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**6. AUTHOR(S)**
Professor David Gelernter

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
Yale University
Dept of Computer Science
New Haven CT 06520

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Accomplishments under this grant were: The researchers defined a new "sensor/actuator" view of process trellis software architecture for data fusion. The trellis architecture was ported to a LAN environment. The researchers tested a new LAN-capable sensor/actuator package by developing a monitor-controller for the Piranha adaptive parallelism environment. A trellis-structured wide area Piranha system is the next goal of the researchers.



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ANNUAL + **Final Project Report** per DL

**AFOSR-91-0098**

# "Using the process trellis to organize large-scale parallel realtime monitors and expert systems"

Submitted by:

David Gelernter, Associate Professor
Principal Investigator
Department of Computer Science
Yale University
51 Prospect Street
New Haven, CT 06520
(203) 432-1278
gelernter@cs.yale.edu

## Final Report on AFOSR-91-0098

Research in connection with this grant accomplished a number of things:

1. We defined a new "sensor/actuator" view of the process trellis software architecture for data fusion. The original architecture served only in the role of passive monitor. The sensor/actuator version can serve not only to monitor but to control realtime processes. The sensor/actuator extension is a natural one in the trellis context, but requred extensions to the design and the implementation of the existing software.

2. We ported the trellis architecture to a LAN environment. The original (parallel) program ran only on shared-memory multiprocessors. The code is written in C-Linda, which is portable to essentially any asynchronous parallel environment, including LANs. But the trellis package depends not only on the correct execution of code; it also performs (heuristically) optimized realtime scheduling of trellis modules onto available nodes. The heuristic scheduler is based on an analytic model of the hardware. Porting to the LAN environment required the development of a new (and more complicated) underlying model and heuristic scheduler.

3. We tested the new LAN-capable sensor/actuator package by developing a monitor-controller for the Piranha adaptive parallelism environment. