DIGITAL GUITAR WORKSHOP – A PHYSICAL MODELING SOFTWARE FOR INSTRUMENT BUILDERS

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ABSTRACT

Instrument builders have an ideal of sound in mind. Their experience in craftsmanship guides them through the production process. It is a more or less trial-and-error method. Each part of the instrument considered to be relevant to fit the imagination is going to be modified during the production process. The whole production process starting from a certain imagination of sound to the completed guitar and backwards represents an inverse problem. Still at best the solution would be inverse, where the builders would know how a geometry looks like producing the desired sound. The physical modeling software Digital Guitar Workshop (DGW) is a tool for guitar builders to do both, the trial-and-error as well as the inverse problem solution. Therefore 32 sample guitars were measured in terms of geometries of each part and radiation using microphone array techniques including the Minimum Energy back-propagation method. Selecting a preferred guitar out of the sample, builders can use a Graphical User Interface (GUI) to change properties of the instruments in detail like quantity, size and position of fan bracings, top and back plate thickness distribution, sound hole size and position, bridge size and position and much else. Builders can use the graphical soundboard to pluck a virtual tone which is calculated immediately to surveil the whole design process . The physical model of the guitar sound, simplified with respect to longitudinal waves and ribs, bases on the principles already widely publicized by R. Bader: Computational Mechanics of the Classical Guitar. (Springer 2005). Furthermore the builder can change an existing sound in the software by in- or decreasing sound strength within a chosen band and bandwidth with an equalizer. Subsequently the software proposes a geometry which meets this sound with best approximation. This inverse problem solution in the existing software version is a simple search algorithm using a large sample of pre-changed guitar geometries. The huge database shows large deviations in sound when changing the basic shape of the guitar and small deviations in detail by changing the fan bracing or plate thickness.Future work will be to improve the mentioned sound processing algorithm towards a mathematical solution.