



Generation of Multi-Scale Models for Metamaterials through Symbolic Computation

PhD in Applied Mathematics and Scientific Computing

Applications are invited for a PhD Thesis at the FEMTO-ST Institute (see www.femto-st.fr) in Besançon FRANCE.

本文将通过一种新的符号计算方法，重点研究多尺度、多物理场超材料模型家族的发展。它将在 MEMSALab 开发的背景下进行，这是一种多尺度模型生成软件，它结合了偏微分方程的渐近技术和计算机科学领域的重写技术。这项工作将作为 MEMSALab 开发团队和 FEMTO-ST 声学团队之间合作内容的一部分进行。该联盟所涵盖的技能包括渐近建模的数学方法，通过重写技术进行符号计算的理论计算，软件工程，偏微分方程模拟以及超材料建模和设计。

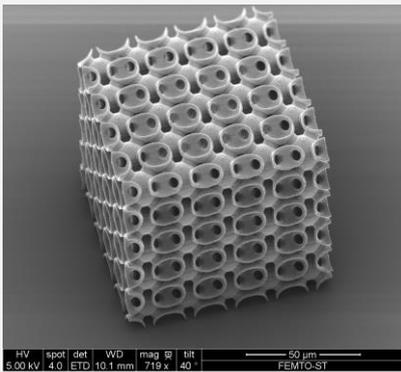


Figure 1 : Mechanical metamaterials made at FEMTO-ST by direct laser writing and exhibiting an auxetic elastic behavior under compression. Alternatively at high frequency this material can be seen as phononic crystal.

The PhD thesis will contribute to the effort of development of a framework of symbolic computation dedicated to multi-physics and multi-scale model construction for their automatic derivation and will be focused on applications to the very exciting field of wave propagation in metamaterials, see Fig. 1.

This field of applied physics has a strong and fast expansion with many existing or expected applications. A large number of multi-scale modelling works have already been published and they still constitute a very active and attractive research field. They are based on partial differential equation (PDE) techniques and they yield models that are computationally affordable while direct simulation require computing power far away from the today computer capabilities. However, it is noticeable that most of these models are not yet available in general purpose engineering simulation software while they are clearly needed. Our goal is to change this situation.

The PhD thesis work will be based on our expertise on asymptotic modeling of PDEs and on the symbolic computation tools that we have developed over the years with the purpose of automatic model

derivation. It will also benefit of the strong experience in design, modeling and fabrication of metamaterials.

The thesis will be done in the Time and Frequency Department of the FEMTO-ST institute, a joint research unit of the National Scientific Research Center (CNRS) and of the Université de Bourgogne Franche-Comté, see <https://www.femto-st.fr/fr>.

For more scientific information, see the websites of Professors Michel Lenczner and Muamer Kadic:

<http://members.femto-st.fr/michel-lenczner/>

<http://members.femto-st.fr/muamer-kadic/>

Requirements: Applicants should have a good undergraduate degree and a master in Theoretical Physics or Applied Mathematics including a good background in Partial Differential Equations.

Application: Please email a CV, marks and ranking since the first university year, a letter of motivation as well as one or two recommendation letters to michel.lenczner@univ-fcomte.fr