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# Preface

## Purpose

This is a hands-on guidebook on distributed simulation (DS), specifically on High Level Architecture (HLA), with a view toward software development. It contains a variety of examples to support learning by doing. It offers practical advice on real-world development issues for the novice engineers and programmers who are entering the field of distributed simulation.

## Rationale

The book elaborates the implementation of an HLA federation covering all areas from the object model development to federate application development by exemplifying all the federate interface service areas. More importantly, the federate application development is based on the layered architectural style, which provides a clear separation of concerns. The implementation is based on the latest HLA standard, known as HLA Evolved, yet we point to the related topics with HLA 1.3 specification in the interest of backward compatibility. We also present a running example involving a great deal of variation to illustrate several practical issues of federate application development. The implementation is not based on a specific commercial runtime infrastructure (RTI) software, but rather based on generic and extendible tools that can be obtained freely. One is SimGe, a freeware, which is a fully dressed HLA object model development tool and a code generator. Second is RACoN, which is fundamentally an open-source .NET wrapper for HLA RTI application programming interface (API). The book serves as the only comprehensive reference for both tools by giving downloadable sample case studies with the source code. Moreover, this book contains a unique chapter that shows the practitioner how to employ HLA in (multi) agent-based simulation.

The prominent features are as follows:

- It comes with the tools RACoN and SimGe to enable the reader work at a conceptually high level.

- Numerous step-by-step examples and code snippets help the reader to understand the RTI concepts.
- It includes a running example involving a great deal of variation to illustrate several practical issues of federate application development.
- It includes a larger-scale case study involving multi-agents. The scenario is based on the maritime border surveillance with the help of a fleet of unmanned surface vehicles.
- It includes downloadable sample source code.
- It uses Microsoft .NET platform and the C# programming language for all implemented examples and case study.
- It provides a fast start-up on HLA federation development giving an implemented sample for each service area of the HLA federate interface specification.
- It includes a unique chapter to employ the HLA in multi-agent simulations.
- It covers not only federate application development, but also object model construction.
- Many chapters include questions for review and further study.

## Book Overview

The book is structured as follows. Chapter 1 is a high-level introduction to the essential concepts of modeling and simulation, while highlighting DS as the focal area of interest. Chapter 2 introduces the fundamental concepts and the principles of HLA. Chapter 3 takes a look into federation development and presents development guidelines. These three chapters together lay the technical background for federation development.

The remaining chapters constitute three major parts of the book: object model development, federate implementation, and advanced topics. Chapters 4 and 5 present an introduction to object model development and then elaborate on the subject through a case study. Using the object model in the case study, Chaps. 6–8 elucidate the details of implementing a federate application. Last, Chap. 10 considers some advanced topics by discussing the connection between agent-based simulation and HLA. Then, Chap. 11 provides a complete case study to put it all together.

The chapters are structured in a layered way so that the initial chapters include more generalized topics such as M&S and HLA concepts. As we proceed, each chapter brings more specialized topics relying on the knowledge of the preceding ones.

## Web Material

The software tools and examples used in the book are freely available on the web.

## **Audience**

This book is intended for students of distributed simulation, based particularly on High Level Architecture. It can be used as a textbook or reference book for an upper undergraduate/lower graduate course, probably named as distributed simulation or distributed interactive simulation.

## **Final**

We believe that the most prominent contribution of this book is to provide a starting point and all-in-one resource for HLA-based distributed simulation development without depending on any commercial tools. The book is complementary, in regard to its implementation slant, to model-based engineering approach for distributed simulations.

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