GPSS WORLD[tm]: A BRIEF PREVIEW

Springer W. Cox

Minuteman Software
132 Great Road, Suite 200
Stow MA, 01775

ABSTRACT

GPSS World[tm] is a complete redesign and reimplementation of the popular GPSS/PC[tm] Simulation Environment. The limitations of the old PC DOS environment and the emerging trends in desktop computing have combined to motivate drastic changes which are planned for the new environment to be made available beginning in 1992.

Keywords: GPSS, discrete event simulation.

1 DESIGN OBJECTIVES

The quickly changing scene in the computer industry is shifting the presumptions upon which the design of Simulation Environments is based. For those who implement such systems, the end-user's computer configuration is a moving target which will be very different when the Simulation Environment is commercially available from that available when the design principles were originally sanctified. For this reason, the premises of design must be based on a projection of current trends several years into the future.

Nearly all the current trends represent improvements in potential simulation power which must be made available to the ultimate end-user of the resulting Simulation Environment.

The primary hardware trends are: faster central processor speeds, improved intelligence of the graphics display processor, larger inexpensive random access memories, larger and quicker hard disk subsystems, and increased levels of multiprocessing--both tightly and loosely coupled.

On the software side, Graphical User Interfaces (GUIs) will surely dominate the desktop in the 1990s. Improved multitasking and multiprocessing are being incorporated into Operating Systems scheduled for the near future. In addition, graphics standards and trends that have established the environments of expensive engineering workstations are about to make their mark with individuals running simulations on desktop machines.

These forces lead directly to a set of design objectives for future Simulation Environments. Tradeoffs favor the use of additional memory, disk space, processing time, and internal graphical complexity for improved simplicity and interactivity on the user interface.

At the same time, enthusiasm must be somewhat tempered by the observation that although great improvements in visualization are technically possible, in fact, physical realism is not usually the primary objective of a simulation study; problem resolution is.

Not only can additional "realism" represent an attractive fantasy having little to do with the real-world, but the addition of visual complexities is actually a step in the wrong direction, when it is simplicity that is sought.

We, then, take on as objectives for GPSS World that the newly available power available in future desktop computing systems be brought to the user as Simulation Power, but at the same time, that the sanctity of simplicity and interactivity of the user interface be preserved.

2 WINDOWING

GPSS World is a complete rewrite of the GPSS/PC Simulation Environment. Although extremely high priority is placed on a high level of GPSS/PC compatibility, nevertheless, the visual appearance of the environment is very different. For example, a screen editor is built into the Graphics User Interface (GUI), a powerful multiwindowing system is fully utilized, and a new fast compiler reduces model load time to just a few seconds. At the same time, the high level of user interactivity at run time is retained.

GPSS World allows an arbitrary number of windows, of various types, to be opened on one or more simulations. For example, multiple Blocks Windows could be opened, each on a different part of the model. The actual windowing configuration is highly flexible, allowing animations and detailed entity windows to exist side-by-side. In this manner, the cause and effect relationships among model structures can be examined, analyzed, and modified. This level of interactivity requires an online, rather than post-processed, animation. Similarly, online comparisons, and even data exchange, between models will be possible under a variety of circumstances.

3   VIRTUAL MEMORY

Memory constraints felt by large models will be relieved by the use of Virtual Memory. Thereby, model and entity size restrictions will be generally lifted. Similarly, the Savable Program representation of GPSS/PC will no longer restrict memory needed for other uses. All such little-used components will be able to be swapped out onto auxiliary storage, thereby causing little interference with model execution.

Virtual Memory has many advantages, but it is not a panacea. While it will yield a great advantage when little used parts of the environment are swapped out, there are practical limits to the amount of actively utilizable virtual memory. This quantity can exceed the amount of physical memory installed, but not by a very large factor. It is very difficult to give rules of thumb, but many virtual memory operating systems suffer serious performance problems when physical memory is overcommitted by more than 20-30%. The good news is that this is easily remedied by adding physical memory, which continues to plunge in price.

4   THE MODELLING LANGUAGE

GPSS World will have an internal general purpose modelling language that will enrich the power available to the modeler. If he/she chooses, detailed logical programming can be added easily within the sequence of processing

The internal language will provide a set of built-in probability distributions as well as a wide range of system functions, such as the close control of animations. User defined subroutines will be easily incorporated, and optionally registered in a global subroutine library.

