Exascale, Tablet, and Smartphone: As Energy limits Redefine Computers, how can Computational Science Benefit?

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After two decades transistor scaling in density, speed, and energy (a.k.a. Moore's Law), the properties of technology scaling have shifted. In the new era of Moore's law, density continues to scale rapidly, but speed and energy scaling are much slower. In this era of energy-constrained performance, across the computing industry (smartphone, tablet, exascale computer) is engaged in a broad-based shift to parallelism and also heterogeneity.

Heterogeneity can yield large energy and performance benefits (10-100x), but also present major challenges for software development, tuning, and portability. We will describe a vision of the future of computing with a particular focus the opportunity that heterogeneity represents, and a new paradigm, "10x10", which enables systematic approach to heterogeneity in computer architecture, but as important enables a structured approach to software and algorithms for these future computer systems. We will outline the critical challenges for 10x10 paradigm and systems, and some early progress and evidence of viability.

Bio for Andrew A. Chien:

Dr. Andrew A. Chien is former Vice President of Research of Intel Corporation where he led a "bold, edgy" research agenda in disruptive technologies. He also led Intel's external research programs and Higher Education activities. Under his leadership, Intel Research launched new efforts in robotics, wireless power, sensing and perception, nucleic acid sequencing, networking, cloud, and ethnography. Working with external partners, Chien was instrumental in creation of the Universal Parallel Computing Research Centers (UPCRC) focused on parallel software, the Open Cirrus Consortium focused on Cloud computing, and Intel's Exascale Research program.

For over 20 years, Chien has been a global research and education leader, and an active researcher in high performance systems – architecture to software – and has published widely. At UCSD from 1998-2005, he served as SAIC Endowed Chair Professor in Computer Science and Engineering, and created the Center for Networked Systems. While at UCSD, he also founded Entropia, a widely-known Internet Grid computing startup. From 1990 to 1998, Chien was a Professor of Computer Science at UIUC with joint appointments at the National Center for Supercomputing Applications (NCSA) where he was a research leader for parallel computing software and hardware, and developed the well-known Fast Messages, HPVM, and Windows NT Supercluster systems.

Dr. Chien is a Fellow of the ACM, AAAS, and IEEE.   Chien currently serves on the Board of Directors for the Computing Research Association (CRA) and Editorial Board of the Communications of the Association for Computing Machinery (CACM). Chien received his Bachelor's in Electrical Engineering, Master's and Ph.D. in Computer Science from the Massachusetts Institute of Technology.