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Poster

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Computational Framework for Single Instruction Multiple Data (SIMD)

Architectures Applied to Digital Signal Processing

Single Instruction Multiple Data (SIMD) architecture is embedded in most microprocessors; this feature can be exploited to implement computational efficient algorithms. In general, any algorithm implementation, which makes use of SIMD capabilities, should be re-derived taking into account the advantages and requirements of the SIMD architecture. Such is the case of mathematical and logical operations over N elements at a time (N depends on the element`s data-type, access pattern, memory addressing mode, and other characteristics)

In this paper, the valuable features of the SIMD architecture are explained and a framework is proposed to deal with the derivation and implementation of well-known 1D and 2D signal processing algorithms such as: matrix addition, ultiplication, and transposition; convolution, correlation, and Mathematical Morphology operations; Fourier and Wavelet transformation operations

The proposed framework is divided in two: the first deals with the algorithm itself. That is, how to improve a given algorithm when multiple data operations are available and how to order all memory accesses to be SIMD compliant. The second part deals with the coding techniques chosen to access the SIMD capabilities of a given microprocessor in a generic fashion (Intel PIII, P4, Motorola PPC-7400 microprocessors are considered) for simple math operations required in the given algorithm. Finally, these two results are merged to come-up with a computational efficient implementation

All proposed SIMD-aware algorithms were found to be faster than their scalar counter-part. When available, they were compared with state-of-the-art algorithms and/or computational implementations (which may be SIMD-aware or not). The most remarkable results come from the Fast Fourie transform algorithm which achieved an improvement in execution speed raging from 1.9 to 4.7 and 1.6 to 4.3 than the scalar versions for 1D and 2D respectively

R&D results should be brought into the classroom in a timely manner. Content can be integrated via the WEB using flexible information maps and contextual databases that enables students to use the information in a flexible fashion that accommodates to their needs. Our results form a case study in the ISTEC Chips&Salsa WEB effort demonstrate this.