Simulation with Visual SLAM and AweSim

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To Anne, many thanks for many happy years
Alan

To Michael, husband and best friend
Jean

To Nora, wife, friend and colleague
for her support, advice and love
David

Preface

This textbook presents a process for problem resolution, policy crafting and decision making based on the use of modeling and simulation. Detailed descriptions of the methods by which Visual SLAM® and AweSim® support this process are presented throughout the book.

The text introduces general information on the use of simulation in industry and government. Information is presented on modeling perspectives (Chapter 2), modeling and simulation process (Chapter 3) and applications of simulation (Chapter 15). Chapter 16 describes standard statistical distributions and random sampling procedures. Chapter 17 presents general statistical methods for estimating performance from simulation outputs. Specific uses of statistical techniques are included throughout the many examples in the text.

Chapters 4 through 13 provide a detailed description of Visual SLAM. The organizational structure provided by Visual SLAM for building models is explained, illustrated and applied. Input procedures and output reports are described in the 26 examples, 27 illustrations and hundreds of explanations of Visual SLAM components. Problem-solving support for simulation using databases, interactive processing and graphics capabilities is detailed in Chapter 14 where the capabilities of AweSim are presented. Exercises are given at the end of each chapter which require the application of the material presented.

Visual SLAM is an advanced simulation language for building models of systems and for automatically simulating the models to produce performance measures. Visual SLAM supports the three world views of network, discrete event and continuous modeling. By combining these world views, Visual SLAM is a Simulation Language for Alternative Modeling. Visual SLAM also includes a hierarchical network view that includes object-oriented subnetworks. This hierarchical network capability is a major technical advance in network simulation. The interfaces between the alternative modeling approaches are explicitly defined to allow new conceptual views of systems to be explored. User inserts and event routines can be developed in either the Visual Basic or C languages.

To support the entire problem resolution process AweSim provides a database, project maintainer, interactive execution environment (IEE), standard textual and graphical reports and concurrent and postprocess animation facilities. AweSim has links to other application programs for documentation, communication, statistical

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analysis, board room presentation preparation and report writing. Furthermore, the AweSim environment provides for file management, model component management, model reuse and updating, database management of simulation outputs and, in general, problem-solving support.

The GERT/GASP/SLAM family of products has been well received and has contributed to the tremendous increase in the use of modeling and simulation throughout the world. A key ingredient of their success is the development, maintenance and support provided by Pritsker Corporation which will continue for the Visual SLAM and AweSim products. Upward compatibility has been maintained so that models developed with SLAMSYSTEM can be translated for use with Visual SLAM.

There are many ways to use this textbook for teaching simulation from a modeling perspective. Chapters 1 through 8 and 14-16 provide for a one-quarter course on network modeling and simulation analysis. When using AweSim, there is complete documentation of the Visual SLAM language online. This facilitates building models, translating them for processing and obtaining simulation outputs. AweSim's database facilitates the statistical analysis of simulation outputs as it maintains the individual simulated observations. AweSim provides the tools necessary to learn simulation modeling and its use in the problem-solving process.

For a semester course, Chapters 9 and 10 can be added to present the flavor of discrete event and continuous modeling using networks as a foundation. Chapters 11 and 12 provide for detailed modeling of systems using discrete event and continuous world views with all three world views combined in the models presented in Chapter 13.

Chapters 9 and 11 deal with user inserts and discrete events which may be coded in either Visual Basic or C. For student convenience, Chapters 9 and 11 are provided in two flavors: Visual Basic or C with the letters VB or C appended to the chapter numbers. In Chapters 10, 12, 13 and 14 where models contain user-written code, both Visual Basic and C versions of the code are provided where appropriate. For these chapters, the figures which contain code have the letters VB or C appended to the figure number. This textbook on simulation modeling with Visual SLAM and AweSim is the first to present three different modeling world views with user extensions being able to be written in Visual Basic or C. When using the C version of Visual SLAM, the data structures important to modeling and simulation can be explored and developed. With the Visual Basic version, an object-oriented view of simulation modeling can be presented.

From a teaching perspective, Visual SLAM and AweSim represent a significant advance. The programs are completely extensible and are easy to use for those familiar with Windows-based products. The open-ended nature of Visual SLAM and AweSim will allow you to pursue many topics associated with modeling and simulation based on your expertise. This includes the introduction to queueing and

inventory theory as well as scheduling and optimization algorithmic evaluation and development.

Simulation languages are developed in an evolutionary manner. For Visual SLAM and AweSim, this has occurred over a thirty year period starting with the developments of GASP for discrete event and continuous modeling and Q-GERT for network modeling. For those interested in the development and evolution of these languages, the book *Papers • Experiences • Perspectives* is recommended. The design, development, documentation and testing of Visual SLAM and AweSim was a team effort and, in addition to the authors, the team included Bill Lilegdon, Janet Reust, Cathy Stein and Brad Resner. The authors thank Bill, Janet Cathy and Brad for their efforts.

We would like to thank Jim Wilson for his continuous support and significant contributions to Chapter 17; Bill Lilegdon for the Excel macros to provide the statistical outputs directly from the AweSim database; Michael Schmeiser, Janet Reust and Dave Martin for their support in the develoment of the ULAMjr example; UNOS for granting us permission to use material on organ transplantation; Lt. Col. Steven Parker for providing a preliminary version of the retirement evaluation model; and David Vaughan and Dave Withers of Lexis-Nexis for their suggestions and review regarding the development of visual subnetworks.

This book directly uses material contained in the books and papers by Thomas Schriber, George S. Fishman and Bruce Schmeiser. We thank these friends for granting us permission to use this material. Our thanks and appreciation go to Miriam Walters and Donna Kuipers for their efforts in the typing and preparation of numerous copies of the manuscript and to Anne Pritsker for reviewing and editing the manuscript.

A Solutions Manual for the exercises at the end of each chapter is available from Systems Publishing Corporation, P.O. Box 2161, West Lafayette, IN 47906. We wish you success in mastering the modeling concepts and simulation pro-cedures described in this book. When you do, you will have a modeling frame-work and a simulation tool to solve meaningful problems.

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