Comparison of Parallel Simulation Techniques
ASCET-RS

In this series of comparisons a solution with ASCET-RS has been described (see SNE 17). Results are presented now for the coupled predator-prey population model that forms the second test example for the comparison of Parallel Simulation Techniques.

Description of ASCET-RS: ASCET-RS stands for **A**dvanced **S**imulation and **C**ontrol **E**ngineering **T**ool - **R**ealtime **S**imulator. It is an integrated design and rapid prototyping environment for modelling and simulating linear, nonlinear, continuous, discrete and mixed systems. Portability for on-site operation, and realtime capability for time-critical events help to optimize the entire development process.

ASCET-RS is an open system as it allows data input and output from and to other systems, system modifications and parameter variations during simulation and hardware-in-the-loop applications. Special features are parameter optimization under realtime conditions, state machine description and multi-processing.

ASCET-RS is a Transputer based parallel system. Simulations take place on the array of Transputers (T805) connected to a PC as a front end computer. For inter-processor communication the messages are sent via the Transputer-"Links" (serial, 20 Mbit/s transfer rate). Model equations can be distributed to different ASCET-RS blocks. The user can specify on which processor a block will be placed.

Model description: The ASCET-RS block editor is used to define inputs and outputs of individual blocks, as well as their equations. The functional description of a block is based on a high level language with special elements for simulation. The function can be a mixture of nonlinear differential and algebraic equations. All simulations have been done using single precision and Adams-Bashforth-algorithm for integration with step-size dT=0.001. Figure 2 shows the block description for the predator-prey populations w1 and w2.

The ASCET-RS code for the other populations is also very simple and is not included in this note due to space limitations. It is available to anyone interested on request.

The different blocks are connected in the ASCET-RS modelling window (figure 1). At each communication interval the data of the output values in one block are sent to the corresponding input signals of the other block.

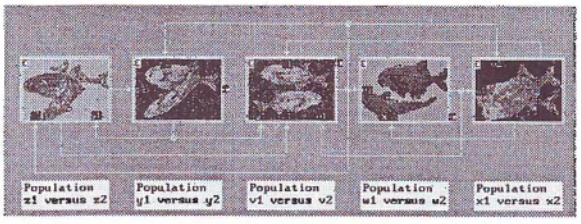

Figure 1: ASCET-RS modelling window

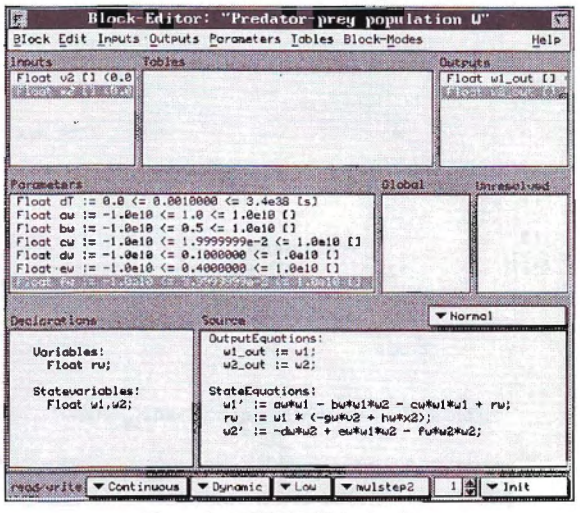

Figure 2: ASCET-RS block editor

Simulation and results: Blocks are compiled and linked to the run-time system. All simulations are done in background. During the calculation it is possible to view values of variables continuously, to stop or create blocks.

For the coupled predator-prey population model the five populations are distributed on up to five processors. In addition we will examine the influence of the communication overhead through the parallelization.

First, all five tasks were located on different processors, therefore the communication overhead was high. With communication performed at every integration step (c_{int}=dT=0.001) the parallelization resulted in a speed-up-factor of f=1.71, with reduced communication (c_{int}=4dT) f increased to f=3.53. Increasing the communication interval to c_{int}=10dT led to a factor of f=4.52.

In the ASCET-RS Transputer window the Transputer links can be connected. Figure 3 shows the used configuration of the links with 5 Transputers T1 ... T5.

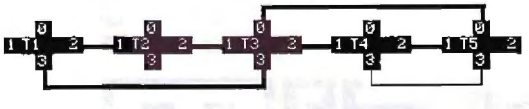

Figure 3: ASCET-RS Transputer window

Enlarging the communication interval c_{int} means that the integration algorithm uses "old" input values for more than one step.

Therefore figure 4 shows the solutions for the populations w1(t) and w2(t) for c_{int}=dT and c_{int}=10dT. The deviation at t = 100 is less than 10E-2.

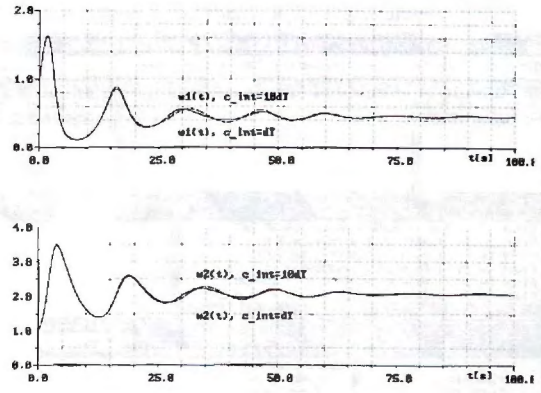

Figure 4: w1(t) and w2(t) for c_{int}=dT and c_{int}=10dT

We executed our test problem on various numbers of Transputers for various communication intervals. The results are depicted in figure 5.

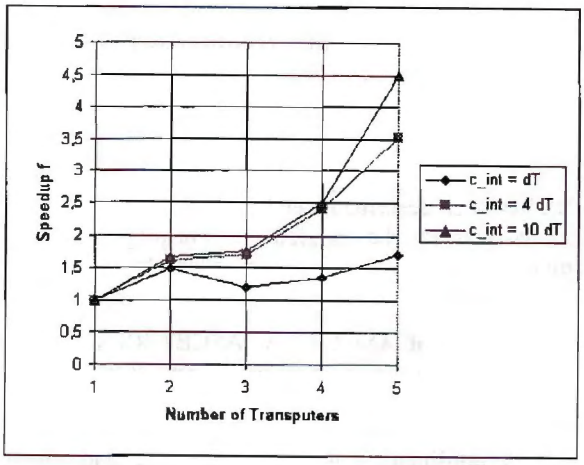

Figure 5: Speedup-factors

Being familiar with ASCET-RS, programming and testing the parallel solutions took about 2 days.

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