Modelling human muscle activity

(no full paper provided)

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Abstract

As we move into the 21st Century, increasing attention and recognition is being given to in-silico biology and the related grand-scale projects encompassed by phrases such as "the virtual human" or "the physiome project"[1]. Simply put, the aims of such projects are to develop integrative biophysically based models and computational frameworks that can be used to understand human health. Currently, the use of modelling in the biological arena lags well behind that of many other non-biological fields. This is, perhaps, not surprising given the complexity of biological systems compared with those constructed by humanity. However, the stage is set for a revolution in biological science driven by the rapid development and application of biomedical modelling. This is being motivated, in part, by significant increases in computational power, enabling even more complicated models to be constructed and solved. Accelerated model development is also being forced by the massive amounts of data now being generated, courtesy of such technologies as gene sequencing and advances in medical imaging. Further impetus is being provided via funding agencies and various institutional review boards increasingly requiring, or even mandating, researchers to consider the use of models as an alternative to animal experimentation.

With all this as a background, the question naturally arises: Will animal experimentation become obsolete at some point in the foreseeable future? Perhaps disappointingly for some, the answer is an emphatic NO. The reason for this is simple—models are, by design and necessity, simplifications of reality and cannot reproduce the full gambit of behaviour of an organ or similarly complex system. This does not, however, mean that models are of no use. As frequently happens, a wide range of experiments, all with a common overarching aim of trying to understand some process, mechanism or disease state, and involving different preparations, species, drugs etc, are performed at various laboratories spread around the world. In such situations, models may be the only mechanism by which sensible conclusions can be drawn from the collective data from these experiments. Models should thus be viewed in symbiosis with experimentation.

In this talk, state-of-the-art models of cardiac, skeletal and smooth muscles of the human body will be presented. The importance of these models will be illustrated by addressing a variety of clinically motivated questions. To reinforce the symbiotic nature of modelling and experimentation, the assumptions and limitations of the models will be highlighted, together with some details of the various animal and human experimental programmes that are being planned to address these.

[1] See www.physiome.org or www.physiome.org.nz