REAL-TIME PHYSICAL MODELING OF LARGE INSTRUMENT GEOMETRIES USING COUPLED FPGAS

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ABSTRACT

A recent methodology utilised to simulate and synthesize physical models of complete instrument geometries is extended to facilitate the implementation of larger physical models in real-time. The existing system utilises explicit finite difference methods to simulate and synthesize physical models of music instruments on Field Programmable Gate Array (FPGA) hardware. To extend the computational abilities of the existing system, it is enhanced by more recent FPGA hardware consisting of two FPGAs of the Virtex-7 family, a 2000T and a 690T which are connected to a personal computer via a PCIe interface protocol. A first implementation of a large scale geometry using explicit finite difference methods is compared to a specifically adapted pseudo-spectral implementation of a plate model, which is applied to simulate a geometrically correct model of a grand piano soundboard. A central interest of this work lies on the applicability to real-world problems arising in instrument acoustic research and instrument design. Thus, a dynamic configurability and contrallability of the models is sought after. To this end, an Input/Output protocol is utilised for real-time adaptability of the physical parameters of each model part. The simulation results of the soundboard model are compared to measurements taken on real grand piano soundboards in different production stages.