EE 382C Embedded Software Systems

Project Proposal

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Programmable VLIW versus SIMD Architectures for DSP and Multimedia Applications

Objective: The goal of this project is to evaluate the effectiveness of two different techniques for exploiting the Instruction Level Parallelism (ILP) available in Digital Signal Processing (DSP) and Multimedia applications. VLIW (Very Long Instruction Word) architectures have multiple functional units to take advantage of such a parallelism, while the SIMD (Single Instruction Multiple Data) approach operates on multiple data in a single instruction. To experiment with the above two techniques, modern commodity processors from each is chosen; Texas Instruments Inc.'s TMS320C6x, a VLIW processor, and Intel's Pentium II with MMX, a SIMD representative.

Previous Work: Effectiveness of MMX instructions for DSP and Multimedia applications was evaluated for a Pentium processor in [1]. A number of commercial DSP and general-purpose processors are benchmarked by [2] for DSP kernels. Several media benchmarks are introduced and characterized in [3]. A DSP benchmarking methodology is introduced in [4]. Our past research did some comparisons between VLIW and SIMD for DSP kernels [5]. All of the above work focuses on different aspects; [1] does comparison on both kernels and applications, but only on a Pentium processor. In [2], only kernels are used as opposed to com-

plete applications and more over certain kernels are missing. In [3], though several relevant benchmarks are introduced, there is no implementation either for VLIW or SIMD. Only few kernels are evaluated in [4], and in [5] we did not benchmark large applications. The goal of this work is to extend our earlier work by benchmarking real applications.

Benchmarks: To evaluate the efficiency of each technique, several benchmarks will be chosen from real world DSP and Multimedia applications. The benchmarks are expected to be in the following categories:

- Audio/speech Processing (Compression, De-Compression, Filtering, etc)
- Image/Video Processing (Compression, De-Compression, MPEG decoding, video conferencing, etc)
- 3D Graphics applications
- Speech/Image Recognition (finger print, voice recognition, etc)
- Data Encryption/Decryption
- Other relevant areas

References:

[1] R. Bhargava, L. John, B. Evans, and R. Radhakrishnan, "Evaluating MMX Technology Using DSP and Multimedia Applications", IEEE Micro-31, pp. 37-46, Dec. 1998.

[2] J. Bier and J. Eyre, "Independent DSP Benchmarking: Methodologies and Latest Results", Proc. ICSPAT, Toronto, Sep. 1998.

[3] Chunho Lee, et al, "MediaBench: A Tool for Evaluating and Synthesizing Multimedia and Communications Systems", IEEE Micro-30, Dec. 1997.

[4] V. Zivojnovic, J. Martinez, C. Schläger and H. Meyr. "DSPstone: A DSP-Oriented Benchmarking Methodology". Proc. of ICSPAT'94 - Dallas, Oct. 1994.

[5] D. Talla and L. John, "Performance Evaluation and Benchmarking of Native Signal Processing", submitted to Europar99.