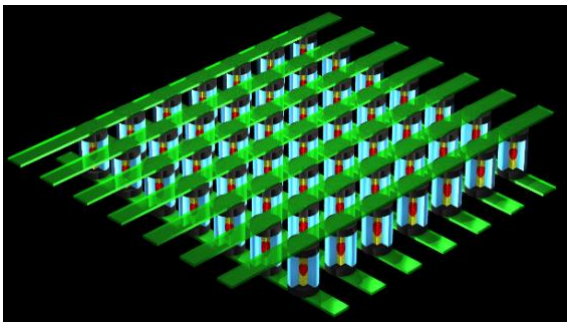
IBM Research –Zurich

Phase-change memory devices for non-von Neumann computing



For decades, conventional computers based on the von Neumann architecture have performed computation by repeatedly transferring data between their processing and their memory units, which are physically separated. As computation becomes increasingly data-centric and as the scalability limits in terms of performance and power are being reached, alternative computing paradigms are searched for in which computation and storage are collocated. A fascinating new approach is that of computational memory where the physics of nanoscale memory devices are used to perform certain computational tasks within the memory unit in a non-von Neumann manner.

Computational memory is finding applications in a variety of application areas such as machine learning and signal processing [1]. Most importantly, it is very appealing for making energy-efficient deep learning inference hardware, where the neural network layers would be encoded in crossbar arrays of memory devices [2]. However, there are several challenges that need to be overcome at both hardware and algorithmic levels to realize reliable and accurate inference engines based on computational memory.

We are inviting applications from students to conduct their Master thesis work or an internship project at IBM Research – Zurich on this exciting new topic. The goal of the project is to develop and optimize phase-change memory (PCM) [3] for non-von Neumann computing. The work will involve experimental characterization and modeling (physical as well as behavioral) of PCM devices. It also involves interacting with researchers across IBM research focusing on various aspects of the project such as device fabrication, circuit design and algorithmic development. The ideal candidate should have a multi-disciplinary background, mathematical aptitude and strong experimental and programming skills. Prior industrial internship experience will be very valuable. Prior knowledge on emerging memory technologies such as phase-change memory is a bonus but not necessary.

If you are interested in this challenging position on an exciting new topic, please send your most recent curriculum vitae including a transcript of grades by email to:

Benedikt Kersting (bke@zurich.ibm.com) and Abu Sebastian (ase@zurich.ibm.com)

[1] A. Sebastian, M. Le Gallo, R. Khaddam-Aljameh *et al*. Memory devices and applications for in-memory computing. *Nature Nanotechnology* (2020). https://doi.org/10.1038/s41565-020-0655-z

[2] V. Joshi, M. Le Gallo, S. Haefeli *et al*. Accurate deep learning inference using computational phase-change memory. *Nature Communications* (2020). Pre-print at https://arxiv.org/abs/1906.03138

[3] M. Le Gallo and A. Sebastian, "An overview of phase-change memory device physics", J. Phys. D: Appl. Phys. (2020) https://iopscience.iop.org/article/10.1088/1361-6463/ab7794