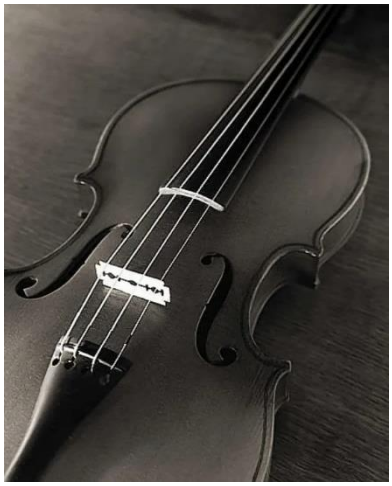


Sharpening the scientific tools for violin making

Online conference organised
by Claudia Fritz
Institut d'Alembert, Sorbonne Université - CNRS, Paris

5 - 9 October 2020
CET time zone

Monday 5 October 2020	
10:00 am to 10:45 am	Colin Gough: Violin transitional modes
11:00 am to 12:00 am	Jim Woodhouse: The acoustics of the banjo
1:30 pm to 2:50 pm	Lei Fu: Exploring the perception of violin qualities: student- vs. performance-level instruments, strings and soundpost height
3:00 pm to 4:00 pm	Augusto Sarti and Fabio Antonacci: Musical Acoustics Lab in Cremona
4:00 pm	Musical interlude by Cristian Fatu: Bach – Sarabande, on the 1714 "Jackson" Stradivari

Tuesday 6 October 2020	
10:00 am to 12:00 pm	Romain Viala: Numerical and experimental approaches for instrument making
2:00 pm to 4:00 pm	Iris Brémaud: Tonewoods: at the crossroads between wood physics and craftsmanship knowledge

4:00 pm	Musical interlude by Cristian Fatu: Kreisler – Recitativo & Scherzo Caprice, on the 1742 “Sloan” Del Gesu.
6:00 pm to 7:30 pm	Sarah Lämmlein: Violin varnish induced changes in the vibro-mechanical properties of spruce and maple wood

Wednesday 7 October 2020

10:30 am to 12:00 pm	Colin Gough: Acoustic characterisation in the workshop
2:00 pm to 3:00 pm	Sebastian Gonzalez : violin shape optimisation with finite elements modelling and artificial intelligence
3:00 pm to 3:30 pm	Mirco Pezzoli : directivity analysis of the historical Cremonese makers
3:30 pm to 4:00 pm	Raffaele Malvermi: machine intelligence in the support of the Cremonese makers
4:00 pm	Cédric Lebonnois: artistic and sound evolution of a trio through close interaction with the makers of their instruments and bows Musical interlude by Trio Joseph Hel: Goldberg Variations on instruments made by Bruno Dreux and Benjamin Paule, and bows made by Léo Pastureau (Orléans, France).

Thursday 8 October 2020

11:00 am to 12:00 pm	Tim Duerinck: Music instruments with extra fiber? Composite materials for soundboards from theory to practice
2:00 pm to 3:00 pm	George Stoppani: Chemistry for violin makers
3:00 pm to 4:30 pm	Jean-Philippe Echard: History of varnishes
4:30 pm to 5:00 pm	Jacob von Lippe: Deconstructed violins as an educational tool for kids

5:00pm to 5:30 pm	Jacob von Lippe: The KLANG:FOKUS festival. Exploring the sound of 20 years of making
5:30 pm	Musical interlude by Nathan Giem: Bach – Partita

Friday 9 October 2020

10:00 am to 11:00 am	Francesco Piasentini: Industrial X-ray CT for violin makers: a path to teleportation
11:00 am to 12:30 pm	George Stoppani: Gut strings and all it entrails
2:00 pm to 4:00 pm	Claudia Fritz: Some results from the Bilbao project
4:00 pm	Musical interlude by Cristian Fatu: Paganini – Caprice 24 on the 1714 “Jackson” Stradivari

Information and Registration

Attendance is free but registration is required: https://forms.gle/NuMDqAmCAjY7VhLr6

All talks will be presented through Zoom and the private Zoom links will be emailed to all attendants one day prior to the conference.

Colin Gough

Birmingham University, UK

Violin transitional modes

The composition and influence of the mid frequency range - frequency range transitional modes of the violin and viola ae illustrated by measurements and audio examples.

Acoustic characterisation in the workshop

A quick, easy to use, inexpensive facility is described which can be permanently be set up in the corner of a workshop for routine acoustic characterisation of an instrument at all stages of its making. The measurements use two sub-miniature elecret microphones costing less than a cup of coffee, one adapted to act as an accelerometer on the head of a pendulum supported hammer and the other as a microphone inside the body of the instrument acting as a miniature concert hall. Typical measurements for the violin, viola, cello and double bass are shown which highlight difference their acoustic behaviours and influence of the f-holes, bridge and island area.

