ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

DYNAMICS@ETH
Institute for Geotechnical Engineering (IGT)
Institute for Mechanical Systems (IMES)
Institute of Structural Engineering (IBK)

Next Dynamics Colloquium

On digital twins, mirrors and virtualisations

Prof. Keith Worden
Department of Mechanical Engineering
The University of Sheffield

Abstract

A powerful new idea in the computational representation of structures is that of the {\em digital twin}. The concept of the digital twin emerged and developed over the last two decades, and has been identified by many industries as a highly-desired technology. The current situation is that individual companies often have their own definitions of a digital twin, and no clear consensus has emerged. In particular, there is no current mathematical formulation of a digital twin. A companion paper to the current one has presented the {\em essential} components of the desired formulation. One of those components is identified as a rigorous representation theory of models, how they are validated, and how validation information can be transferred between models. The current paper will outline the basic ingredients of such a theory, based on the introduction of two new concepts: {\em mirrors} and {\em virtualisations}. The paper is not intended as a passive wish-list; it is intended as a {\em rallying call}. The new theory will require the active participation of researchers across a number of domains including: pure and applied mathematics, physics, computer science and engineering. The paper outlines the main objects of the theory and gives examples of the sort of theorems and hypotheses that might be proved in the new framework.

Bio and research area

Professor Worden began academic life as a theoretical physicist, with a degree from York University and a PhD in Mechanical Engineering from Heriot-Watt University eventually followed. A period of research at Manchester University led to an appointment at the University of Sheffield in 1995, where he has happily remained since.

Prof. Worden's research is concerned with applications of advanced signal processing and machine learning methods to structural dynamics, with particular focus on non-linear systems. Together with Chuck Farrar, Keith has co-authored the go-to book on structural health monitoring. He works on developing automated systems for inspection and diagnosis, with a view to reducing the cost-of-ownership of these high integrity structures. The methods used are largely adapted from pattern recognition and machine learning. The experimental approaches developed range from global inspection using vibration analysis to local monitoring using ultrasound.

Date: **Monday, March 11, 2019**
Time: **5:00 pm**
Place: **HIL E 4, Stefano-Franscini-Platz 5, map**
Host: **Prof. Eleni Chatzi**