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INTRODUCTION TO SLAMSYSTEM®

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ABSTRACT

SLAMSYSTEM is an integrated simulation system for advanced personal computers based on the Microsoft Windows interface (under MS DOS) or the OS/2 Presentation Manager. This tutorial will discuss SLAMSYSTEM's support for the range of tasks performed in a SLAM II simulation project.

1 SLAMSYSTEM OVERVIEW

SLAMSYSTEM integrates software supporting the range of tasks performed in a simulation project. All features are accessible through pull-down menus and dialog boxes, and are selected from the SLAMSYSTEM Executive Window, shown in Figure 1.

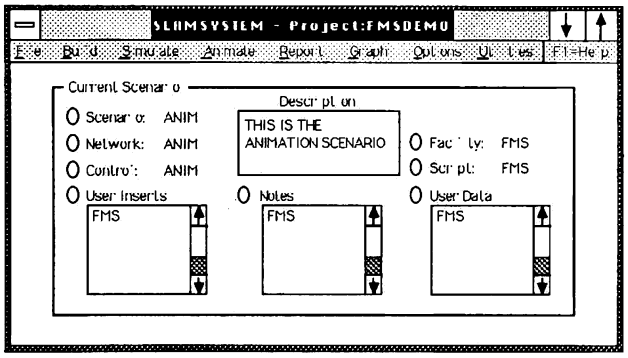


Figure 1. SLAMSYSTEM Executive Window

A SLAMSYSTEM project consists of one or more scenarios, each of which represents a particular system alternative. A scenario is comprised of components such as a network and control, user inserts and user data, animation facilities and scripts, notes for model documentation, and model output. The Current Scenario Box in the SLAMSYSTEM Executive Window shows the components associated with the scenario presently being analyzed.

SLAMSYSTEM's project maintainer removes the burden of remembering the procedure necessary to perform the tasks of simulation, animation, and output review. Each time the modeler requests one of these functions, the project maintainer examines the components of the current scenario to determine if any of them have been modified, indicates whether tasks such as model translation and executable creation should be performed to reflect the changes, and allows the user to specify whether these tasks should be done prior to performing the requested function.

Since SLAMSYSTEM is a Windows application, multiple tasks may be performed in parallel while simulations are executed in the background. The simulation modeler can switch between tasks by using a mouse to click in the appropriate window.

2 BUILDING MODELS WITH SLAMSYSTEM

SLAMSYSTEM may be used to build SLAM II models with the assistance of the graphical network builder (Figure 2) and the forms-oriented control builder. These

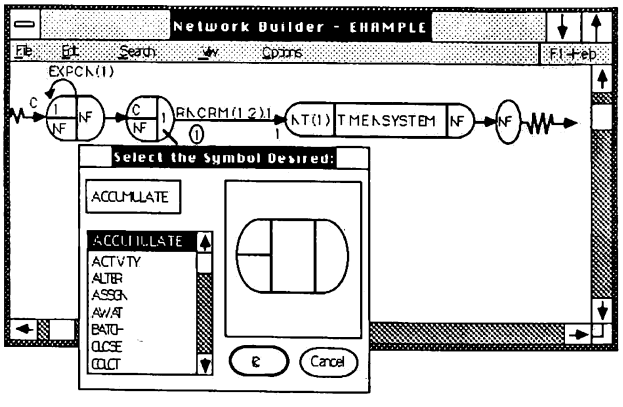


Figure 2. Graphical Network Builder and the Forms-Oriented Control Builder

builders use the mouse and a forms-based approach to aid the modeler in the entry of the system description. They remove the need to remember syntax and field definitions, and allow the modeler to concentrate on constructing models.

