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Method and Apparatus To Create A Low Power Programmable Stencil Processing Engine for Image/Video Processing and Related Applications

Stanford researchers have developed a new technology to create a programmable yet low power processing core targeting imaging systems. This core is built around a 2D-stencil processing data-path. 2D stencil based operations are often the most computationally intensive parts of an image processing application. While these operations involve a lot of computation, they are also very regular and thus very efficient hardware implementations are possible. However traditional data-parallel architectures such as GPUs, SIMD units and DSPs are not optimized to fully exploit this regularity. As a result this optimized core can achieve 10-100x lower energy consumption for this class of algorithms compared to GPU/SIMD/DSP solutions. In addition to the 2D-stencil data-path this core includes a wide but light-weight SIMD unit as well as a generalized reduction network to facilitate parts of the computations which are not stencil based.

A potential application of this is in mobile platforms such as cell phones and tablets which are limited by power / battery life constraints. Smart phone cameras are rapidly replacing traditional P&S cameras as the primary imaging device for consumers. However, the quality of these cameras is severely limited by small form factor of cell phones that prevents the use of better optics and bigger imaging sensors. This technology can be an enabler for advanced computational photography and computer vision techniques for the camera systems in these devices, to help them achieve greater image and video quality. This is of course not the only application area, in fact any power-limited imaging processing system would benefit from this technology. Apart from imaging this can also be generalized for use in any other 2D signal processing application making use of small to moderate size stencil based kernels.

Applications

- Image processing applications in embedded imaging systems such as consumer cameras, cell phones, and tablets.
- Any 2D signal processing application making use of small to moderate size stencil based kernels

Advantages

- Enable advance image processing capabilities within limited power budget to improve the quality of images and videos produced by cell phones and other embedded image systems

Publications

- Wajahat Qadeer, Rehan Hameed, Ofer Shacham, Preethi Venkatesan, Christos Kozyrakis, and Mark A. Horowitz. 2013. “Convolution engine: balancing efficiency & flexibility in specialized computing.” In Proceedings of the 40th Annual International Symposium on Computer Architecture(ISCA '13).

Patents

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