogen) atoms, obtained from the slope at the origin, as a function of Q^2 of the factor or function of the dynamical structure of the incoherent quasi-elastic ($\omega \approx 0$) scattering of neutrons. The mean-square displacements obtained depend neither on Q nor time, and we therefore consider the protein system as an ensemble in equilibrium averaged over all spatial scales.

The aim of the placement is to study the dynamical transition as a function of Q and of time, to gain a better understanding of how the dynamical transition evolves within a protein. This will require investigating the feasibility of using the multivariate statistical techniques of principal component analysis (PCA) to analyse the dynamical structure function (or mean-square displacements) on the Q and time scales together. These are new techniques in this domain but are certainly promising. They have recently been used at the ILL in a Swedish-ILL collaboration to study the dynamics of an enzyme with and without inhibitor.

Activities of the trainee:
1 – Use the Bicout-Zaccai dynamical transition model to develop the PCA methodology;
2 – Apply the methodology to analyse the neutron scattering experimental data obtained for proteins by J. Peters (ILL).

Key words: incoherent neutron scattering, dynamical transition, ACP, PCA
Level required: 4th year university studies in physics
Notes: This post is an internship with a maximum duration of 5 months.

INTERNSHIP (REF. THEO_2) THEORETICAL DETERMINATION OF EXCITED MAGNETIC STATES IN STRONGLY CORRELATED SYSTEMS

For the last 20 years exotic states of matter, such as high temperature superconductivity, quantum critical points, spins liquids etc..., have been discovered in strongly correlated systems. It is also in these compounds that can be found coupled properties highly desirable for applications, as for instance magneto-electric or magneto-optic couplings. The origin and variety of the properties found in strongly correlated compounds originates in the preservation in these systems of numerous degrees of freedom (spin, charge, network, orbital, etc...) that are hindered in more conventional systems. In Grenoble we have the chance to host several large scale facilities, such as neutrons diffraction, able to provide experimental insights in these systems.
In order to build a complete and coherent picture one however needs some theoretical support. On this point, the need to treat on an equal footing many degrees of freedom increases the difficulty for the theoreticians.

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The objective of this internship is to participate to the theoretical development of numerical methods able to describe strongly correlated systems. The methods that will be used are named ab initio as they aim is to solve the Schrödinger equation as exactly as possible while taking into account the whole complexity of its chemical composition and crystallographic structure.

The student will thus be initiated to

- the analytical development of controlled approximations for solving the Schrödinger equation
- the design and implementation of the associated algorithm
- the application of the methods to real examples

Activities of the trainee:
After a first initiation to the Configuration Interaction methods (allowing to solve in an approximate however controlled and accurate manner the Schrödinger equation for ground and excited states), the student will participate to the work in progress in the group around the development of a software aiming at computing the ground and excited (in particular magnetic) states of strongly correlated compounds and able to efficiently use hundreds or even thousands of processors. In this framework the student will have access to regional and national computer centres.

Key words: Theory; Magnetic excited states; Inelastic Neutrons Diffraction
Level required: 4th year university studies in physics, theoretical chemistry or computing
Notes: This post is an internship with a maximum duration of 4 months

INTERNSHIP (REF. SON_1) NEUTRON OPTICS MULTILAYERS: CONSTRAINT ENGINEERING WITH MAGNETRON SPUTTERING

"Supermirrors" are multilayer structures; they are made up of up to thousands of nanometer-thin layers. Because of their optical characteristics they can be used to modify the properties of neutron beams. When reactive magnetron sputtering is used to deposit the layers, the internal constraints building up in the layers often lead to the destruction or delamination of the deposit. Previous trainees have studied several of the parameters which can be modified reasonably easily on our semi-industrial coating machine, and have managed to reduce the constraints significantly. These parameters are linked to the often complex physico-chemical mechanisms at play when a thin layer is deposited using a plasma. The aim of the placement is to study empirically the effect of certain parameters on the multilayers, and to use the results for "constraint-engineering" with a view to producing multilayers suitable for use in neutron optics. In addition to the deposits and constraint measurements, structural characterisations could also be performed, using specular X-ray and/or neutron reflectivity or diffraction if the occasion allows.

[1] C.Roubeix, 2017, Polytech Marseille 2nd year placement, C. Mauc, 2016, Phelma 2nd year placement,M. Simonsen & U. Bengaard, 2011, Bachelor project, Univ. Copenhagen, R. Girard-Desprollet, 2010, Phelma 2nd year placement.

