Abstract: Design Space Exploration of Optimal Many-Core Processors for Sound Synthesis of Guitar

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Abstract

Recent advances in physics-based sound synthesis have offered huge possibilities for the creation of new musical instruments. However, its higher computational complexity compared to signal modeling has limited its use in real-time applications. This has motivated research on parallel processing architectures that support the physics-based sound synthesis of musical instruments. This paper presents a design space exploration of optimal many-core processors for the physics-based sound synthesis of the acoustic guitar by quantitatively evaluating the impact of the sample-per-processing element (SPE) ratio, which is the amount of sample data directly mapped to each processing element (or varying the number of processing elements for a fixed sample size) on system performance and efficiency using architectural and workload simulations. The effect of the sample-to-processor ratio is difficult to analyze because it significantly affects both hardware and software design as the SPE ratio is varied. In addition, the optimal SPE ratio is not typically at either extreme of its range. This paper illustrates the relationship between problem size, SPE ratio and processing element architecture for a target implementation in 130-nm technology. Experimental results indicate that a SPE in the range of 2,756 to 11,025 (or the number of PEs between 24 and 96) provides the most efficient operation for synthesizing guitar sounds with 6-note polyphony sampled at 44.1 kHz, yielding the highest area and energy efficiencies.

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