Can we create a virtual Stradivari?

Instruments of the old masters are important references for high acoustical quality. Thus it is a goal to understand their physical behaviour as far as excitation, vibration and radiation is concerned. The question is how to disclose the secret of these old masters. Several studies [1]-[3] show that the acoustic behaviour of a violin depends on the distribution of its eigenfrequencies, the radiation of the various modes and additional aspects like e.g the damping. Thus modern tools like the experimental modal analysis, deflectional shape analysis and numerical simulations can support the working process of violin makers.
Can “tonal copies” of famous old violins be reached, and can we design a “perfect

Experimental modal analysis of a violin by Martin Schleske [3]

violin” in a virtual way by a computational optimization-process and perform it afterwards? In many applications computational models allow studying the influence of the decisive parameters and lead to an optimized structure. However in case of a violin just the outer geometry is well defined. The anisotropic parameters (density, module, damping properties) of the natural material wood and the impact of the individual working process (carving) on the stiffness is a challenge for a 3-D numerical virtual violin.

Thus the SoftwareLab should be a first step in the direction of modelling, starting with 2 decisive elements:

1. Modelling just of the top of the violin corpus and comparison of computed and measured eigenvalues with the experiences obtained during the manufacturing process under consideration of the special effects related with the anisotropy of wood. (Chair of Computation in Engineering)
2. Modelling of the Helmholtz-Resonance under consideration of flexible top and bottom plates with a special focus on the related fluid-structure coupling. (Lehrstuhl für Baumechanik)

Accompanying measurements of e.g. physical parameters of the natural material or the vibration pattern of the top of the violin can be carried out in the scope of students-projects (Civil- and Environmental Engineering) at the Lehrstuhl für Baumechanik

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