

Report on Interview with Prof Krishna Palem

Date: 13 Nov 2007

CC: Prof CC Hang, National Univ of Singapore

KP: Prof Krishna Palem, Rice University.

CC: How did you conceive the idea of PCMOS which abandons precise logic in favour of probability - rather counter-intuitive for a Professor?

KP: In 1999, I started working with DARPA in connection with power aware computing systems. However, as part of this work, I was struck that people were not taking advantage of algorithmic/application properties to help save energy. They were talking about architectures, operating system changes and so on. A particularly powerful breakthrough in computer science was the invention of randomized algorithms, which led to much faster (running time) algorithms compared to those that were not randomized; randomized algorithms, following the style of monte carlo simulation, use randomness to guide the computation. At the same time, I was reading Feynman's lectures on computing wherein, he was using gas pistons to describe how energy consumption can be linked in a fundamental physics sense to computing. This gas piston abstraction allowed me to (fairly easily) see how a device with randomness and hence a step in a randomized algorithm can be created, with less energy since, using our college notions of entropy, more randomness means more entropy, and hence less energy consumption. Moving this concept from a gas based switch or computer to CMOS led to PCMOS where work done by the piston is replaced with varying the voltage.

CC: But such a strange idea was unlikely to be accepted by other academics? I guessed you would have a difficult time with your peers.

KP: Yes, it is striking that you noted this idea of how mainstream research dominates. I have incrementally seen how the idea has been increasingly accepted in going from the physics (curiosity being the response) to PCMOS (intrigue being the response) to applications in signal processing (understanding and appreciation leading to a best paper award being the response). This took five to six years all together. So, definitely, it was challenging for researchers to accept it, even very good top flight researchers.

CC: How was the response of the VC community?

KP: The issue of feasibility grew from intense skepticism to the beginnings of seeing an opportunity over the six years. I did not approach VCs since they are, if anything based on past experience, even more conservative. So, I simply am waiting for next year when we will have fully working chips, partly done at NTU with us in fact, and the skepticism will be behind us for good.

CC: Do you envisage a pervasive impact of PCMOS in future?

KP: We wish to explore four commercial domains in parallel all of which need and use CMOS based solutions today: 1. DSP engines 2. Wireless including cell phone platforms 3. Graphics engines 4. Bioengineering with vision and auditory support with the vision part having possible connections to digital camera sensors. All of this will be in the context of ultra low power/energy.

CC: Which are the likely commercial products which will use PCMOS?

KP: The applications are very much in the areas addressed in the previous question. Thus, streaming video and audio in cell phones, sensor arrays to correct vision loss or in cameras, rasterizing graphics processors, and so on. In all cases, quality and energy savings will be traded off.

CC: This seems to have a similar characteristics to a previous case of Fuzzy Logic invented by Prof Zadeh in 1965. His invention was largely dismissed by the academic community until the Japanese engineers demonstrated real industrial/commercial applications 10 years later.

KP: I see and hope I am correct that this idea of PCMOS and probabilistic (just good enough) design as maturing to early stage commercialization in three more years. That makes the whole cycle to be nine years which is not that much different from Zadeh's experience.

CC: What motivated you to persevere in getting your idea applied to create impactful innovations?

KP: For a while now, most inductive ideas (as opposed to deductive such as the discovery of DNA or the big bang) seem to thrive when multiple disciplines meet. In my case, Physics, computer science and electrical engineering with an informal smattering of the economics of computing. I think that this will be my best bet--very multidisciplinary approaches to thinking and not being limited at all by risk since I was tenured at the Courant institute at the time and so it seemed a shame if I could not take as much risk as I can, I

asked myself the question: what will happen if I fail? Answer:
Practically nothing What will happen if I succeed? Answer: A lot!