Network symbols are selected from a graphical palette and located with the mouse. The symbol's parameter values are specified by filling out a form of information applicable to the particular symbol. On-line error checking is performed upon completion of the form so that input errors can be corrected immediately. Networks can be viewed at three levels of detail. At the highest level, more than 150 symbols can be seen at once. The Windows "Clipboard" can be used for copying a set of symbols to other positions in the network or to other networks or applications. Symbols may be repositioned by selecting and re-locating them with a mouse. The Network Builder also facilitates model building by providing context-sensitive help, searching capabilities, and options for placing symbols at grid points, selecting symbol colors, and flowcharting models by defaulting symbol parameters.

A model's control statements are entered by selecting from a palette of available statements. The parameters of each statement are defined by entering the desired values in the fields of a form specific to that type of statement. As with network symbols, most fields have default values.

Alternatively, networks and controls may be entered in SLAM II statement format with SLAMSYSTEM's textual editor. The Network Builder is capable of loading a network built textually by automatically placing symbols to create a graphical network.

3 OUTPUT ANALYSIS AND PRESENTATION

SLAMSYSTEM provides the capability for comparing simulation outputs from various scenarios both graphically and textually. A report "browser" allows alternative textual outputs to be compared side by side. Graphically, output may be viewed in the form of bar charts, histograms, pie charts, and plots. Bar charts can be used to display the value of a statistic across as many as 10 scenarios. It is possible to view multiple windows of graphical output at the same time, as shown in Figure 3. Graphical and textual information from SLAMSYSTEM graphs and reports can be exported to other Windows packages for additional analysis and for documentation.

4 ANIMATING MODELS

Animations are created under Windows with the Facility and Script Builders. The Facility Builder is used to design background screens, symbols and graphs, to define points on the screen where animation actions will occur, and to create application files which specify the background

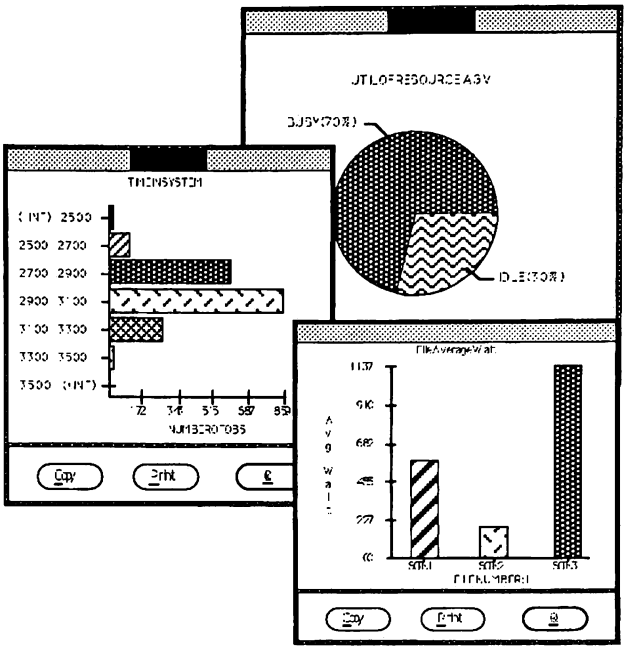


Figure 3. Multiple windows

screens and graphs to be used during an animation. The Script Builder is used to specify which animation actions should occur when a particular simulation event happens. Animations can be performed either concurrently with the simulation or in a "post-process" mode. Plots, barcharts, histograms, and trend graphs may be shown along with symbol movements, color changes, numeric value displays, text placements, and stack updates. Two screens can be updated simultaneously, and up to 255 screens may be swapped into memory during an animation.

The Facility Builder allows the modeler to design background screens and symbols by drawing lines, outlines, boxes, circles, ellipses, arcs, and points using 16 standard colors, 16 hatch patterns, and 16 colored patterns. Sections of the background screens and symbols can be copied, moved, mirrored, rotated, and color swapped. Symbols may be transported back and forth between symbol tables and background screens. Facility screens can be imported from other software packages such as AutoCad.

The Script Builder allows animation rules to be entered with a forms system which is very similar to the one used in the Control and Network Builders. The parameters of each script statement are specified by filling out a form for the particular statement. The form displays all the options for each parameter, and on-line help is available.