Jim Woodhouse

Department of Engineering,
Cambridge University, UK

The acoustics of the banjo

The banjo has an immediately distinctive sound compared to other plucked-string instruments. This talk will use measurements, theoretical modelling and synthesised sounds to investigate which aspects of the physics of the instrument are responsible for this characteristic sound. The models can also be used to hear the effect of adjustments to many different parameters of the instrument, of interest to players and instrument makers for understanding tonal adjustments.

Lei Fu

McGill University, Montreal Canada / Sorbonne University, Paris, France

Exploring the perception of violin qualities: student- vs. performance-level instruments, strings and soundpost height

Three experiments will be reported. The first experiment explored whether there would be greater perceptual agreement when comparing violins meant for entry-level vs. advanced players, whether there would be significant perceptual differences between these two categories of violins and whether some structural vibration characteristics could be found to explain these differences.

The other two studies investigated the origin of the disagreement among players through two specific modifications to the violin. The second study investigated how different strings affect the perception of violin qualities. Two violins of the same make with similar sound quality and playability were employed. They were both strung with Dominant strings initially. Subjects played the violins, described and rated the difference (on eight criteria - *responsiveness*, *power*, *resonance*, *brightness*, *clarity*, *richness*, *balance* and overall quality) between the two violins during a session labeled D1-D2. Subsequently, the strings of violin 2 were changed to a different brand (Kaplan or Pro-Arte), unbeknownst to the players, and players had to re-evaluate the differences between the two violins (session D1-K2 or D1-P2). The third study involved both playing and listening (using recorded sounds) experiments to investigate how changes in soundpost height (for a fixed soundpost position) affect the perceptual qualities of the violin and what is the threshold of change below which players and luthiers do not perceive differences. A height-adjustable carbon fibre soundpost was employed. During the playing experiment, subjects played, in a first phase, a provided violin on which the soundpost height was modified by the experimenter in order to find their optimal soundpost height. Then, in a second phase, the experimenter varied the soundpost height randomly in ten trials (including cases where no change was made) within a range of approximately +/- 0.1 mm around their optimal height. During the listening experiment, subjects listened to 16 pairs of recordings through a computer interface and were asked, for each pair, whether the violin setup was the same or different.

Augusto Sarti

The research conducted at the Musical Acoustics Lab of Politecnico di Milano

This lab is located in the prestigious “Museo del Violino” in Cremona, Italy, where masterpieces of the most prestigious Cremonese violin makers are preserved.

Having our lab in this beautiful location, however, comes with a great deal of responsibilities, and numerous challenges. In order to study prestigious historical instruments we have had to develop all kinds of non-invasive measurement methodologies, which are able nonetheless to bring to life the most relevant acoustic and timbral features of the instruments without giving up measurement accuracy.

Fabio Antonacci

Mirco Pezzoli

Musical Acoustics Lab, Politecnico di Milano, Italy

Cremona is renowned not only for its violin making mastery and the related heritage, but also for the fact that over 150 luthier workshops are currently active in the City. The Lab has a long-standing collaboration with them, and this fact offered us the chance to analyse numerous instruments.The availability of a large dataset of measurements, captured signals and sound fields, descriptors, etc., covering both historical and modern violins; and the challenges posed by the non-invasivity of the measurement techniques required to follow a new route, through the convergence of distinct research areas such as artificial intelligence, signal processing and computational acoustics.

In the first talk Augusto Sarti and Fabio Antonacci will offer an overview on some of the research advancements of the Musical Acoustics lab during the years. Mirco Pezzoli (directivity analysis of the historical Cremonese makers) and Raffaele Malvermi (machine intelligence in the support of the Cremonese makers) will then focus on some specific research directions that are currently being pursued.

Romain Viala

Institut Technologique Européen des Métiers de la Musique, Le Mans, France

Numerical and experimental approaches for instrument making

The research and innovation department at ITEMM aim to develop and transfer new approaches and act as a resource hub for insturment makers. During this presentation, different applications, approaches and new tools will be presented. Especially, some examples will be given such as : low cost 3D scanner, a free tool for bow making, new tools for violin makers made with free softwares and 3D printers, simple approaches to measure dynamics, and a brief sum up of the state of art of musical acoustics, computations on violin dynamics and tonewood.

