Programa de Pós Graduação em Modelagem Computacional

Ciclo de Palestras

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HORÁRIO: 14 às 18 horas

LOCAL: Sala 4118 – Faculdade de Engenharia

("Anfiteatro Escadinha")

Computer models of electro-mechanical interactions in the contracting heart

Prof. Joakim Sundnes

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Abstract:

The rhythmic contraction of the heart is regulated by complex interactions between electrical, chemical, and mechanical processes. Computer models based on non-linear continuum mechanics coupled with biophysical descriptions of the involved processes have been developed for several decades, and represent a valuable research tool for biomedical science. As the accuracy and predictive power of the models are continuously increasing, they also hold potential for direct clinical use. However, in spite of substantial progress, model development and utilization is still hindered by a number of fundamental challenges. Important challenges include the complexity of the sub-cellular processes regulating electro-mechanical coupling, rapid dynamics of the electrical signal conduction, as well as the difficulty of modeling the complex mechanical behavior of active and passive heart muscle tissue. In this presentation we will compare two different approaches to modeling active-passive mechanical behavior of cardiac tissue, and present recently developed numerical methods for efficient simulations of coupled cardiac electro-mechanics. Finally, we present results of applying the models to study alterations of electro-mechanical interactions in infarct-injured hearts.

From diagnostic imaging to image-based interventional planning of cerebral aneurysms

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Abstract:

In the last few years, some of the concepts behind the virtual physiological human began to be demonstrated on various clinical domains, showing great promise for improving healthcare management. In the current talk, we provide an overview of image- and biomechanics-based techniques that, when put together, provide a patient-specific pipeline for the management of intracranial aneurysms. The derivation and subsequent integration of morphological, morphodynamic, haemodynamic and structural analyses allow us to extract patient-specific models and information from which diagnostic and prognostic descriptors can be obtained. Linking such new indices with relevant clinical events should bring new insights into the processes behind aneurysm genesis, growth and rupture. The development of techniques for modelling endovascular devices such as stents and coils allows the evaluation of alternative treatment scenarios before the intervention takes place and could also contribute to the understanding and improved design of more effective devices. A key element to facilitate the clinical take-up of all these developments is their comprehensive validation. Although a number of previously published results have shown the accuracy and robustness of individual components, further efforts should be directed to demonstrate the diagnostic and prognostic efficacy of these advanced tools through large-scale clinical trials.