Training Opportunity for Luxembourgish Trainees

Reference	Title	Duty Station
LU-2020-TEC-EDD	**Artificial Intelligence Bench Marking Utilising state-of-the-art FPGAs**	**ESTEC**

Overview of the unit's mission:

The Data Systems Section is responsible for project support and technology development of space applications for all that concerns on-board data handling and processing systems (essentially control computers, data handling computers, specialised processors for payload data processing, solid state mass memories, microelectronics devices, Application Specific Integrated Circuits (ASICs), data and command & control busses, on board networks and corresponding support software).

The Section is, besides activities related to the specification and validation of data systems, also actively involved in the design of the required building blocks. These elements must comply with high reliability and availability requirements combined to specific immunity to the space environment, in particular related to radiation induced effects. The Section is also responsible for developing and prototyping communication protocols used within the flight avionics system (CAN, SpaceWire, Milbus) and between space and ground. Development of new, non conventional processing methods, based on machine learning and artificial intelligence for on board dependable systems on processors and FPGA is also a possible study topic.

You are encouraged to visit the ESA website: www.esa.int/ESA

Overview of the field of activity proposed:

Research in Artificial Intelligence (AI) has been revitalized in the last years, driven by the recent advancements of Machine Learning (ML) and the advent of large Artificial Neural Networks (ANNs). Due to the intrinsic parallelism between neurons and layers, the ANNs can be efficiently accelerated by hardware. The state-of-the-art SRAM FPGAs deliver significant advantages in the implementation of ANNs in terms of throughput, reduced cost and higher fault tolerance (due to possibility of implementing redundant synapses and neurons). These large ANNs introduce demanding computing requirements in terms of processing power and data storage increasing the Size, Weight and Power (SWaP) of the system. Moreover, the SRAM FPGAs are vulnerable to radiation-induced Single Event Effects (SEEs). Thus, low-power and radiation hardening design techniques should be developed for the FPGA ANNs to enable their integration in onboard computing modules for dependable applications.

Since AI based solutions in space are being proposed for different purposes (e.g. Earth Observation, Science or Navigation) one has to ensure that algorithms can run on suitable on-board hardware. This activity explores how to efficiently perform neural network inference on space hardware, if currently available hardware can support these applications and future explore application requirements. The activity may be seen as bench-marking of available state-of-the-art FPGAs and their capability of running ANNs based on specific space related applications.

Required education:

- Master-level degree in a relevant engineering or science discipline
- Fluency in English and/or French the working languages of the Agency