Tonewoods: at the crossroads between wood physics and craftsmanship knowledge

Iris Brémaud

Laboratoire de Mécanique et de Génie Civil, Montpellier, France

"Tonewoods" could be primarily defined by their historical processes of selection – and current processes of choice – by instrument makers. Yet, understanding the causes underlying these selection processes, as well as some consequences resulting from these choices, calls for a wide span of disciplines. In this talk, I will present a possible methodology to bridge the craftsmanship uses and knowledge of tonewood, together with wood science (in the wide sense of the term) and some insights from social sciences and humanities. The proposed methodology is organised in 5 steps that form a "loop": (1) Surveys with artisans to collect wood knowledge and encountered issues; (2) Identification of underlying physical-mechanical phenomena; (3) Exploration of the diversity and variability of wood species and properties; (4) Physical-mechanical consequences of processes and treatments used in craftsmanship; (5) Analysis of the sensory perception of wood variability and properties by its expert users. After an introduction to the basics of wood physics, the different steps of this transdisciplinary methodological approach will be illustrated by an array of research, grounded upon analytical review of literature of the past decades, and continued by research we recently conducted on wood uses by musical instrument makers, with a focus on luthiers of string instruments, and occasional illustration from other organological families.

The interplay of violin wood and its varnish

Sarah Lämmlein

EMPA, Zurich, Switzerland

For protection against wear and changes in environmental conditions as well as to enhance the instrument's appearance, wooden stringed instruments are varnished. Beside these intended effects, it is known that varnishes result in changes of the vibro-mechanical wood properties, which determine the sound properties of the violin. Within this project, the impact of different varnish systems on the hygroscopic and vibro-mechanical properties of the wood were investigated. The focus was laid on the effect of the varnish systems on the sorption behavior of tonewood and on an extensive study of the varnish-induced vibro-mechanical changes, both experimentally and numerically.

The conducted neutron imaging measurements and modal analysis showed that the particular materials and their possible combinations influence the properties differently. Further investigations and analysis will allow a characterization at the micron to instrument scale and result in a scientific understanding of the variations in mechanics, vibrations and sorptivity of varnished wood. These insights provide a new tool supporting luthiers when selecting a suitable varnish material and enable the design of higher quality varnish procedures for string instruments.

Sebastian Gonzales

Musical Acoustics Lab,
Politecnico di Milano, Italy

Violin shape optimisation with Finite Elements Modelling and Artificial Intelligence

We will present the results of two different approaches for violin top plate optimization. On the first half of the talk, starting from a outer 3D scan of the Messiah, an algorithm for optimizing the frequency response of the top through its thickness is presented. Then, this time starting from the outline of the Messiah, a method for the prediction of the frequecy response using Artificial Intelligence will be shown for constant thickness plates. In particular, how the data set is created, the relation between shape and modal response, and a possible representation of the violin outline from Principal Component Analysis will all be detailed. If time allows, we can see how historical examples clusterise in the PCA diagram.

Tim Duerinck

Instrument Making - School of Arts, Ghent University, Belgium

Music instruments with extra fiber? Composite materials for soundboards from theory to practice

Violins are traditionally made out of wood, but what is the alternative? What can we learn from going outside-the-box?
This presentation will discuss various composite materials and the effect they have on the vibrational and acoustical behavior of bowed instruments. The goal of this research is not to mimic the sound of wooden instruments, but to explore the variety of other sounds that can be made with these materials.
First, I will report on the making method: how high quality composite instruments can be made by hand using methods that can be adopted by other luthiers. Next the violins are studied using a variety of methods: non-contact modal analysis, radiation measurements, psychoacoustic analyses and artistic research methods. This allows us to follow the effect the various materials have on the vibrational, acoustical and artistic behavior of the instruments. Finally, based on these insights, three artistic cellos were constructed using carbon fiber, glass fiber and flax fiber respectively.
The results provide interesting insights in the complex world of violins and cellos and the wonderfully subjective parameter ‘preference’.

A very basic introduction to chemistry for violin makers

I am an amateur chemist with no teaching since I was about 16, but I have read all sorts of material, thought a lot about particular substances and their reactions and done a lot of practical work. What I lack in formal training I try to make up for in knowledge of specific details. I will not attempt to cover all of the basics as that is clearly impossible in the time frame. There will be a lightning fast summary of the history through alchemy, the periodic table to the early 20 th century approach. I will attempt to put the various things we use into categories in a way that may help understanding of their use and how they can be modified. Violin makers need to know something about wood chemistry, aging and treatments, chemical staining and the risks involved plus, obviously varnish composition and colouring agents. We will look at oxidation, dehydration, decarboxylation and polymerisation. If all goes well you will be in a better position to learn more via internet searches.

