

Maximum Performance Computing for Exascale Applications

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Abstract. Ever since Fermi, Pasta and Ulam conducted the first fundamentally important numerical experiments in 1953, science has been driven by the progress of available computational capability. In particular, computational quantum chemistry and computational quantum physics depend on ever increasing amounts of computation. However, due to power density limitations at the chip we have seen the end of single CPU performance scaling. Now the challenge is to improve compute performance through some form of parallel processing without incurring power limits at the system level. One way to deal with the system "power wall" question is to ask "what is the maximum amount of computation that can be achieved within a certain power budget". We argue that such Maximum Performance Computing needs to focus on end-to-end execution time of complete scientific applications and needs to include a multi-disciplinary approach, bringing together scientists and engineers to optimize the whole process from mathematics and algorithms all the way down to arithmetic and number representation. We have done a number of such multidisciplinary studies with our customers (Chevron, Schlumberger, and JP Morgan). Our current results with Maxeler Dataflow Engines for production PDE solver applications in Earth Sciences and Finance show an improvement of 20-40x in Speed and/or Watts per application run.

Biography

Prior to founding Maxeler, Oskar was Member of Technical Staff at the Computing Sciences Center at Bell Labs in Murray Hill, leading the effort in "Stream Computing". He joined Bell Labs after receiving a PhD from Stanford University. Besides driving Maximum Performance Computing (MPC) at Maxeler, Oskar is Consulting Professor in Geophysics at Stanford University and he is also affiliated with the Computing Department at Imperial College London, having received two Best Paper Awards, an Imperial College Research Excellence Award in 2007 and a Special Award from Com.sult in 2012 for "revolutionising the world of computers".