INTRODUCTION

The virtual physiological human: tools and applications II

This issue of Phil. Trans. R. Soc. A is the second part of a double issue devoted to the virtual physiological human (VPH) initiative, which has been launched as part of the European Commission’s Seventh Framework Programme for Research and Development.

As highlighted in part I of the double issue (Gavaghan et al. 2009), this second part contains a number of exemplar projects that highlight the usefulness and limitations of the application of VPH-style models to actual research and development challenges. These applications cover diverse organ systems, from kidney function (Harris et al. 2009; Moss et al. 2009) to cardiac structure (MacLeod et al. 2009; Plank et al. 2009), electrophysiology (Fink & Noble 2009; Koivumäki et al. 2009; Severi et al. 2009; Stewart et al. 2009) and mechanics (Lee et al. 2009), and from pulmonary ventilation (Darquenne et al. 2009; Plotkowiak et al. 2009) to vascular supply (Grinberg et al. 2009) of the brain, and its structure and function (Armstrong & van Hemert 2009; Eickhoff et al. 2009).

Historically, organ-specific ‘vertical’ modelling has largely developed based on independent efforts dedicated to the various organ systems, and it is one of the aims of the VPH to (re-)unite these efforts for mutual benefit. The potential of this can be illustrated even by this small collection of papers. The reasons for wanting to do so are that (i) many of the ‘horizontal’ level-of-integration-specific challenges are common among biological tissues and (ii) the VPH ultimately needs to be able to ‘couple’ the different organ systems (what is a heart without blood flow, what is blood pressure regulation without the kidney, what oxygen carrier is blood in the absence of lungs and what is brain function without oxygenation?).

Accordingly, multiple levels of structural and functional integration need to be connected within, and among, organ systems. The range illustrated in this issue goes from ion channel and transporter function (Fink & Noble 2009; Koivumäki et al. 2009) and their interactions with the extracellular environment (Severi et al. 2009), to integration of behaviour at the level of cells (Stewart et al. 2009), tissues (Grinberg et al. 2009; Moss et al. 2009) and organs (Darquenne et al. 2009; Lee et al. 2009; Plotkowiak et al. 2009), to models that take into account individual histo-anatomical features (MacLeod et al. 2009; Plank et al. 2009) and assess high-level complex functional activity, from fly brain activity (Armstrong & van Hemert 2009) to human speech generation (Eickhoff et al. 2009).
Of course, this represents only a snapshot of the vast range of research questions that are already being targeted by VPH-related efforts. The diverse activities call for integration, from topical access solutions to existing knowledge and models (Harris et al. 2009), to cross-community collaboration, integration and exchange (e.g. via network activities as described in http://www.vph-noe.eu).

Still, the VPH initiative is on a path-finding mission. We are therefore delighted that the Royal Society has allowed us to communicate part of this work via its Phil. Trans. R. Soc. A. We are looking forward to providing further updates via this longest running scientific journal, which—belying its age—has been firmly at the forefront of attention to, and support of, the post-genomic challenges of developing a quantitative biology of systems such as the VPH.

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Peter Kohl1,*, Peter V. Coveney2 and David Gavaghan3

1Department of Physiology, Anatomy and Genetics, University of Oxford, Oxford OX1 2JD, UK
E-mail address: peter.kohl@dpag.ox.ac.uk

2Centre for Computational Science, University College London, London WC1H 0AJ, UK

3Oxford University Computing Laboratory, University of Oxford, Wolfson Building, Parks Road, Oxford OX1 3QD, UK

*Author for correspondence.

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