RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM
(one page maximum)

Field: Materials Science, Mechanics, Fluids

Subfield: (Applied Physics, Chemistry, Mathematics, Mech. Eng.…)

Title: Modeling of metal nanoparticles embedded in viscoelastic media using fluid-structure interaction approach.

ParisTech School: Arts et Métiers Sciences et Technologies

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Research group/Lab: LAMPA
Lab location: Angers
(Lab/Advisor website):

Short description of possible research topics for a PhD: (10-15 lines in English + optional figure)

Vibration modes in nanostructures present a major interest in characterization of the materials properties. In particular, virus is known to resonate in the confined-acoustic dipolar mode with microwave of the same frequency. Indeed, investigating the vibrational modes of viruses has been motivated by the possibility of using ultrasonic waves to destroy or to inactivate a virus present in a living organism. The vibration of a free homogeneous and isotropic sphere was studied by Lamb using the theory of elastic media. However the free sphere model used to interpret the experimental results is a rough approximation of the actual environmental conditions of nanoparticles. A more general theory based on nonlocal elasticity for accurately predicting the vibration modes of nanosphere embedded in a viscoelastic media is the subject of this thesis. Several constitutive laws of the viscoelastic medium must be considered in order to obtain a more realistic model.

Required background of the student: (What should be the main field of study of the applicant before applying?)

Master Mechanics, Physics, Mathematics.

A list of 5 (max.) representative publications of the group: (Related to the research topic)

1. A. El Baroudi and J. Y Le Pommellec. Bleustein-Gulyaev waves in a finite piezoelectric material loaded with a viscoelastic fluid, to appear in *Wave Motion* (2021).
2. A. El Baroudi. A note on the spheroidal modes vibration of an elastic sphere in linear viscoelastic fluid, *Physics Letters A*, 384(23), 126556 (2020).
3. X. Yang, A. El Baroudi and J. Y Le Pommellec. Analytical approach for predicting vibration characteristics of an embedded elastic sphere in complex fluid, *Archive of Applied Mechanics*, 16 pages (2020).
4. A. El Baroudi and J. Y Le Pommellec. Surface wave in a Maxwell liquid-saturated poroelastic layer, *Applied Acoustics*, 159, 6 pages (2019).
5. A. El Baroudi and J. Y Le Pommellec. Viscoelastic fluid effect on the surface wave propagation, *Sensors and Actuators A: Physical*, 291, 188--195 (2019).