Physical Modeling of Gaygeum with Application to Sound Engine in Musical Synthesizer

U. P. Chong[1] **and S. J. Cho**[2]

Abstract: In this paper, we describe a sound synthesis of Korean musical instrument called gayageum and an implementation of sound engine using a TMS320C6713 DSP. A musical synthesizer consists of three parts: input/output, sound engine for sound synthesis and main processor to control the whole system. Particularly, the sound engine needs a lot of computations to execute sound synthesis algorithms. Therefore, it sometimes uses a digital signal processor.

We used physical modeling for sound synthesis algorithm that is a part of the sound engine. The term physical modeling refers in this case to the mathematical or computational simulation of sound production mechanisms of musical instruments. We synthesized sounds of gayageum using digital waveguides. Gayageum has 12 silk strings supported by 12 movable bridges called anjok. The strings are plucked with fingers to produce a clear and delicate tune. The movable bridges, anjok, transmit the vibration of strings and percussion between bridge and body to resonator. Hence, the generation of fundamental frequency is affected by the anjok. For this, we made anjok model through research for fundamental frequency variation by position of anjok. To make gayageum model, we assumed that all systems are linear time invariant and gayageum contains three models: string model, anjok model, and resonator. Gayageum model is made by linear combination of these systems. There are two kinds of playing styles for gayageum: left-hand playing style and right-hand playing style. We made excitation signals that correspond to each right-hand playing style and used these signals as the input of gayageum model. In order to perform proposed algorithm, we used a complete DSP system to calculate lots of operations. The DSP board includes the C6713 floating-point digital signal processor and a 32-bit stereo codec for input and output. When a key is pressed, the DSP executes algorithm to synthesize gayageum sound using excitation signals stored in memory. From this process, we could synthesize gayageum sounds whose sampling rate is 44.1 kHz and quantization bit is 16 bits. For this, we made an interrupt-driven program using C programming language.

[1] Department of Computer Engineering and Information Technology
University of Ulsan
680-749 San 29, Mugeo 2 - Dong, Nam-gu, Ulsan, South Korea
upchong@ulsan.ac.kr

[2] Department of Computer Engineering and Information Technology
University of Ulsan
680-749 San 29, Mugeo 2 - Dong, Nam-gu, Ulsan, South Korea
sjcho75@mail.ulsan.ac.kr