ASCI Spring school 2017-May-31

Biography

Kees van Berkel started his R&D career at Philips Research in 1980, after an MSc degree in EE from TU Delft. Since 2000 he has been a fellow at Philips, NXP, ST-Ericsson, and Ericsson, until mid 2015. He obtained a PhD in CS from TU Eindhoven in 1992, where he is a part-time full professor since 1996.

Kees pioneered asynchronous VLSI from theory to mass production. Likewise: embedded vector processing for software-defined radio. His research interests include software-defined radio, vector processors, multi-core architectures, resource management, and low power. His latest interest is exascale computing for radio astronomy.

Title:
Exascale Computing for Radio Astronomy: GPU or FPGA?

The Square Kilometer Array (SKA) is a large radio telescope planned to be operational in 2022. With a photon-collecting surface of approximately one square kilometer it promises:

- unprecedented sensitivities for radio signals,
- with unprecedented compute requirements (≈ exascale=10^{18} floating-point ops/sec.),
- and unprecedented power consumption (≈20MWatt ≈ 30M€/year).

The SKA is a lead application for exascale computing. According to leaders in exascale computing, the required power efficiency suggests the need for hardware-software co-design, heterogeneous architectures, and GPUs as accelerators.

In this presentation we explore the exascale compute requirements for the SKA and the nature of the algorithms. The 2-dimensional Discrete Fourier Transform (DFT, $N \times N$, $2^{10} \leq N \leq 2^{14}$) is one of the heavier kernels. We review existing FPGA and GPU based 2D-DFT implementations using rooflines as tool. These rooflines are then used to predict throughputs for state-of-the-art and future GPUs and FPGAs. Would FPGA-based acceleration for exascale computing be an option?