5 OS/2 ANIMATOR

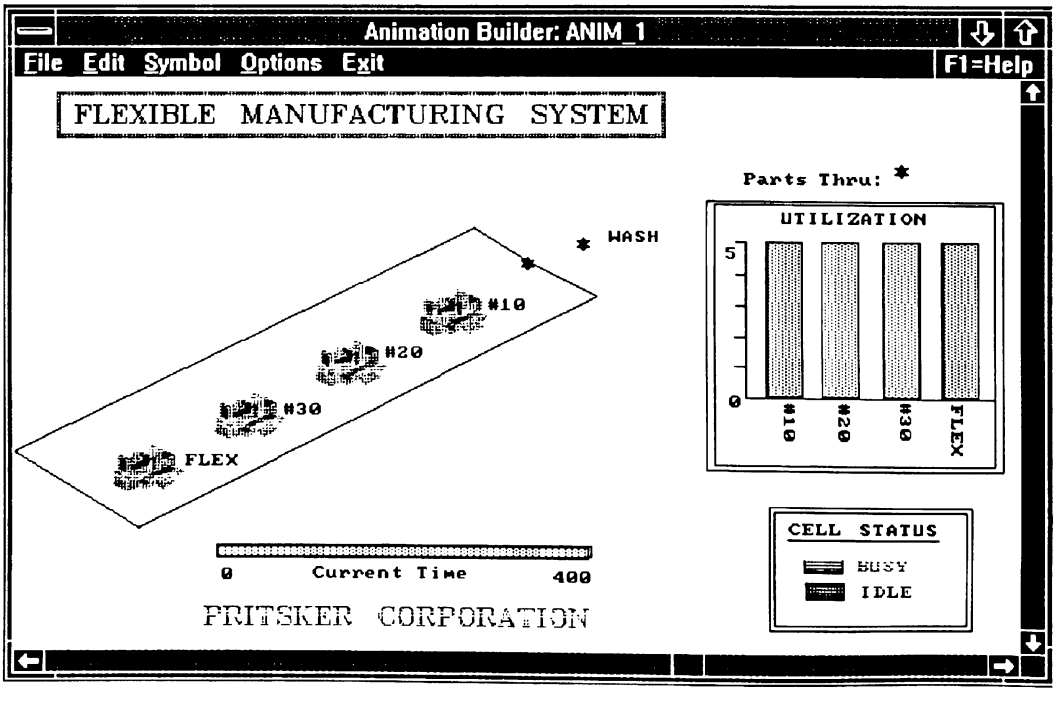
The SLAMSYSTEM OS/2 animator utilizes special features of the OS/2 operating system. These special features include preemptive multitasking and a windowed user interface. Preemptive multitasking allows multiple animations of a single simulation model to be displayed concurrently. The windowed interface is utilized in the graphical animation builder to increase the animation developer's productivity. In addition, advanced animation constructs dramatically reduce the amount of time required to animate complex situations.

With the SLAMSYSTEM OS/2 animator, one may develop and display multiple animations of a single simulation. For example, the modeler can create one animation of a system at an aggregate level and another at a department level, side by side in separate windows. The two views may then be displayed by selecting those animations through the SLAMSYSTEM executive and running the simulation.

Animation constructs under the OS/2 animator are called actions. Many of these actions directly correspond to elements in a SLAM II network model. These direct mappings are provided for activities, resources, queues, global variables (either as counters, plots, or bar graphs), AGV segments and cranes. For example, the ACTIVITY action shows movement of a symbol. It requires that the modeler define a symbol, a graphical path location where movement of the symbol will be shown, and the number of an activity in the SLAM II model to which to tie the movement.

