

Coupled simulation of vibration and sound radiation of Stradivari in large space

Masao Yokoyama^{1*}, Amane Takei², Ryo Yoshidome² and Genki Yagawa³

¹ Meisei University, 2-1-1 Hodokubo Hino Tokyo 191-8506 Japan, masao.yokoyama@meisei-u.c.jp (<http://www.cello-maker.com/research/>)

² University of Miyazaki, 1-1 Gakuen Kibanadai-nishi, Miyazaki 889-2192 Japan, takei@cc.miyazaki-u.ac.jp

³ Toyo University and University of Tokyo, Kujirai, Kawagoe, Saitama 350-8585 Japan, yagawag@gmail.com

Key Words: *Violin, Time evolution, Vibration, Acoustics, Numerical simulation*

The vibration and the sound field around the body of an old violin made by Stradivari are studied in this paper, where the highly precise geometry of the violin is scanned using a micro-CT scanner. After the noise in the scanned data is eliminated using a CAD software for post-processing, the geometry data are saved in the simulation software[1].

Assuming the orthotropic properties of woods (spruce and maple), the major vibration modes of the violin[2], such as A0, center bout rotation, B1-, B1+, and the acoustic pressure level at the surface of the violin body are calculated using the finite element method.

Next, using the sound pressure distribution at the surface of the instrument, the sound pressure spreading in a rectangular box simulating a concert hall is calculated with the open-source parallel acoustic analysis software: ADVENTURE Sound [3][4]. It is concluded that the sound pressure in the hall radiated from the violin is successfully simulated.

REFERENCES

- [1] Yokoyama, M. "Coupled numerical simulations of the structure and acoustics of a violin body." *The Journal of the Acoustical Society of America* 150.3 (2021): 2058-2064.
- [2] Woodhouse J., "The acoustics of the violin: a review," *Reports on Progress in Physics* 77.11 (2014): 115901.
- [3] ADVENTURE Project home page: <https://adventure.sys.t.u-tokyo.ac.jp/> (Access on 15 Nov. 2021)
- [4] Kudo A. and Takei A., "Performance evaluation of wave-sound analysis code: ADVENTURE Sound," *Proceedings of The 40th JSST Annual Conference: International Conference on Simulation Technology*, Kyoto, Japan, Sep. 1-3, 2021.