

SIMULATION ACCELERATOR

There is performing...then there is outperforming.

In this category is EAI Simulation Associates, Inc. of West Long Beach, New Jersey, a design leader in supplying parallel systems for real-time high fidelity simulation.

Under Goddard Space Flight Center Small Business Innovation Research (SBIR) contracts, EAI Simulation Associates developed a new digital simulation computer called the Advanced Real-Time (ARTS) System. Its architecture is based on the analog model of computation instead of the classical von Neumann model. SBIR work included development of a simulation product that outperforms all other computers, including supercomputers, on a wide range of continuous system simulation applications. The successful completion of that NASA work led to the formation of the company in 1994.

EAI Simulation Associates has a joint marketing, distribution, and maintenance agreement with Halifax Corporation for the commercial sale of new all-digital simulation products. Among them is the SBIR-funded computer product, a data flow processor that provides supercomputer performance. Five ARTS systems have been sold including over \$2 million in sales to Japan. The product has been used in numbers of applications to support aerospace and automotive work, as well as in the electric power and chemical reactor industry.

The truly innovative feature of the accelerator processor resides within the scheduling compiler. This compiler does not translate code into an intermediate language such as C or FORTRAN. Instead, it breaks down source statements into threads of elementary operations. These operations are then automatically scheduled to execute directly, with maximum fine-grain parallelism, on very long instruction word hardware.

Marketing of the data flow processor by Halifax is underway, a product-add to that company's line of flight simulation systems and computer simulation services to civilian and military users.

The accelerator designed by EAI Simulation Associates is the only digital system that offers never-before-attained computational speeds. Put to the test, a real-time simulation of a Space Shuttle main engine was undertaken. Stable and accurate results were achieved, with the system simulating Space Shuttle main engine controllers, high-speed turbo pumps, and other elements. Temperatures, pressures, and flow rates were computed for fuel, oxidizer and coolant.

This simulation was no easy task. The model required 40 integrators, several hundred summers and multipliers, 38 dividers, and 32 arbitrary function generators. Three of those generators were functions of two variables.

The evaluation certified that the accelerator hardware can run applications "as is" in real time with four processors. In a comparative test, a supercomputer took over 250 microseconds, which was more than eight times slower than real time.

A Halifax simulation system equipped with the EAI Simulation Associates accelerator has been designed to perform the functions of the analog processor in a hybrid simulation. By using the accelerator, a pair of 17-foot racks costing over \$1.5 million can be replaced with a single cabinet at about a quarter of the cost. An entire simulation can be programmed in floating point in a single source language.



Small in size, powerful in computer punch. EAI Simulation Associates developed a new computer simulation processor, yielding better-than-supercomputer performance.