Advanced animation actions are provided for modeling more complex system constructs. One of these actions can be used to accurately represent the movement of parts along a conveyor. The modeler identifies a graphical path where movement will appear, a symbol or symbols to move, and the simulation event or events which trigger the action. The symbols may be made to appear instantly on the path or they may be moved from the beginning of the path to a buffer area in a specified time. When a symbol is removed from the buffer, the remaining set of entities moves forward just as packages on a conveyor behave when the lead package is removed.

The symbols manipulated by the animator are of two types: graphical items one wants to display or move, and the background on which they will appear. These symbols are stored in standard OS/2 bitmap format. This allows them to be exchanged between programs using the OS/2 clipboard. For example, the modeler may have a facility layout drawn in AutoCad with OS/2. This layout can be copied to the clipboard and pasted into the SLAMSYSTEM animator as the background for the animation. In addition, a utility is provided with the SLAMSYSTEM animator which converts any portion of the OS/2 Presentation Manager (PM) screen to a bitmap. This allows the modeler to import images from OS/2 PM programs which do not support the clipboard.



6 INTEGRATION OF SLAMSYSTEM WITH OTHER SOFTWARE

The SLAMSYSTEM user will typically use SLAMSYSTEM with other software programs for systems analysis. SLAMSYSTEM was designed to be used in an integrated manner. Using the Windows or Presentation Manager standards it is easy to move data into or out of SLAMSYSTEM.

Modelers often want to drive their simulation models from historic data. The SLAMSYSTEM project framework includes a user data element as part of the scenario definition. This data element may contain schedule, routing, or facility configuration information. It is read by the SLAMSYSTEM model during the simulation execution. The user can create this data with a spreadsheet or the built in data editor provided with SLAMSYSTEM, saving the information in standard text format. Routines are then added to the model to read the data during the simulation execution.

A SLAMSYSTEM animation can use graphics created from other programs. As discussed in the animation section, the graphical elements manipulated by the animation program can be created using CAD, drawing, or paint programs. They can be loaded into SLAMSYSTEM by using the OS/2 bitmap format or, under Windows, the Dr. Halo cut format. Many programs support these formats directly or a graphical translation program can be used.

Graphics can also be exported from SLAMSYSTEM. The output charts and plots created by SLAMSYSTEM can be exported, via the Windows or Presentation Manager clipboard, to other applications. For example, a pie chart created by SLAMSYSTEM may be copied to the clipboard and pasted into a word processing document describing the results of the model. Another way to export graphics from SLAMSYSTEM is to capture different views of the system during the animation. SLAMSYSTEM provides a utility program to support the capture of these animation screens. These screens can be used as part of a desktop slide presentation using Harvard Graphics or Storyboard for example.

The standard SLAMSYSTEM output reports are often exported to other packages for communication or analysis purposes. Analysts use sections of the standard SLAMSYSTEM report with a spreadsheet to add cost data to simulation output. The report can be imported into the spreadsheet via the clipboard or by using a standard text file importing feature available in many of the popular spreadsheet programs.

7 CONCLUSION

SLAM II is a proven, powerful modeling methodology. It has been used for hundreds of simulation projects and as the basis for simulation courses in many colleges and universities. Published applications describe models dealing with problems in manufacturing, transportation, material handling, staffing, experimental design, communications systems, and many more.

Continuing development of SLAM II and simulation support software has culminated in TESS and SLAMSYSTEM, integrated simulation systems for workstations and personal computers. SLAM II, TESS and SLAMSYSTEM are distributed by Pritsker Corporation, which offers regularly scheduled training classes as well as applications support.

AUTHOR BIOGRAPHY

WILLIAM R. LILEGDON is Product Manager for Engineering Products at Pritsker Corporation. He received a Bachelor of Science Degree in Industrial Engineering from Purdue University. Joining Pritsker in 1981 as simulation analyst he applied SLAM II to projects in the aerospace industry. He has led the development of MicroNET, SLAM II/PC, and SLAMSYSTEM simulation products. In his current position he is responsible for the development, distribution, and support of Pritsker's Engineering Products.