The language will open up several new areas of opportunity for GPSS/PC users. For example, numerical integration will be conveniently available as a function call. In addition to an automatic integration provision, it will be easy to create continuous state, and mixed continuous/discrete state models. As a part of the user-directed level of a spatial animation, this provides an easy way to numerically integrate the dynamics of motion.

5   ANIMATION

One of the most important design goals of GPSS World, is the simplification of the tasks required in the synthesis and analysis of simulation models. To this end, a completely redesigned animation option is planned for GPSS World.

A separate program, Simulation Studio™, will be available to construct backgrounds and active shapes. It is basically a draw program allowing great flexibility in zooming and panning, and in the transformation of objects. It can be used to create shape families for use in an online animation of the simulation. This incorporation of the animation into the environment itself, simplifies the user interface and retains a high level of interactivity. As of this writing, post processing and 3D options are being considered as follow-on enhancements.

There will be several levels of involvement of the user with the animation. At the simplest level, no additional programming will be required to control the animation. A usable visualization will result simply from the use of GPSS modeling statements. This level is intended for those who require only a minimum visual representation of the state of the simulation. Much of the same information will be available in the regular entity windows, as is now the case with GPSS/PC.

For those users who wish to customize the animation further, the properties of the motion of elements in the animation can be attributed to a set of paths defined in the background of the scene. When the simulation is run, the active objects move according to specified rules of motion. This level can be further controlled by statements of the new Modelling Language, referenced above.

The final level of involvement of the user with an animation will allow him/her to program the kinematics of motion. A free-form movement of all active elements will be controllable in 2 or 3 dimensions, by utilizing statements in the Internal Modelling Language. The simulation environment, in turn, will provide automatic

collision detection. However, the user will be responsible for providing an appropriate reaction.

6 HIERARCHICAL MODELING

One need felt for some time by GPSS/PC users has been for a hierarchical abstraction mechanism. GPSS World will provide the ability to easily define submodels, which then can be treated as though they were user defined GPSS Blocks. In this manner, details of nearly any complexity can be pushed down to a lower level of abstraction, thereby simplifying the current level under consideration. The reverse process will enable users to expand lower level modelling details for examination and modification.

These new hierarchical methods will promote either top-down or bottom-up model development. From the top down, details can be easily stubbed using ADVANCE blocks--to be replaced later, by modelling details in a SUBMODEL block, The bottom up approach allows a description of modelling details to be encapsulated into individual submodels, which can be reused within the current model, or actually saved in a submodel library for use elsewhere.

7 ON OBJECT ORIENTED LANGUAGES

The properties of object oriented languages have been examined for inclusion into GPSS World. However, we find that this paradigm is quite different from the traditional world view of GPSS. Its inclusion, in toto, would add a considerable amount of unnecessary complexity to the user interface. For this reason, we choose to implement the Modelling Language of GPSS World with power sufficient to accomplish the same results as an object oriented language, but without all of the additional complexities implied by the object oriented environment. The language(s) used to implement GPSS World, itself, is another matter not within the scope of this paper.

Our conclusion is that while object oriented languages are structures of considerable aesthetic beauty, they add nothing which cannot be done within the simpler GPSS world view. Further, GPSS World is being designed for use by analysts who are not full-time professional programmers.

8 FUTURE CONSIDERATIONS

As you can see, as of this writing, specification of the total GPSS World system is not complete, and will not be so at the time of First Customer Ship (FCS). Soon thereafter, a sequence of enhancement releases will continue to enrich the GPSS World Simulation Environment. Some of the FCS features will be refined, and new enhancements will be added. Much remains to be done with respect to new processors, run time control, and Distributed Simulation Environments. These will be addressed at FCS or soon thereafter.

Similarly, the tradeoffs between realistic 3D animations, the complexity of the user interface, and ever more powerful (but still limited) desktop computing power, will continue to be explored. There are exciting things ahead for the front-line creators of "real-world" simulations. We plan to bring the new possibilities to fruition as quickly as possible.

AUTHOR'S BIOGRAPHY

SPRINGER COX received his degrees in Physics and Computer Science from Cornell University and Syracuse University, respectively, and has completed an advanced study program at MIT. He worked in computer performance evaluation and modeling for IBM and Xerox, and, in 1977, went to the R & D Group at DEC to simulate virtual memory operating systems. In 1982, he founded Minuteman Software for the purpose of creating a microprocessor based interactive simulation environment. He has published over a dozen papers, and has spoken at technical conferences in North America and Europe.