

Ségolène CALLARD

Deputy Director of INL

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Écully, March 1st, 2021

To whom it may concern,

I, the undersigned Dr. Ségolène CALLARD, deputy director of the Institut des Nanotechnologies de Lyon (INL UMR CNRS 5270), certifies that Annachiara RUOSPO, started today (March 1st, 2021) her 3 months PhD Student internship.

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Écully, 31/05/2021

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I, the undersigned Dr. Ségolène CALLARD, deputy director of the Institut des Nanotechnologies de Lyon (INL UMR CNRS 5270), certifies that Annachiara RUOSPO, finished today (Mai 31st, 2021) her 3 months PhD Student internship.

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Deputy Director of INL

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ATTESTATION

Objet : Attribution d'une aide financière à la mobilité entrante
IDEXLYON

Vu la décision de la commission d'attribution des aides à la mobilité doctorale IDEXLYON - année 2019, en date du 14 novembre 2019 ;

Vu la délibération du CA de l'Université de Lyon en date du 13 mars 2019 (délibération N°16-CA-2019) ;

Il est décidé que :

Une aide financière d'un montant de 1 000 € par mois est attribuée, dans le cadre de l'IDEXLYON, à Annachiara RUOSPO, inscrite en doctorat auprès de l'Ecole Polytechnique de Turin - Italie - pour un séjour doctoral d'une durée de 3 mois au sein de l'Institut des Nanotechnologies de Lyon - France.

Une prise en charge des frais de voyage de son domicile vers son lieu d'accueil est associée à l'aide financière. Cette prise en charge est limitée à 500€ pour un voyage aller-retour.

Un acompte de 75 % sera versé au doctorant sur présentation d'un certificat de présence dans l'unité de recherche d'accueil en 2020, signé par le responsable de l'unité ou l'encadrant et d'une attestation d'assurance pour la durée du séjour. Le solde sera versé au vu d'un certificat de fin de séjour signé par ledit responsable ou encadrant.

Le Directeur général des services de l'Université de Lyon est chargé de l'exécution de la présente décision.

Fait à Lyon, le 19 novembre 2019, pour servir ce que de droit.

Khaled BOUABDALLAH

Président de l'Université
de Lyon



Lyon, February 16, 2021

Doctoral Mobility grants- IDEXLYON
Incoming mobility
Year 2021

IDEXLYON supports international mobility for doctoral students by continuing its financing programme for doctoral student's mobility. Scientific outgrowth, for the research units, of the doctoral student's work, will be evaluated by the Université de Lyon, with the researchers welcoming and supervising the students during their mobility.

In November 2019, the Ph.D. student **Annachiara RUOSPO** was accepted for the Doctoral Mobility Grants - IDEXLYON, which consisted of a period abroad, in Lyon, of 3 months. Due to the COVID-19 situation, it has been rescheduled to March-May 2021.

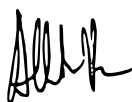
Therefore, I declare that the Ph.D. student Annachiara RUOSPO, receiving an IDEX mobility grant, will start her IDEX mobility stay on **March 1st, 2021** with the Institut des Nanotechnologies de Lyon, UMR 5270 directed by Mrs Catherine BRU-CHEVALLIER, under the supervision of Professor **Alberto Bosio**. The research period will last three months, up to **May 31st, 2021**. Due to the uncertain situation caused by the covid pandemic, the activity will start remotely.

Annachiara RUOSPO, born on April 19th, 1993, Italian, residing in Le More, 3 - RUTIGLIANO (BA) – ITALIA, is a PhD student employed by Politecnico di Torino, Italy, since 01/11/2018. She is a member of CAD & Reliability Group within the Dipartimento di Automatica ed Informatica (DAUIN) and her Polito supervisor is Professor **Ernesto Sanchez**.

In this period, she will carry out a study entitled "Reliability Analysis of Convolutional Neural Networks", which description is specified in Annex 1.

Sincerely,

Prof. Dr. Ing. Alberto Bosio
Full Professor,
INL - Ecole Centrale de Lyon, France
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Membre de  UNIVERSITÉ
DE LYON

ANNEX 1 – DESCRIPTION DE L'ETUDE / STUDY DESCRIPTION

Title: Reliability Analysis of Convolutional Neural Networks

Deep Learning [1], and in particular Convolutional Neural Networks (CNNs), are currently one of the widely used predictive models in the field of machine learning. CNNs are today exploited in various applications such as object recognition, drug discovery, natural language processing, up to safety critical applications like autonomous driving [2-5]. Unfortunately, the computational cost of CNNs is often out of reach for low-power embedded devices, and for datacenter-style hardware platforms too. For example, the amazing performance of AlphaGo [5] required 4 to 6 weeks of training executed on 2000 CPUs and 250 GPUs for a total of about 600kW of power consumption (while the human brain of a Go player requires about 20W). New Computing Paradigms (i.e. beyond Von Neumann) and Emerging Technologies (i.e., beyond CMOS) are under investigation to make CNNs sustainable and really usable by end users. Among them, the Approximate Computing (AxC) paradigm [6] exploits the CNNs' inherent resilience to errors by relaxing the need for fully precise operations to improve energy efficiency. However, energy efficiency is not the only parameter. Indeed, depending on the application other metrics have to be considered. For example, in safety-critical applications, reliability plays a major role (i.e., the capacity to provide good enough results despite the presence of faults or external threats). Along with reliability aspects, the safety of these emerging technologies must be taken into account. Nowadays, they constantly behave in human environment and therefore, it is necessary to guarantee their correct behavior even during the mission life of the devices. A joint work on the analysis of the impact of external threats on the CNN behavior has been already published by Alberto Bosio and Annachiara Ruospo [7]. External threats will be modeled by as faults affecting a specific component of the CNN. The component can be either software (e.g., a data structure) or hardware (e.g., the multiplier). One modelled, an injection engine will be developed. The injector will force the CNN to deviate from the normal behavior by artificially injecting the fault. The difference between the expected (i.e., golden) and the faulty behavior assess the reliability of the CNN w.r.t. the injected fault. To have a statistically significant outcomes, a huge number of faults has to be injected. Moreover, the behavior of the faulty CNN strictly depends on the input set of stimuli. The scope of the research stay is thus to target the generation of a meaningful set of stimuli to be used during the fault injection. The problem is how to measure the quality of the input stimuli. Some metrics exists in the field of functional verification (e.g., how many time a given variable change its status during the application of the input). The skills of Annachiara will be thus fundamental to work in this direction. The outcomes of this work will be extremely useful in the context of the two running projects IMPULSION ODeLe and ANR AdequatedL.

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