a place of mind
THE UNIVERSITY OF BRITISH COLUMBIA

Supervisor Contact: Prof. Mattia Bacca, Ph.D.
Department of Mechanical Engineering
office: Room 165 Bldg ICICS - mail: 2054-6250 Applied Science Lane
The University of British Columbia, Vancouver, B.C. V6T 1Z4, Canada
email: mbacca@mech.ubc.ca, phone 604-827-5076

MECH 493 project: The mechanics of cutting and puncture

Background and research goal

This project concerns the mechanics of tissue cutting, essential for biomedical and industrial applications (robotic surgery and automated material processing). It involves the theoretical analysis of the physical and geometrical determinants of cutting and piercing via Finite Element Analysis and some experimentation.

Tasks to be performed by the student

The student is expected to be a fast learner of the finite element analysis (FEA) and use commercial software like Abaqus. The analysis will be conducted by accounting for nonlinear material behavior and nonlinear structural behavior (nonlinear geometry). The student will perform simulations based on FEA and Matlab/Python coding to perform parametric investigations on the physical and geometrical determinants of cutting. We will consider cutting of a large slab of material and cutting of a thin film, in which mechanical instability is expected to play a major role. The student is also expected to be a fast learner of the basic principles of fracture mechanics. Materials energetic analysis will involve the study of the interplay between the stored strain energy in the material and its work of fracture (or toughness).
In addition to the computational analysis, the student will also learn how to perform mechanical testing by cutting soft gels and measuring the force-displacements curves, from which the important characteristics will be extracted and compared against the theory.

Facilities and team:

The student will launch simulations from their laptops or from a provided computer. They will also perform cutting experiments, under the supervision of a graduate student or postdoc. The student will also interact with the group and the PI as part of the training process. Possibly, the student will attend the weekly group meetings.