McGill

Mechanical Engineering Colloquium

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Texas A&M University at Qatar
Wednesday, July 8, 11:00am-12:30pm
Macdonald Engineering 267

Dynamics of filaments for surgical applications

Abstract:

The medical profession is in need of simulations that can realistically reproduce the complexity of surgical scenarios. Sporadic efforts have taken place at large US research institutions and training hospitals (i.e. Massachusetts General Hospital, Stanford, Harvard) who have received government funds (DARPA, ONR, ARF etc.) to make simulation training a mandatory part of their education. This is in sharp contrast to the aviation industry which has relied on flight simulators for the training of pilots for almost one hundred years. In addition, within these efforts, the modeling of tissues and organs (i.e. brain or heart) has received more attention than the modeling of surgical devices.

Our research program, sponsored by Qatar Foundation, aims to develop a physics-based software that will enhance the training of medical school students in the art of suturing and knotting, some of the most challenging surgical tasks. We have identified three techniques (Cosserat rod theory, Discrete Variational Integrator and the Viterbi algorithm) to model the spiral-type dynamical configurations of surgical filaments. The Cosserat theory is a continuum rod theory while the two others are discrete optimization-based programming techniques originally developed for information theoretic problems related to text strings. The program is interdisciplinary in nature with researchers drawn from mechanics, electrical engineering, computer graphics and the medical fields. I will give an overview of the many elements of the program and will show some of the results obtained so far.

Biographical Sketch:

Dr. Annie Ruimi has recently been promoted to Associate Professor of Mechanical Engineering at Texas A&M University at Qatar. She holds BS and MS degrees in aerospace engineering and a PhD in mechanical engineering from the University of California at Santa Barbara. Her research uses a combination of theoretical and computational tools to solve problems represented by rod-like structures with applications in medical simulations and drillstring dynamics. She also investigates the relationship between microstructure and material properties to design advanced (or smart) materials for automotive applications. She teaches courses in Statics, Dynamics and Vibrations and Mechanics of Materials. She is an international collaborator on a large National Science Foundation (NSF) funding awarded to Texas A&M University (Texas) for the development of an International Institute for Multifunctional Materials for Energy Conversion (IIMEC), that bring together researchers from more than eighteen countries in the Middle-East, North Africa and the Mediterranean region. She is the Lead Principal Investigator on three proposals funded by the National Priorities Research Program (NPRP) managed by the Qatar Foundation.