UCL

The biggest engineering problem in the world … ever

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Modeling and identification of metabolic systems

CARSON, E. R., C. COBELLI, AND L. FINKELSTEIN. *Modeling and identification of metabolic systems*. Am. J. Physiol. 240 (Regulatory Integrative Comp. Physiol. 9): R120–R129, 1981.—Introductory principles of physiological systems analysis by computer simulation or computation are introduced. The problems of model formulation, identification, and validation are examined. Selected guidelines for successful modeling are suggested, and examples of such applications in the field of endocrinology and metabolism are given.

mathematical model; compartment; physiological systems analysis; control system; system identification

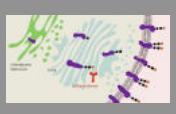
This is a polemic!

It addresses the dangers of underestimating the engineering scale and complexity of the task we have undertaken

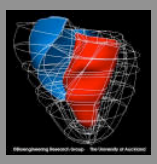
Systems Engineering 101

Only when you understand the task that lies in front of you can you devise an appropriate strategy. A mistake now - in the planning stage - of systems biology will be immensely costly subsequently

The models that we have built so far have been small and concerned with only a limited range of phenomena



They are tightly tied to the parameter data. This data is deployed for this purpose only and is shorn of context



The models are hand-crafted and stand-alone. They are presented with a limited range of metadata

They are usually presented statically with pre-digested results. Modelling assumptions are submerged and the models are stripped of their rationale

The models are flat and there is no indication or understanding of the level at which these models should be built. There is no ‘information hiding’

Models are presumed to live till publication. They are not designed for change and they lack traceability. The models are 'not engineered'

Now … imagine what systems biology will be like if we succeed in our ambitions …

Many 10s of thousands of different highly complex models expressing different phenomena and at different levels of detail

Each part of heterogeneous assemblages of models with diverse ownership

Evolving and changing independently and as ‘families’ … sometimes contested. With ‘interpretations’ that themselves change and must be managed

Directly tied to the wealth of (changing) bioinformatics data and to the scientific literature

Directly tied to experimental data and protocols

Related to a complex set of (changing) computational resources required to interpret models

Responding to challenging usability and visualisation demands from a wide variety of stakeholders

Oh yes … add security for medical data, curation and reproducibility for science data, and verification for pharmaceutical regulation

The biggest (software) engineering problem in the world … ever! Means planning for the management and engineering challenges now. Not modelling, not biology but model management