



## Substitution of spruce tonewood with composite materials tailored using numerical models: an application to archtop guitar \*

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### Abstract

Stringed instrument making traditionally requires selected wooden materials, called tonewood. Numerous species are used, especially spruce and maple for domestic species and rosewood, ebony, mahogany and pernambuco for tropical ones. Nowadays, the shortage of sufficiently large trees as well as the impact of climate change has led to current and future supply issues. Multilateral treaties to protect endangered wood species are now including several of the above mentioned species, and may include more in the future. In parallel, during the last decade, composite materials made with natural fibres have increasingly been studied and used. The bio-based composites associate fibres from annually renewable sources and bulk wood cores with epoxy resin to create materials that exhibit adjustable mechanical properties. The long-term objective of this work is to demonstrate that such materials can be tailored to mimic the vibro-acoustical behaviour of tonewoods and seen as a sustainable solution. In this study, numerical models of stringed instruments are used to optimize the architecture of bio-based composites to copy the dynamic behaviour of a spruce archtop guitar soundboard. The dynamic response of the manufactured composite parts are measured and compared to the model predictions in order to validate the model-based recipes of composites.

Keywords: Bio-based composites, Tonewood, Optimisation, Virtual prototyping, Archtop guitars

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