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Computational Medicine and Virtual Patient - From Experiments to Tools: Summing-up the Symposium

Jari Hyttinen

Ragnar Granit Institute, Tampere University of Technology, Tampere, Finland

Correspondence: J Hyttinen, Ragnar Granit Institute, Tampere University of Technology, P.O. Box 692, FIN-33101 Tampere, Finland. E-mail: jari.hyttinen@tut.fi, phone +358 3 247 4003, fax +358 3 247 4013

Abstract. Models have always been used as tools to analyze the basic functions of physiological systems. Every textbook in physiology is full of graphs and models of the systems. Now the models are emerging from the intuitive level towards the level that they can be directly applied in clinical practice. Already in some fields complex computational models are in everyday clinical use such as in the modern radiation treatment planning. Computational fluid dynamics or computational bioelectromagnetism are emerging fields providing promising clinical applications, however, before that is reached, some features of the modeling procedure may require further enhancement. Furthermore, there are areas where the models required are complicated with mixed physical phenomena and thus exceedingly difficult to solve. The key question is what makes some modeling applications clinically usable? The ground for the existing and emerging model applications in medicine lies not just on the recent development in computational science. The tools developed in MR and other imaging modalities and the methods to analyze the images to construct patient tailored or adaptive models are the key elements for the true clinical applications. With the recently developed methods the geometry can be acquired. However, the methods to measure or estimate the physical properties of the tissues are lacking. For example, the mechanical properties of blood or surrounding tissues providing the parameters for the computational fluid dynamics and further fluid-structure-interaction or the electric impedance of the tissues are based mainly on in vitro measurements. New developments such as MR-current density imaging may provide the required data and enhance the models to meet the criteria for clinical applications. Further, the clinical measurements providing data to validate the simulations, such as some hemodynamic parameters are sometimes very hard or impossible to obtain. The last but not least necessity is that the models can actually present new information for the physicists. This can be reached only if the models help in providing more personalized diagnosis than the traditional methods based on the large databases. The computational medicine is emerging, however, to reach the state of the virtual patient the combined efforts in computational science, medical imaging, clinical measurements and clinical science are required.

