# Nicolas Baudin travel grant - Internship in France proposal form

* = mandatory fields

## SECTION 1: Hosting institution in France

### Hosting institution in France*

<table>
<thead>
<tr>
<th>Name*</th>
<th>centralesupélec</th>
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### Hosting laboratory / research team in France

<table>
<thead>
<tr>
<th>Name*</th>
<th>Chair Photonics and LMOPS EA 4423 Laboratory LMOPS</th>
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<tbody>
<tr>
<td>Address*</td>
<td>CentraleSupélec – Campus de Metz, 2 Rue Edouard Belin, F-57070 Metz France (EU)</td>
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</table>

### Supervisor of the intern in France

<table>
<thead>
<tr>
<th>Name(s)*</th>
<th>Dr. Damien Rontani / Dr. Nicolas Marsal</th>
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<tbody>
<tr>
<td>Function*</td>
<td>Assistant Professor (both)</td>
</tr>
<tr>
<td>E-mail*</td>
<td><a href="mailto:damien.rontani@centralesupelec.fr">damien.rontani@centralesupelec.fr</a> / <a href="mailto:nicolas.marsal@centralesupelec.fr">nicolas.marsal@centralesupelec.fr</a> / <a href="mailto:marc.zolver@centralesupelec.fr">marc.zolver@centralesupelec.fr</a></td>
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<td>Contact ph*</td>
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## SECTION 2: Internship offer

### Topic of the internship (title)*

Neuro-Inspired Photonic Systems for All-Optical Information Processing

### Dates of the internship*

(nb: this program supports 3 to 6 month internships with a starting date earlier than December 31, 2018)

<table>
<thead>
<tr>
<th>Start: (from)</th>
<th>01/09/2018</th>
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<tr>
<td>End: (to)</td>
<td>31/01/2019</td>
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### Scientific and academic objectives of the internship *

(***detailed description of the internship content, work expected from the intern and expected outcomes**)

**Content**: There have been multiple demonstrations that neuro-inspired systems can achieve computation with high-energy efficiency [Merolla14], while performing complex tasks such as pattern recognition, data mining. The definite objective being to provide learning and cognitive capacities to engineered photonics architectures comparable to those of complex neural architectures such as the mammal brain. Amongst the many existing proposal in cognitive computing, reservoir computing has focused significant attention since its initial discovery a decade ago [Jaeger02]. The main idea consists of a three-layer architecture: (i) an input layer detect the data and transmit it first to the second layer (ii) a dynamical networks with a complex topology including recurring loops and finally transmitted to (iii) an output layer. This generic structure, also known as an echo-state network (ESN) allows to map the input data to a higher-dimensional space before being processed by the output nodes, which apply a simple readout function with optimized coefficients (weights) via training. The trained output allows for the input to be mapped to its corresponding class. The training is similar to that of an artificial neural network, except here the only part of the reservoir computer to be trained is the output. Reservoir computing has proven to be particularly effective in complex computation tasks such as spoken digit recognition and time-series (e.g.: chaotic, financial) forecasting but was mostly realized in simulations.

**Work and outcomes expected**: The objective of the intern will be to analyze using numerical simulations and experiments (if time is permitted) how the structure of a photonics reservoir computer currently under construction in the LMOPS Laboratory will impact its computing performance. We will therefore implement representative instances of various topologies of our experimental setup and observe the corresponding level of performance for different common computational tasks. Our experimental setup relies also on analog-to-digital conversion, it is known from study on physical reservoir computing that quantization error can significantly impede the performance of the reservoir [Appeltant11]. The intern will analyze the impact of quantization and also robustness to noise of our photonic reservoir computer.

**References**


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**Name of industrial partner** *

(participation of an industrial partner is highly recommended)

Cliquez ici pour taper du texte.

**Main contact at the French industrial partner** *

Cliquez ici pour taper du texte.

**Main contact at the French industrial partner’s branch in Australia** (if applicable)

Cliquez ici pour taper du texte.

**Role of the industrial partner in the internship project**

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SECTION 3 : Expected profile of applicant

Level of study *
(priority will be given to Bachelor’s degree Honours students and Master’s students)

Undergraduate (BS) or Graduate Students (MS) with degree in Electrical Engineering, Applied Physics or Engineering Physics preferred

Discipline*
Photonics, Electronics, Machine Learning, and Signal Processing

Required qualities, knowledge and skills*
Qualities: Rigorous, creative, and interested by interdisciplinary research. Skills: Programming in Matlab and/or Python and data analysis. Knowledge: Signal Processing, Basic understanding of dynamical systems (e.g.: differential equations, recurrent maps) and linear regression. Basic understanding of electromagnetic wave physics and photonics devices (e.g.: amplitude modulator, photo-detector…)

Other specific eligibility criteria *
(such as citizenship requirements, language requirements…)

No restriction on Citizenship (providing that the French Government is approving the candidate after vetting). A good level in oral and written English is required. Basic knowledge in French is not required but will make the experience more interesting for the candidate fully immersed in a French academic environment. Due to institutional cooperation and agreements, candidates from Flinders University, University of Queensland, University of Technology Sydney and Macquarie University will be welcomed.