OTTO VON GUERICKE
UNIVERSITÄT
MAGDEBURG

FACULTY OF
ELECTRICAL ENGINEERING AND
INFORMATION TECHNOLOGY

CHAIR FOR
HARDWARE-ORIENTED
TECHNICAL
COMPUTER SCIENCE
HTI
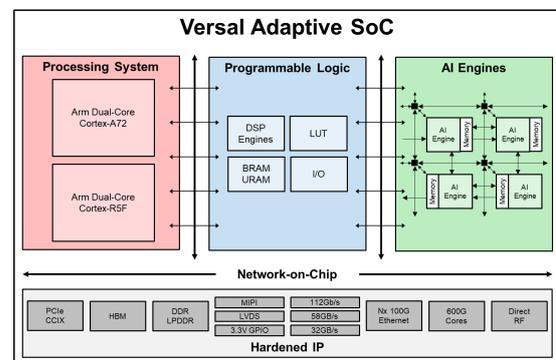
Exploring AI Engine capabilities in Ultra-High Field MRI systems

Research project/Bachelor/Master Thesis

Research field

The continuous growth of computing demand in scientific and medical applications has led to the adoption of powerful accelerators such as GPUs and TPUs in large HPC datacenters. However, the main bottleneck has shifted from computation to data handling—massive datasets cannot be transferred to the Cloud fast enough for real-time processing.

In the post-Cloud era, computation is moving toward the Edge to process data closer to the sensors, reducing transmission overhead, latency, and power consumption. To support this shift, Adaptive System-on-Chips (SoCs) like the AMD Versal chip that integrates CPUs, programmable logic, and a grid of AI Engines has been proposed. This SoC enables real-time, dataflow-oriented processing, which

has the potentially of process high amount of data on the fly without storing them on external memory, so avoiding memory limitations.

While these architectures are mostly used for AI workloads, their potential for non-AI domains remains under-explored. In particular, this architecture can become the key technology for real-time data processing in Ultra-High Field MRI (UHF-MRI) scanners that will benefit from AI Engine–based processing to overcome data transfer bottlenecks and enable on-the-fly computation of large data streams at the Edge.

Research topic and working hypothesis

In this thesis the student will get a MRI reconstruction algorithm to be adapted to run on AI Engine within the Versal SoC, and the student will focus on scaling it for a targeted UHF-MRI scanner. In order to achieve improvement the student has to analyze the computational requirements using analytical models like roofline model and then customize part of the processing on the AI Engine, defining a dataflow approach for the selected algorithm.

Skills

Required:
- Knowledge in Verilog or VHDL
- Knowledge in C/C++

Desired:
- Basic knowledge of Vivado
- Knowledge of MRI reconstruction algorithm and parallel computing

Contact

Dr.-Ing.
Daniele Passaretti
daniele.passaretti@ovgu.de
G03-319

Scan the QR Code for
Link to the Website