Introduction

Nowadays, technology advances in sync with the speed of light, noting that simulation is a practice, which extends to take into account factors concluded from scientific research emanating in the U.S. since the late 1940s, yet simulation is unanimously viewed as a science; therefore, the book tackles the current technologies and applications in simulation and modeling in a systematic, comprehensive manner.

Due to the high costs of network infrastructure and the constant rising of unanswered questions regarding technology, simulation has become a good choice for estimation of the performance of networks. Additionally, such methodology for requirements determination can be extended to serve as a blueprint for business (or management) simulation by providing an initial model for creating a business simulation to subsequently show how it can be incorporated into an application.

This allows one to capitalize on conceptual models in a business that have been created for requirements determination by extending them with the conceptual model of runtime management, thus covering the core decision-taking science, particularly in view of the well-known fundamental economic decision theory, to which individuals attribute rational choices from a range of alternatives.

The Challenges

The need to define what appropriate path to follow at any given crossroad triggers the concept behind this project, as any attempt to deal with a problem demands an adequate
understanding of the challenges that exist. Such challenges can be further illustrated, as addressed in this book:

First, simulation of a system with limited data is challenging, as it calls for a certain degree of intelligence built in to the system.

Second, the overall employment of remotely controlled vehicles functioning in the ground, air, and marine domains requires investigating the critical issues in the command and control of such vehicles.

Third, a proper understanding of the simulation tools, underlying system algorithms, and user needs is challenging.

Fourth, healthcare systems pose many of the challenges, including difficulty in understanding the system being studied, uncertainty over which data to collect, and problems of communication between problem owners.

**Searching for a Solution**

Solutions to the problem of defining simulation technologies and application are tackled in this book: for instance, the book presents various based simulation methodologies that may be customized and used in the simulation of a wide variety of problems. Additionally, the book presents a model-based approach resulting in simulation architecture that integrates proven design concepts, such as the model-view-controller paradigm, distributed computing, Web-based simulations, cognitive model-based high-fidelity interfaces and object-based modeling methods.

Moreover, the book shows how simulation allows the identification of critical variables in the randomized clinical trial (RCT) by measuring their effects on the simulation model’s “behaviour.”

**Organization of the Book**

The book is organized into 15 chapters. A brief description of each of the chapters follows:

Chapter I provides a comprehensive explanatory platform of simulation background, reviewing simulation definitions, forms of models, the need for simulation, simulation approaches and modeling notations.

Chapter II offers an overview on the distributed simulation in industry, in view that, although the observance of a distinction between continuous and discrete simulations has long been a practice in the simulation community at large, human interactivity in simulation (“human-in-the-loop”) HLA literature often uses a different terminology and refers to *time-stepped* and *event-driven* simulation.

In addition, Chapter III presents the object-oriented approach for the development of an optical burst switching (OBS) simulator, called OBSim, built in Java.
Subsequently, Chapter IV illustrates how natural language modeling (NLM), a conceptual modeling language, methodology for requirements determination can be extended to serve as a blueprint for business (or management) simulation by providing an initial model for creating a business simulation.

Consequently, Chapter V presents a suggested system development life cycle, “relay race methodology” (RRM). The RRM is based on the philosophy of a relay race, where each runner in the race must hand off the baton within a certain zone, usually marked by triangles on the track race.

On another note, Chapter VI sets forth a new model-based simulation methodology that may be customized and used in the simulation of a wide variety of problems involving multiple source-destination flows with intermediate agents. It explains the model based on a new class of neural networks, called differentially fed artificial neural networks, and the system level performance of the same.

Additionally, Chapter VII presents a model-based approach that the authors adopted for investigating the critical issues in the command and control of remotely operated vehicles (ROVs) through an interactive model-based architecture.

Furthermore, Chapter VIII reports on the use of simulation in supporting decision-making about what data to collect in a randomized clinical trial (RCT). The chapter shows how simulation also allows the identification of critical variables in the RCT by measuring their effects on the simulation model’s “behavior.”

In the same token, Chapter IX addresses the problem of modeling finished products and their associated sub-assemblies and/or raw materials. A production system is a set of policies that monitors and controls finished products and raw materials, as it determines how much of each item should be manufactured or be kept in warehouses, when low items should be replenished, and how many items should be assembled or ordered when replenishment is needed.

Chapter X illustrates the use of mathematical modelling and simulation to discover the reasons for data to behave in certain ways, as it suggests the use of simulation and modeling of knowledge-mining architecture by using recurrent hybrid nets; particularly in view that hybrid nets combine arithmetic and integrator elements to and from nodes for modeling the complex behavior of intelligent systems.

Likewise, Chapter XI demonstrates the development of a novel compromise linear programming having fuzzy resources (CLPFR) model as well as its simulation for a theory-of-constraints (TOC) product mix problem using MATLAB® v. 7.04 R.14 SP.2 software. The product mix problem considers multiple constraint resources. The developed CLPFR model helps in finding a robust solution with better profit and product mix solution in a non-bottleneck situation. The authors simulate the level-of-satisfaction of the decision maker (DM) as well as the degree of fuzziness of the solution found using the CLPFR model. Simulations have been carried out with MATLAB® v. 7.04 R.14 SP.2 software.

However, Chapter XII provides mainly an overview of the ongoing technology shift inside the vehicles and couples this to simulation possibilities and thereby introduces the business process simulator-based design (SBD). The perspective in this chapter is human-machine interaction (HMI) and therefore addresses human-in-the-loop simulators, keeping in mind the fact that simulation could and even must be used on other levels in order to optimize and verify more technical functions.
On another note, Chapter XIII tackles business aspects of simulation, amongst other things: describing the relationship between business process reengineering (BPR) and change management, the role of simulation in supporting BPR, notwithstanding the future challenges of business process simulation, along with an illustration of simulation technology limitations in reengineering business processes, characteristics of successful simulation and some simulation applications.

While Chapter XIV introduces virtual reality and augmented reality as a basis for simulation visualization, within this context, it shows how these technologies can support simulation visualization and gives important considerations about the use of simulation in virtual and augmented reality environments. Hardware and software features, as well as user interface and examples related to simulation, using and supporting virtual reality and augmented reality, are discussed, stressing their benefits and disadvantages. The chapter discusses virtual and augmented reality in the context of simulation, emphasizing the visualization of data and behavior of systems. The importance of simulation to give dynamic and realistic behaviors to virtual and augmented reality is also pointed out. The work indicates that understanding the integrated use of virtual reality and simulation should create better conditions for the development of innovative simulation environments as well as for the improvement of virtual and augmented reality environments.

In conclusion, Chapter XV aims to develop artificial mechanisms that can play the role emotion plays in natural life, in order to build agents with the mission to “to bring life” to several applications, amongst other things: information, transaction, education, tutoring, business, entertainment and e-commerce. In light of the fact that artificial emotions play an important role at the control level of agent architectures, emotion may lead to reactive or deliberative behaviors, it may intensify agent’s motivations, it can create new goals (and then sub-goals) and it can set new criteria for the selection of the methods and the plans the agent uses to satisfy its motives. Since artificial emotion is a process that operates at the control level of agent architecture, the behavior of the agent will improve if the agent’s emotion process improves.