

Optimization of Vertical and Horizontal Beamforming Kernels on the PowerPC G4 Processor with AltiVec Technology

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Embedded Software Systems

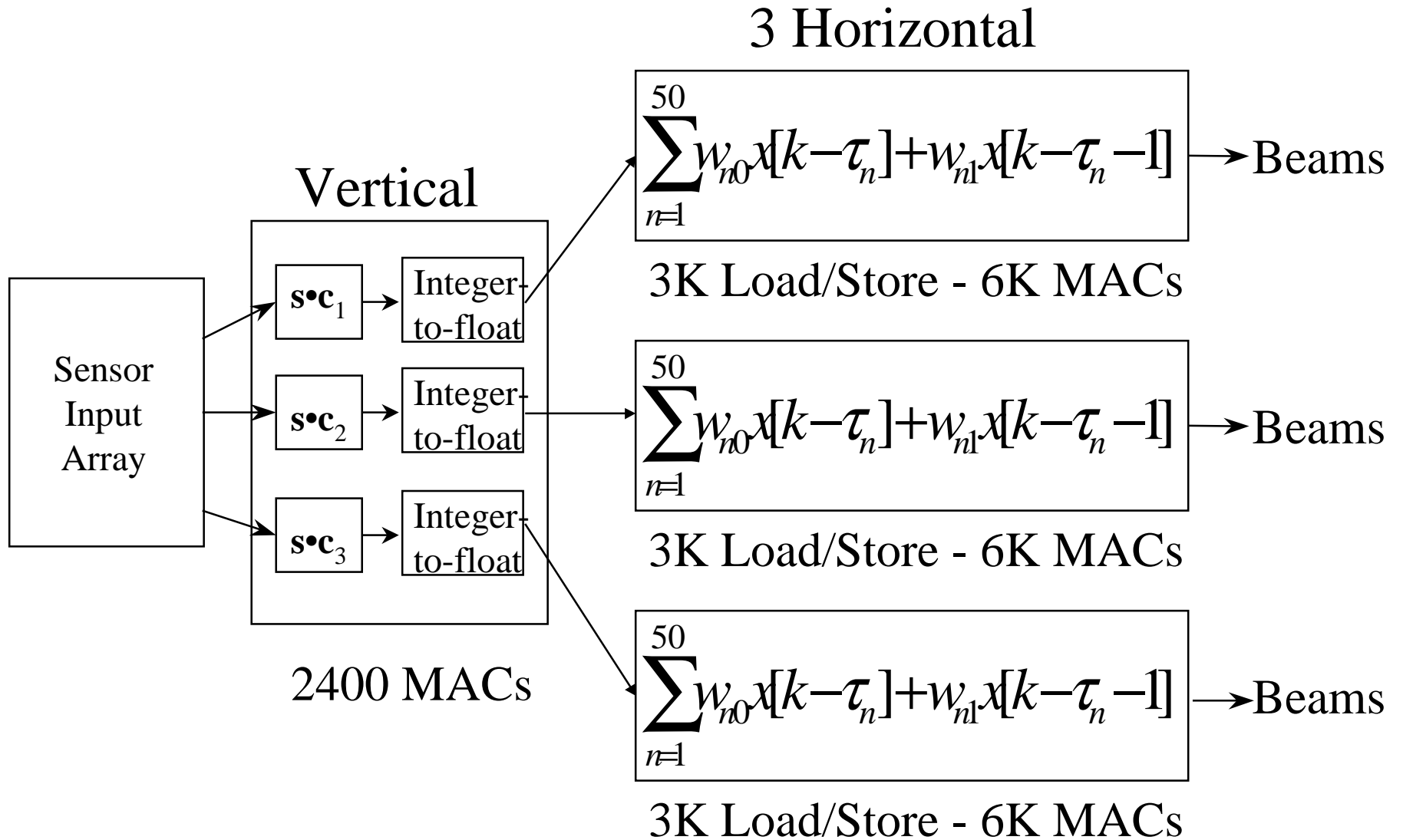
Literature Survey

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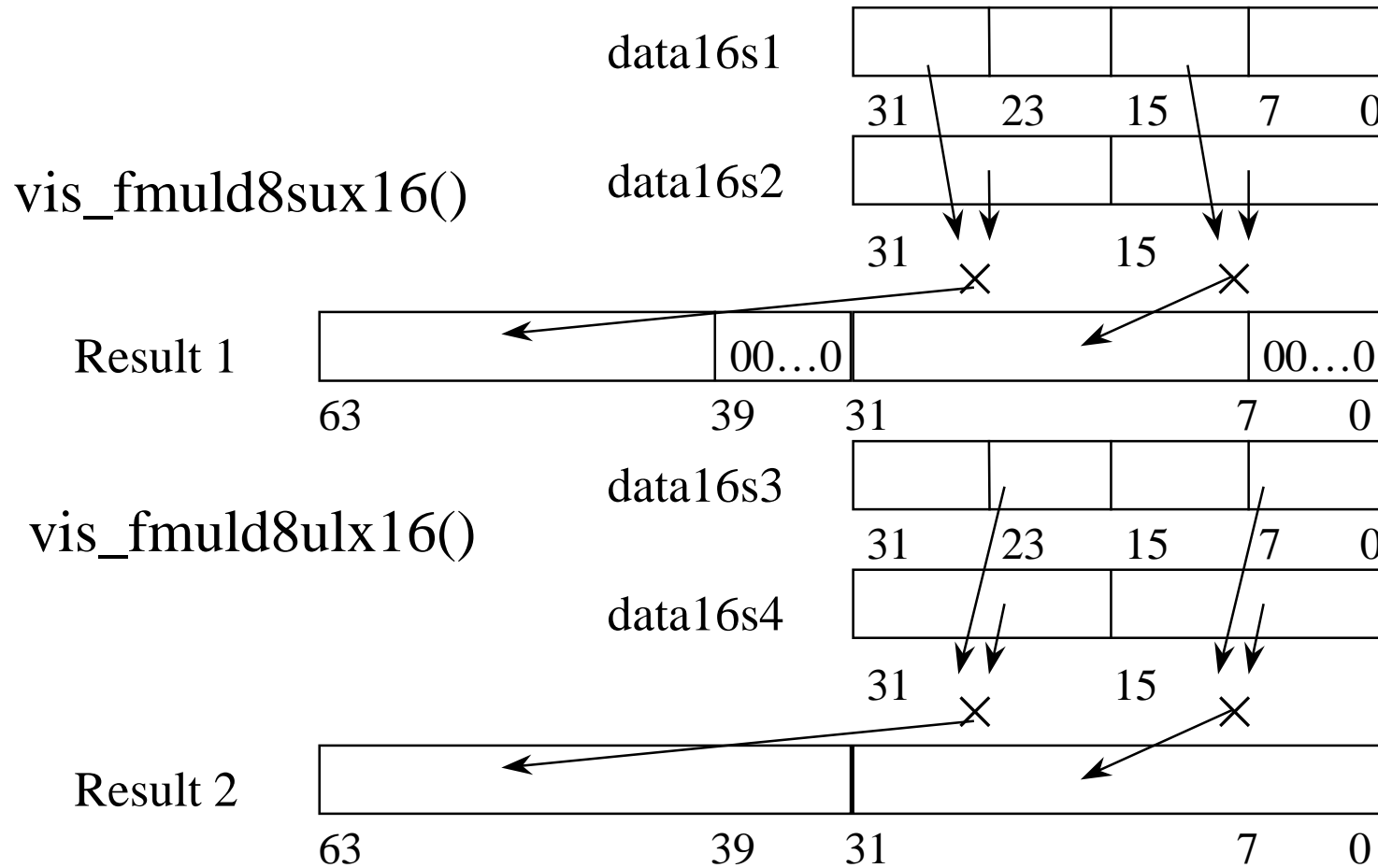
Sonar Beamforming

- Sensors project underwater 3-D image
 - Beamformer locates object location
- Vertical Beamformer
 - Takes input from 10 vertical transducers
 - Computes 3 dot products: $\mathbf{s} \cdot \mathbf{c}_i$; $i=1,2,3$
- Horizontal Beamformer
 - $$b[k] = \sum_{n=1}^{50} w_{n0} x[k - \tau_n] + w_{n1} x[k - \tau_n - 1]$$
 - Weighting w_{n0} , w_{n1} , time delay, τ_n

Beamforming Kernels



16x16→32-bit Multiplication



Proposed Implementation

- The Newer Native Signal Processing
 - PowerPC G4 with AltiVec
- Enhanced Vertical Beamformer
 - Four MACs/cycle vs. Two MACs/3 cycles
- Use AltiVec in Horizontal Beamformer
 - Four Floating-point MACs
- Potential Speed-up of > 10

Key References

- R. G. Pridham and R. A. Mucci, "A Novel Approach to Digital Beamforming." *Journal Acoustical Society of America*, vol. 63, no. 2, pp. 425-434, Feb. 1978.
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- H. Nguyen and L. K. John, "Exploiting SIMD parallelism in DSP and multimedia algorithms using the AltiVec technology." *Proc. of the 1999 International on Supercomputing* , pp. 11-20, 1999.