George Stoppani

Violin maker & researcher, Manchester, UK

Gut strings – and all it entrails …

On this occasion the emphasis will be on the practical side of stringing historic instruments. What are the differences between historic and modern gut, what parameters define string characteristics, to what extent can we and should we be authentic? In the business of selling strings to musicians and makers there is often a conflict between what they want to do, what has historical credibility and what is actually likely to work in a practical sense. The requirements for treble strings are very different from those of basses therefore different strings characteristics are needed for the different ranges of an instrument.

Jean-Philippe Echard

Musée de la musique, Paris, France

History of varnishes

Jacob von Lippe

Violin maker, Oslo, Norway

Deconstructed violins as an educational tool for kids

The KLANG:FOKUS festival. Exploring the sound of 20 years of making

Francesco Piasentini,

Violin maker, Padova, Italy

Industrial X-ray CT for violin makers: a path to teleportation

Industrial computed Tomography (or iCT) is a fast-growing technique. Nowadays it is well known among violin makers and restorers as a powerful diagnostic tool. High resolution images allow an in-depth analysis of musical instruments and an unprecedented insight on their actual conditions. But iCT move things a little bit further, with its ability to “dematerialize” objects into small voxels (cubic pixels). Like for medical scans, these data can be converted into accurate internal and external surfaces and sent to a 3D printer on the other side of the ocean. These surfaces can be used as reference for mould and template design, or for digitally comparing several violin of the same author hosted in different places in the globe. Makers will gradually move from using only rulers and callipers to work with 3D polygonal mesh and NURBS Surfaces. Teleportation of shapes is already possible, a new milestone for the global community of violin makers.

Next to iCT, 3D structured light scanning is a more affordable tool for “dematerializing” shapes. Example of an economic set-up will be discussed.

What can iCT and 3D light scanning provide for makers?

I will try to answer this question by going through a typical work-flow of iCT scanning, inspecting and reverse engineering of a violin. Examples of iCT applications to the daily work of makers will be given, including extracting 2D contours, 3D printing and milling replicas.

Some results from the Bilbao project

Claudia Fritz

Institut Jean le Rond d'Alembert,

Sorbonne Université, Paris, France

The Bilbao project (led by Unai Igartua and BELE, the Bilbao violin making school and funded by Erasmus+) aims at relating intrinsic characteristic of the materials (wood density and stiffness) and some geometric characteristics of the violin's constituent parts (thicknesses of the plates) with the tonal qualities of the complete violins. To this end, six instruments were carefully built: three instruments with normal backs, each paired with a pliant (thin), normal and resistant (thick) top; similarly, three with normal tops, each paired with a pliant, normal and resistant back. The two examples of normal top paired with normal back serve as a control. Woods for tops and backs were closely matched in density and sound speed. Greater control was achieved by having all plates and scrolls cut by CNC routers. The outside surface was not changed during the experiment, as the graduation was performed entirely on the inside surface. In addition, structural measurements were taken at many steps during the building process and the instruments were then assessed during playing and listening tests after construction in Bilbao, and then six months later in Oberlin. Some results from these series of perceptual tests will be presented and discussed. They provide some insight into the links between sound qualities and plates thickness. In addition, the exploration of a new way to process radiation data in order to better correlate with perception will be presented too.

Players

Cristian Fatu

Burbank, CA, USA

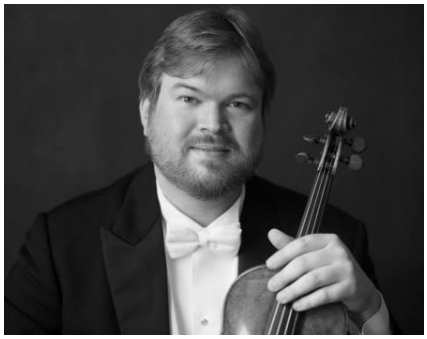
http://www.cristianfatu.com/

The three pieces are part of a larger project, which consists in a series of recordings on William Sloan's instruments: a 1714 Strad and a 1742 del Gesu.

https://vimeo.com/ondemand/strad1714

Cédric Lebonnois - Geneviève Koerver - Julien Churin / Trio Joseph Hel

https://ensemble.triojosephhel.fr/



Nathan Giem

Semperoper - Sächsische Staatskapelle, Dresden, Germany

https://nathangiem.com/

Cédric Lebonnois (viola player) will explain how the relationship between his trio and French violin makers Bruno Dreux and Benjamin Paule and bow maker Léo Pastureau has shaped their sound identity as an ensemble and has contributed to their artistic evolution, in link with the construction of the instruments.

Their interpretation of the Goldberg variations is part of a new multidisciplinary project in creation, combining music, dance and poetry.