SIMULATION SOFTWARE

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Summary

The main attraction of Simulation Software is the ability to easily design and execute models and to analyze the results of simulation: observe animation of experiments, generate statistics, optimize and make decisions.

While treating simulation as constructing a kind of virtual reality for studying an actual process, simulation software is as a rule the main tool for such construction. But the role of this tool in the simulation process may range from spreadsheet or even simple calculator in role business training, to the whole power of the simulation science in Artificial Life or in Virtual Reality, where the simulation itself is only a building tool. Traditionally simulation software is divided into continuous and discrete branches. But this classification is rather obsolete, because the Object-Oriented Approach penetrates into the continuous simulation software (e.g. Object-Oriented Continuous Simulation Language by the team from the Universidad Autonoma de Madrid), and from the opposite side, such methods as the Event-Oriented Approach (e.g. DEVS Specification), make discrete simulation rather like the continuous one. So in our days the continuous/discrete taxonomy in simulation becomes rather fuzzy, and discrete and continuous phenomena should be seamlessly integrated in any discussion of modeling.

There are tens and even hundreds product names on the Simulation Software market. So giving a complete list of the Simulation Software is not possible. Fortunately, there are only few base concepts of Simulation Software development, which will be discussed here after a short survey of the Simulation Software products (see *Fundamentals of Simulation for Complex Systems*).

1. Simulation Software Survey

This short survey is based on the Simulation Software surveys by James J. Swain, University of Alabama in Huntsville, USA, (OR/MS today, February 2001), and M. A. Pollatschek, Management Technion, Haifa 32000, ISRAEL. By no means does it pretend to be comprehensive, but the main trends of the Simulation Software development are presented here.

The characteristic features of software packages in the survey will be the following: Name of the package; Vendor; Type of package; Typical area of application; Availability of a graphic interface when constructing a model; Output analysis support; Support of optimization; Animation and real time viewing; Approximate price. In the columns "Graphical Interface", "Output Analysis", "Optimization" and "Animation" the sign "+" means the presence and the sign "-" – the absence of the option.

It may be said that all the diversity of Simulation Software has grown from SIMULA67 and Forrester's Dynamo languages. Now there are many special languages and packages for simulation.

The following taxonomy of Simulation Software may be given:

1. The most flexible general programming languages (as C++ or Java). Contemporary Object-Oriented programming languages may be considered as a part of General Purpose Simulation Software, because all of them grew up from SIMULA67 and simulationists' efforts.
2. Traditional continuous simulation software (the most advanced packages are also suitable for discrete event simulation):
    a. Block languages: each instruction represents an "electronic block", similar to those used in analog computers.
    b. Mathematically oriented languages: the mathematical model may be used almost directly as the source program (e.g. CSMP Continuous System Modeling Program, sponsored by IBM).
    c. Graph languages: the mathematical model is represented as a special kind of directed graph (the bond graph), or by a System Dynamics graph, using the terminology proposed by J. Forrester.
3. Traditional discrete event simulation (the most advanced packages are also suitable for continuous simulation):
    a. Special simulation languages and simulation packages. They propose definite concepts of simulation and tools for carrying it trough the project. Their disadvantage is that if the problem does not fall exactly in this concept, it is very difficult, if not impossible, to write a suitable program.
    b. Special Purpose Simulation Systems. These systems are highly inflexible, but are most oriented to the subject of the simulation. There is no programming at all, only putting in parameters and setting the system against the simulation field.

(see *Modeling and Simulation Techniques*).

Name	Vendor	Type	Typical Applications	Graphical Interface	Output Analysis	Optimization	Animation	Approximate price
@RISK	Palisade Corp.	Add-on to Excel	New product development and launch, investment analysis, engineering.	+	+	-	-	$400
Arena	Rockwell Software	Program-ming language	Business process simulation, manufacturing, logistic.	+	+	+	+	$13000
AutoMod	Production Modeling Corp.	Program-ming language	Simulation, emulation, manufacturing, material handling.	+	+	+	+	$15000
Extend	Imagine That, Inc.	Program-ming language	Operation research, general purpose continuous modeling.	+	+	+	+	$700
Extend+ BPR	Imagine That, Inc.	Special Purpose Simulation system	Workflow, process modeling, cycle time, banking, healthcare, education.	+	+	+	+	$1000
Extend+Ma nufacturing	Imagine That, Inc	Special Purpose Simulation system	Manufacturing, Industrial and commercial modeling, queuing, costing, throughput analysis.	+	+	+	+	$1000
GAUSS	Aptech Systems Inc.	Program-ming language	All types of numerical analysis	-	-	+	-	$300
GPSS/H	Solverine	Program-	Material handling/ manufacturing,	-	-	-	-	$5000

	Software Corp.	ming language	transportation, mining.					
MAST	CMS Research Inc.	Special Purpose Simulation system	Manufacturing operations, factory flow models automated cells.	+	+	+	+	$3000
micro-GPSS	Ingolf Stahl	Program-ming language	General purpose discrete events simulation	+	+	+	+	$700
ProModel	ProModel Corp.	Special Purpose Simulation system	Manufacturing, capacity analysis, supply chain, process improvement	+	+	+	+	$18000
QUEST	DELMIA Corp.	Program-ming language	Process flow simulation and analysis, manufacturing, material handling	+	+	+	+	not known
Service Model	ProModel Corp.	Special Purpose Simulation system	Business, service organizations, airlines, finance, amusement parks, capacity analysis.	+	+	+	+	$1800
SIGMA	Custom Simulation	Program-ming language	Discrete event simulations.	+	+	+	+	$500 – $1800
Simpro-cess	CACI Products Company	Special Purpose Simulation system	Business, process change management, customer service, call center, logistics.	+	+	-	+	$10000
Simscript II.5	CACI Products Company	Program-ming language	Building large complex high-fidelity discrete event simulation models with 2D graphics and built-in	-	-	+	+	$25000

			animation					
SIMUL8	Visual8 Corp.	Program-ming language	Capacity planning, plant design, workflow improvement, business process reengineering.	+	+	+	+	$400-$500
Taylor	F&H Simu-lations	Program-ming language	Manufacturing, distribution, warehouse, mining, data flow, airport logistics, finance.	+	+	+	+	$19000
VSE	Orca Computer Inc.	Instrumen-tal System for Simulation	Integrated development and execution environment for general-purpose discrete event object oriented simulation.	+	+	-	+	$10000

Table1. Simulation Software characteristic features.

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Biographical Sketch

Yury I. Brodsky is Senior Research Scholar at Simulation and Modeling division of the Computer Center of the Russian Academy of Sciences. He also is Associate Professor of Informatics and Discrete Mathematics at Moscow Pedagogical State University, where delivered lectures on Computer Simulation and Discrete Mathematics. He got his M.S. degree in Systems of Automatic Control from Moscow Physical Technical Institute (PHISTECH) in 1976 and Ph.D. degree in Mathematical Cybernetics from the same institution in 1981. Dr. Brodsky published one monograph and about 50 papers in area of Computer Simulation, Mathematical Modeling, Parallel and Distributed Simulation, Control Theory, Functional Analysis, Theory of Extremums, CAD/CAM. In 1990 the Multilingual Instrumental System for Simulation (MISS) elaborated by Dr. Brodsky in cooperation with Dr. V. Lebedev won the First Prize in the Contest of Software Products arranged in former USSR by Japanese firm ASCII Corporation. Current research interests of Dr. Brodsky center on Software Engineering, Simulation and Mathematical Modeling, and World Wide Web.