TUTORIALS

At The OR Society SW18 Simulation Conference
19-21 March 2018
Ettington Chase Hotel, Stratford, Worcestershire. UK. CV37 7NZ

Tutorials were run for the first time at our 2016 Simulation Workshop and were so popular that they are now a key feature of this conference. Topics are chosen to allow delegates to find out more about the full range of simulation techniques. The tutorials on offer at this year's conference are:-

- Discrete Event Simulation by Prof Stewart Robinson *(Loughborough University)*
- Simheuristics by Dr Angel A. Juan *(Open University Catalonia, Spain)*
- Hybrid Modelling by Prof Sally Brailsford *(University of Southampton)*
- Agent Based Modelling by Dr Duncan Robertson *(Loughborough University)*
- System Dynamics by Dr Martin Kunc *(Warwick Business School)*
- Validation and Verification by Mr Alan Robinson and Mr Paul Glover *(DSTL)*

ABSTRACTS

INTRODUCTION TO DISCRETE-EVENT SIMULATION: HOW IT WORKS
Stewart Robinson, Loughborough University
This tutorial paper introduces the two main building blocks of a discrete-event simulation: modelling the progression of time and modelling variability. The three-phase method, which is used by a number of simulation software packages, is described, and there is a brief introduction to other methods for modelling the progression of time. The use of random numbers and random sampling for modelling variability is also outlined.

A TUTORIAL ON SIMHEURISTICS: HOW SIMULATION CAN EFFICIENTLY SUPPORT METAHEURISTIC ALGORITHMS IN STOCHASTIC OPTIMIZATION
Angel Juan, Universitat Oberta de Catalunya
Uncertainty is present in industrial sectors such as transportation and production logistics, supply chain management, computer and telecommunication networks, or economics and finance. Thus, in order to cope with their stochastic components, simulation methods and techniques are frequently employed in the analysis of complex systems related to these sectors. However, simulation is not an optimization tool, so it needs to be combined with optimization methods whenever the goal is to maximize the system performance or to minimize the associated costs. A large number of these real-life optimization problems are N P-hard and large scale in nature, which makes it necessary the use of metaheuristic approaches to solve them in an efficient way. This paper provides an introductory tutorial to simheuristic algorithms, i.e.: the combination of simulation methods with metaheuristics to efficiently deal with stochastic optimization problems. After motivating the need for simheuristics in today's world and reviewing some related work, a series of key methodological and computational aspects are discussed in detail. Then, several examples of application to

different industries are provided. The paper also describes open research lines and future trends in this emerging area.

VERIFICATION AND VALIDATION (V&V): DOING THE RIGHT THING, IT'S ALL ABOUT GOOD BUSINESS

Paul Glover and Alan Robinson, DSTL

The purpose of this paper and associated workshop is to share perspectives on conducting appropriate V&V for simulation, so as to facilitate the delivery of 'fit for purpose' advice to the customer. This paper provides an overview of UK government advice for achieving this and presents emerging perspectives on how this advice may be enhanced. The purpose of the associated workshop is to briefly summarise the current situation and provide foci for discussion to stimulate sharing as to how this advice could best evolve, for the benefit of simulation in Operational Research (OR).

SYSTEM DYNAMICS: A MULTI APPROACH TO SIMULATION

Martin Kunc, Warwick Business School

System Dynamics (SD) is a unique modelling approach to simulation because it can be employed for qualitative and quantitative modelling. There are important tools and methods within SD that are able to accommodate qualitative modelling. Stocks and flows are the basic components of quantitative SD modelling but quantitative SD modelling shares many commonalities, e.g. empirically driven, validation and verification, and focus on outputs, with traditional simulation methods. This tutorial offers modellers aspects to consider when they want to use SD as a qualitative and quantitative modelling method.

INTRODUCTION TO HYBRID SIMULATION MODELLING

Sally Brailsford, University of Southampton

This tutorial paper provides a basic introduction to hybrid (or multi-paradigm) simulation modelling, as understood by an operational researcher. Hybrid simulation is defined as a modelling approach that uses more than one simulation paradigm from the set {discrete event simulation, agent based simulation, system dynamics}. Hybrid simulation has gained popularity in recent years, partly due to the availability of commercial software for developing hybrid models, and partly due to the capability of hybrid models to tackle different aspects of the same problem situation. The session itself will be a hands-on introduction to hybrid simulation modelling in AnyLogic.

AGENT-BASED MODELS: A TUTORIAL

Duncan A. Robertson, Loughborough University.

We introduce agent-based modelling in this tutorial paper. We introduce the concepts of agent, emergent behaviour and show these concepts in three different agent-based models.

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