UNIVERSITY OF GENOA
DEPARTMENT OF INFORMATICS, BIOENGINEERING, ROBOTICS AND SYSTEMS ENGINEERING
MASTER'S PROGRAM IN BIOENGINEERING

Thesis Project Form

Title (tentative): How soft is a living cell? Try it yourself!

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Description

Motivation and application domain

Tactile palpation is a very common clinical examination technique that is performed by health care practitioner to assess, among others, tissue/organ texture and stiffness. The qualitative evaluation of a palpation test still represents a main diagnosis tool in the clinical practice. The idea of this project is to translate such a common medical procedure into the cellular scale toward the development of new tools to support medical early diagnosis of different pathologies effecting tissue mechanical properties.
To do this you will exploit atomic force microscopy (AFM). AFM is capable to measure surface topography and different physical/chemical properties of biological tissues with extremely high spatial resolution and sensitivity. Among such properties sample stiffness can be quantified by applying small sample deformations and measure the force applied.

General objectives and main activities

The main goal is to develop an haptic interface to operate an atomic force microscope (AFM) (https://www.bruker.com/en/products-and-solutions/microscopes/bioafm/jpk-nanowizard-4-xp-bioscience.html) as a nanoscale-indenter to probe mechanical properties of tissue biopsies. The interface will be based on a tactile device capable to provide force feedback to the operator (https://it.3dsystems.com/haptics-devices/touch). Such device will be interfaced with the AFM software in order to move the probe over the sample surface. The user will therefore be able to physically touch the sample and deform it by applying a controlled force and feel the resistance to such forces.
Main activities:
- to develop off-line virtual sample palpation: software (C++ and/or LabVIEW environment) that reads datafiles collected with the AFM and provides tactile feedback to the user
- to develop on-line sample palpation: software (C++ and/or LabVIEW environment) that operates AFM for indentation measurements while providing tactile feedback to the user
- AFM measurements on tissue biopsies to test and validate the software

Training Objectives (technical/analytical tools, experimental methodologies)

The student will learn:
- to develop an haptic interface
- how to make different pieces of equipment communicate with each other
- to develop both low-lever (device drivers) and control software using C++ environment
- how to perform experiments to measure mechanical properties at the nanometer scale and evaluate/represent measured data
- how to operate an atomic force microscope

Place(s) where the thesis work will be carried out: DIBRIS

Additional information

Pre-requisite abilities/skills: C++ programming knowledge; Aptitude toward problem solving and experimental work

Maximum number of students: 1