Shear wave speed mapping of C. Elegans embryo with passive elastography

Pol Grasland-Mongrain[1], Stefan Catheline[2], Ali Zorgani[2], Thibault Brugière[3], Damien Garcia[3], Thomas Gibaud[1], Marie Delattre[3], Sébastien Manneville[1]
(1) Laboratoire de Physique, Ecole Normale Supérieure de Lyon, Lyon, FRANCE;
(2) LabTAU, INSERM u1032, University of Lyon, Lyon, FRANCE;
(3) Laboratoire de Physique, Ecole Normale Supérieure de Lyon, Lyon, FRANCE;
(4) Creatis, Université Claude Bernard Lyon 1, University of Lyon, Lyon, FRANCE;

Background, Motivation and Objective

Recently, viscoelasticity of a 100 um diameter mouse oocyte has been measured with a 15 kHz propagating shear wave, using passive elastography technique.
This technique has now been applied on a C. Elegans embryo. This embryo is smaller than a mouse oocyte – having a typical diameter of 40-50 um, which increases the difficulty of the measurement. Also, measuring the elasticity of a C. Elegans embryo could help biologists to better understand cell stage development.

Statement of Contribution/Methods

A C. Elegans embryo freshly extracted from an adult has been placed on a gelatin sample. The gelatin sample was put in vibration by a 20 um pipette attached to a piezoelectric actuator working at 40 kHz. The sample was observed with a standard microscope with a 40x objective. A 200000 fps camera recorded images of the sample. Displacements were calculated from the images using a particle imaging velocimetry algorithm. Then, passive elastography algorithm was used to image cell elasticity.

Results/Discussion

The technique has been able to map the speed of the shear wave in the embryo. Qualitatively, we distinguish the embryo from the surrounding gel. We don't observe any internal structure.
We could deduce the shear elasticity from the shear wave speed by supposing that the medium infinite, linear and isotropic – but we prefer to present raw data to avoid making these hypotheses.
Next step is to measure elasticity of embryos at different stage of maturation.