Abstract

In the past fifty years the rapidly developing digital technologies have reached the world of music. The filters, effects and amplifiers which originally were designed with analog electronics, nowadays exist as algorithms implemented on microchips, or processors. Among them, synthesizing sounds of instruments has become more popular, as it gave opportunities creating new sounds, and musical genres. The memory size and clock frequency of microcontrollers show the greatest development. Therefore, more complex algorithms can be run in viable time.

Physics-based sound synthesis requires more time for calculus, than the prior methods, therefore these algorithms have started to spread only in the last few decades. From several techniques for synthesis I use the finite difference method to design a model of the acoustic guitar. I chose this technique, because the tension modulation can be simply modeled with it.

My model is made up of three sub-models. First, the parameters of losses are computed by analyzing plucked samples. The string model is based on the one-dimensional form of the wave equation. This model considers the density of the string's material and its geometrical parameters: diameter, length, radius of gyration. It also includes the parameters of losses and stiffness.

The excitation is given by the physical model of the pick, which consists of two mass points, representing the peak of the pick and the hand which holds the pick, and the spring constant of the pick's material. I have measured the force-pressure response of the guitar body with a force hammer, and designed a digital filter to model the body response. The output of the string model is filtered and thus the synthesized sound is achieved.

At the end of the thesis I summarize the steps of the model creation process, draft the results, and discuss the feasible options of the parameters in the complete model. Finally, I highlight those parts of the model which are suitable for future development.