Activities of the trainee:

- Preparation of a strategy leading to plans for an experiment
- Deposition of multilayers and supermirrors using different parameters
- Determination of the constraints using contact surface profiling (curvature method)
- Characterisations: X-ray and/or neutron reflectivity or diffraction
- Analysis and summary of the results, confrontation with the scientific literature

Key words: Materials science, residual stresses, neutron optics, nanometric multilayers, supermirrors, Fe/Si, instrumentation, structure, interfaces, reactive magnetron cathode sputtering, plasma
Level required: 5th year university studies in materials engineering
Notes: This post is an internship with a maximum duration of 5 months.

INTERNSHIP (REF.: SI_1) UPDATING OF A PHP/SYMFONY APPLICATION IN SECURE CONDITIONS

The application to be worked on during this placement is written in PHP (Symfony framework); it has web-based user and administration interfaces (html5, JavaScript, CSS) and stores the application data in a relational database.

The aim of the placement is to perform a major maintenance update in conditions of total security:

- Migrate the application code from Symfony 2 to Symfony 3.2 and from PHP5 to PHP7
- Add logbook functionality
- Re-assess the measures in place to secure the application. This will involve intrusion testing and reviewing the protection, filter and alert systems.
- Particular emphasis will be placed on the security of the hosting infrastructure with dynamic filtering tools.

The placement will give the student an idea of the techniques used for maintaining applications and keeping them safe. S/he will be working in an international team for whom the operational security of the applications is a constant concern.

Activities of the trainee:

- Analysis of the existing system
- Migration of the technologies used by the application
- Installation of a logbook
- Review of server-side security measures

Key words PHP/Symfony3 development, JavaScript, CSS, Oracle, Git, logbook, security
Level required: 3rd year university studies in computing
Notes: This post is an internship with a maximum duration of 3 months.

INTERNSHIP (REF.: SI_2) ANALYSIS AND IMPLEMENTATION OF TOOLS FOR MANAGING AND MONITORING COMPUTER SECURITY ALERTS

Activities of the trainee:

- Researching, evaluating, testing and selecting tools for consolidation and management of IT security alerts
- Connection to the different alert feedback sensors
- Establishment of the technical procedures for acknowledging and processing alerts.

Keywords: SIEM (Security information and event management), IT security, Intrusion management, NDIS, OWASP, SSI.
Level required: 5th year university studies in computing
Notes: This post is an internship with a maximum duration of 4 months.

INTERNSHIP (REF.: SI_3) DEVELOPMENT OF A SOFTWARE CATALOGUE PLATFORM

The PaNdata software catalogue (https://software.pan-data.eu) is a database of software used mainly for data analysis of neutron and photon experiments.
The catalogue was developed using the Symfony 2 web framework, MySQL for the persistence, ElasticSearch for the search functionalities and GIT for the source control.

Activities of the trainee:
The trainee will help design and implement new features, upgrade the code base to the latest version of Symfony and develop tests.
The student must have strong communications skills and be enthusiastic about software development and best practices, including practical security.

Key words: PHP, Symfony web framework, MySQL, ElasticSearch, GIT
Level required: 3rd year university studies in computing
Notes: This post is an internship with a maximum duration of 5 months

INTERNSHIP (REF SCI_1) DATA ANALYSIS INTERFACE

Production of a browser-style interface allowing an initial analysis to be made of the neutron spectra obtained from the crystals used as monochromators at the ILL.
The interface must meet the following criteria:

- it must be user-friendly
- it must provide a sufficiently detailed analysis of the diffraction spectra to be able to determine the principal characteristics of the crystals being measured (calculation of full width at half maximum, localization of the global maximum, estimation of background noise, integral calculation on a curve, etc...)
- it must allow for the presentation (formatting, charts, etc.) and saving of the data.

Level required: 3rd year university studies in computing
Notes: This post is an internship with a maximum duration of 4 months.

INTERNSHIP (REF SCI_2) CONTROL MODULE FOR A PIEZO MOTOR

Incorporation of a Piezo motor power module in the control module of a stepper motor.
The Piezo power module must be controlled by an analog +10,-10V signal.
The control module currently on the stepper motor provides signals for frequency and direction.
The aim of the placement is to produce the PCB electronics for converting the frequency and direction control signal into an analogue +10,-10V signal.

Activities of the trainee:

- Development of the electronics required for converting the control signal
- Production of the files required for producing the printed circuit, using OrCAD.
- Incorporation and testing of the new electronics in the existing control module.

Level required: 4th year university studies in electronics engineering
Notes: This post is an internship with a maximum duration of 5 months.

INTERNSHIP (REF. SCI_3) DEVELOPMENT OF AN INTUITIVE 3D USER INTERFACE FOR A SPECTROMETER SIMULATOR

The open-source VEXP application provides a 3D simulator based on Three.js in which the user can interact with crystal unit cells displayed in a 3D reciprocal space.

