MediaBench

A tool for Evaluating and Synthesizing Multimedia and Communication Systems
MediaBench

• Benchmark that target on multimedia and communications application.
• Special purpose microprocessor : VLIW, SIMD Microprocessor architecture.
• Capture essential elements of modern embedded multimedia and communications applications.
Benchmarks

- SPECint, SPECfp: Scientific and general purpose computing application.
- TPC: Database application.
- MediaBench: Multimedia, DSP, image processing, and communication application.
Tool used

• DineroIII : Uniprocessor cache simulators written by Mark Hill.
• Impact complier and simulator.
• Shade : Fast instruction set simulator which use a binary translation by SUN.
• Spixtools : Collection of programs which allow instruction-level profiling of applications programs by SUN.
Goals

• Accurately represent the workload of emerging multimedia and communication system.
• Portability.
• Effective for system evaluation as well as system synthesis.
Media application

• **JPEG**: Implement JPEG image compression and decompression for full-color and gray-scale images.

• **MPEG**: Standard for high quality digital video transmission. Used by mpeg2enc and mpeg2dec.

• **GSM**: Implementation of the European GSM 06.10 provisional standard for full-rate speech transcoding.
Media application

- **G.721**: The files in this package comprise ANSI-C language reference implementations of the CCITT G.711, G.721 and G.723 voice compressions.
- **PGP**: Use message digests to form signatures.
- **Pegwit**: A program for performing public key encryption and authentication.
Media application

- **Ghostscript**: Interpreter for the PostScript language.
- **Mesa**: 3-D graphics library clone of OpenGL*.
- **SPHERE (Speech Header Resources)**: A set of library functions and command-level programs which can be used to read and modify NIST-formatted speech waveform files.
Media application

• RESTA : A program for speech recognition.
• EPIC (Efficient Pyramid Image Coder) : An experimental image data compression utility.
• ADPCM : Adaptive differential pulse code modulation.
Performance evaluation

• Single-issue processor.
• 16 KB Direct-mapped split caches with 32 bytes line.
• Impact tool suit provides cycle level simulation of the processor.
• Use mean of all the applications for comparison.
Performance Characteristic

• Doesn’t stress instruction cache : Higher I-cache hit rate than SPECint.
• D-cache read : More effective than SPECint.
• D-cache write : Less effective than SPECint.
• Bus utilization : Very low compare to SPECint.
Performance Characteristic

- Branching rate: Approximately equal for the two suits.
- Integer ALU utilization rate: Approximately equal for the two suits.
- IPC: Slightly higher than SPECint.
Synthesis Validation

• Simple single-issue RISC processor core and on chip cache memory.

• Processor core: IBM 40x PowerPC core with an estimate size of 8 mm² in 0.5 \( \mu \text{m} \) technology.

\[
\frac{\text{Performance}}{\text{Cost}} = \frac{\text{Instruction Count}}{(\text{Core area} + \text{Cache area}) \times (\text{Instruction count} + \text{Misses} \times \text{Miss penalty})}
\]
Synthesis Validation

Performance/cost VS. cache size

• Split direct mapped cache with 16 byte lines.
• Caches are sized between 1KB and 16 KB.
Synthesis Validation

Results

• Optimal design point for SPECint is 2 KB I-cache with 1 KB D-cache.
• Optimal design point for MediaBench is 1 KB I-cache with 1 KB D-cache.
Synthesis Validation

Results

• Performance benefits of large caches do not compensate for the increased cost.
• I-cache of the system that synthesized by SPECint is 2 times larger than system that synthesized by MediaBench!!!
Conclusion

- MediaBench is suitable benchmark for embedded system target on multimedia, DSP, communication.
- Coded in high level language and has been compiled by multiprocessor architecture.
- Different characteristic lead to different system configuration.
Reference

• Chunho Lee, Miodrag Potkonjak, and William H. Mangione-Smith; MediaBench: A Tool for Evaluating and Synthesizing Multimedia and Communications Systems.

• http://www.cs.ucla.edu/~leec/mediabench/