RAW Keynote 2: New Horizons of Very High Performance Computing (VHPC): Hurdles and Chances

Reiner Hartenstein

TU Kaiserslautern
Kaiserslautern, Germany
reiner@hartenstein.de

Reconfigurable Computing (RC) delivers the success story of the century. First launched by the hardware / software co-design scene by adopting FPGAs for embedded system design, now a huge second wave has reached a wide variety of scientific computing communities. Google's yawdropping hit rates illustrate the pervasiveness of Reconfigurable Computing, now also being adopted by supercomputing (Cray, sgi, etc.). From FPGA usage as accelerators, speed-up factors by up to four orders of magnitude and more are reported, as well as floor space requirements and electricity invoice amounts reduced by one order of magnitude and more. This is astonishing, since FPGAs and rDPAs have a substantially lower clock speed than microprocessors and an effective integration density being lower by four orders of magnitude: the Reconfigurable Computing Paradox. Algorithmic cleverness is the secret of success, based on software to configware migration mechanisms, striving away from memory-cycle-hungry instruction stream-based computing paradigms. Even higher speedup is achievable by using coarse-grained reconfigurable datapath arrays (rDPAs) available from a number of start-ups. With automatically partitioning configware / software cocompilers the desktop personal supercomputer is near.

The main benefit of RC, having replaced the use of hardwired accelerators, is their flexibility by non-procedural programmability. This also contributes to more recent developments in system architecture, which rely on processes of evolution, self-organization, adaptation and fault tolerance. The main hurdles on the way to heart-stopping new horizons of cheap highest performance are CS-related educational deficits causing the configware / software chasm and a methodology fragmentation between the different cultures of application domains. Since the von Neumann paradigm is loosing its dominance by emerging reconfigurable main processors using hardwired von Neumann coprocessors as auxiliary clerks, it is time for a curricular upgrade. Current CS curricula do not sufficiently meet their transdisciplinary responsibility. The talk gives a survey on fundamental issues in RC and on new directions in CS-related curricula, focused on a dual paradigm organic computing approach.

1-4244-0054-6/06/$20.00