The aim of the internship is to provide an intuitive and user-friendly UI (e.g. smooth transitions between different points of view, etc.) validated by feedback from the scientist users.
Other developments of the application are also planned: integration of an Android tablet, web application adaptation, testing of a virtual reality device, etc.

Activities of the trainee: Software development

Key words: 3D ; Three.js ; Electron ; Node.js ; Android ; VR
Level required: 4th year university studies in computer science
Notes: This post is an internship with a maximum duration of 4 months

INTERNSHIP (REF. SCI_4) IMPLEMENTATION OF COLLISION DETECTION IN A SIMULATOR OF EXPERIMENTS ON LARGE-SCALE INSTRUMENTS AT THE ILL

experiments are currently simulated in an open-source software, Nomad 3D. For each instrument, Nomad 3D provides the link between Nomad (the ILL's instrument control software) and the 3D SolidWorks model.

The aim of the internship is to extend Nomad 3D by providing two new functionalities:

- Integrate free objects in the instrument scene by providing an intuitive user interface.
- Study and implement different collision detection strategies by comparing precision and speed. Detection will take into account the three types of elements of the scene: instrument parts, walls, free objects.

This involves making significant improvements to the current viewer application. Some VR developments, including the testing of VR devices, are also being considered.

Demonstration videos of Nomad 3D can be viewed here:
http://docs.sites.code.ill.fr/nomad-3d/videos/

Activities of the trainee: Software development

Key words: 3D; Three.js; Electron; JavaFX
Level required: 5th year university studies in computer science
Notes: This post is an internship with a maximum duration of 6 months

INTERNSHIP (REF. SRH_1) **HR MARKETING AND EMPLOYER BRANDING**

Employer branding is the process of promoting a company, or an organisation, as the employer of choice to a desired target group, one which a company needs and wants to recruit and retain.

Duties:

Within our HR department, you will help to create an Employee Value Proposition as a means of presenting the ILL's Employment Brand to both internal and external audiences. This will include:

- Conducting research and proposing a strategy for Employment Branding,
- Reviewing, updating and developing existing information concerning HR on the career website,
- Designing and upgrading communication resources relating to recruitment & integration processes (job descriptions, kakemono, etc.),
- Developing community management (LinkedIn, Twitter, etc.).

Profile:

You are preparing a Master's degree in Communication or Marketing or an MBA.
You are interested in Employer Branding and Community Management.
You are familiar with the Pack Office and Adobe Creative suites.
You have good writing skills and a sound knowledge of English.

Duration:

4 to 5 months.

Benefits:

You will be entitled to:

- A **monthly allowance** whose amount will depend on your profile and the duration of your internship.
- Have **access to the ILL Works Council**'s social, sports and cultural activities.
- **Subsidised meals** at our company restaurant.
- **Subsidised transport** if you use the local public transport system or hire a bicycle.
- A number of **days of compensatory leave** depending on the duration of your internship.

INTERNSHIP PROPOSAL

Internship title

Contribution to the stability and bifurcation analysis of sodium boiling for a GEN-4 SFR

Starting date and location

6 months, February to August 2018 (dates flexible)
CEA center in Cadarache (Aix-en-Provence, France)

Topic description

In the frame of the R&D for GEN-4 Sodium Fast Reactors safety, the stability of sodium boiling in case of an ULOF (Unprotected Loss of Flow) in a core subassembly is currently being investigated. This very dynamic phenomenon requires a robust semi-analytical approach. With this goal in mind, a stability analysis tool is being developed in the Laboratory.

The aim of the internship will be, in support to a PhD program, to contribute to the development of the modelling and the validation and verification of the stability analysis tool with the help of experimental data.

Once a general understanding of the scientific program will be learnt, the first part of the training period will consist in getting some knowledge about the tool's characteristics (physical models and implementation) and in qualifying their implementation by rerunning some test cases (eg. on simplified geometry).
The second part will focus on developing the ability to perform stability analysis of Na boiling on experimental geometry and conditions and providing relevant and enlightening feedback (meshing, robustness and physical closure laws).

Here are the key steps to make this internship a success:
1) Developing the ability to perform stability analysis on experimental conditions by simulating some scaled experiments from the literature
2) Provide useful feedback: identify key issues on which the development and validation efforts should be focused (to improve the relevance and efficiency of development and validation efforts)
3) Contribute to the validation by fitting the model to the experimental data
4) Promoting the definition of some relevant/performant simulations that would provide some directions for next experimental R&D steps

Practical information

Key words: two phase flow thermal hydraulics, sodium boiling
Resources: Na boiling experimental data, stability analysis tool
Requirements: Master student with good MATLAB knowledge
Possibility to continue into a PhD