

# Short Term Scientific Mission Report

## COST Action FP1302

Reference code:

COST-STSM-FP1302-26437

Submitted by:

Romain VIALA

Host organization:

EMPA, Dübendorff, Switzerland

STSM Topic:

FEM models for threated woods

Period:

June, 1<sup>st</sup> to 13<sup>th</sup>, 2015

Description of the work carried out during the STSM:

Presentation of the lab, and of the work carried out earlier at the EMPA on wood treatment.

Learning of Abaqus software (Finite element method software used by the wood lab of the EMPA).

Creation of the FEM models of the different parts of structures interesting for the studies (soundboard, back, vwhole violin).

Evaluation of the impact of the modified properties of treated woods toward musical instrument parts (spruce for soundboard and violin). Study of their dynamical behavior.

Learning of the Ansys acoustics extension for Ansys workbench software in order to check the acoustic radiation of modified wood.

Attend a meeting with Walter Fischli (funder of the project and the other team members) with presentation of parts of my PhD subject in order to check the advantages of a future collaboration.

Measurements of sorption isotherm of spruce tonewood at 25°C (5% - 95% RH)

Observation of the microscopic structure of the wood in LR plane.

Finishing of the Abaqus models to provide them to Marjan.

Last day, visit at Michael Baumgartner workshop, in Basel. He will build the violins with modified woods.

Description of the main results obtained:

**Main result is that now, Marjan and others team members, can use Abaqus Finite element models of different parts of the violin I designed on CAD softwares.**

**It implies that they'll can easily modify the material properties of the models in order to check the impact on the vibratory behavior of the models.**

**For example, one result show that a difference of less than 5% in several material properties can lead to a difference of around 25% on the frequency of several modes, implying big variations in the vibratory behavior of the soundboard within not that big variations of the stiffnesses of the wood.**

**Another result, more than the personal benefit of this experience, is that Romain VIALA owns sorption isotherm curves and microscopic images of the tonewood used in its PhD thanks to Marjan help.**

#### **Future collaboration with the host institution:**

**Future collaborations with the host institution are numerous, such as taking into account the impact of the fluid and of the damping on the vibratory behavior of the models, which has not been implemented yet.**

**Then the acoustic radiation of the models will be studied using Acoustics extension of Ansys (2 weeks were too short to simulate it properly).**

**Next collaboration will be about the characterization of real pieces of wood or even violin with method developed in my laboratory, and the correlation with numerical simulation.**

**The EMPA has proposed Romain VIALA to go there several times during my PhD at their own expenses, in order to extend the collaboration.**

#### **Foreseen publications, communication**

**This collaboration will certainly lead to a paper written in collaboration between Romain VIALA, Marjan GILANI and other members of the team. A strong advantage of this paper will be its multi-disciplinary aspect, in part due to the STSM opportunity;**

**This STSM will also be presented at the next COST conference (after the one in London), in order to present and discuss the work carried out with other members of the COST Action.**

## Confirmation by the host institution of the successful execution of the STSM:

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### **RE: Confirmation of the successful execution of the STSM**

Dear Madam or Sir,

Herewith I certify that Mr. Romain Viala was hosted by Swiss Federal Laboratory of Materials Science and Technology (EMPA) at Dübendorf/Switzerland for compilation of his research related to numerical simulation of violin. He delivered valuable results from such analysis and by parametric studies on the interrelation between the wood sorptivity and orthotropicity of mechanical properties and the vibration of instrument. The obtained results from STSM are important for explaining the played role by the material properties, on vibration and acoustics of violin. We expect the initiated collaboration will be continued, for validation of the numerical model with comparing the results from simulation and experimental characterizations of built research violins, at EMPA and FEMTO-ST. We acknowledge the support of COST FP1302 for making this study possible.

Yours sincerely,

*Sedighi Gilani*

Dübendorf, 15.6.2015

Marjan Sedighi Gilani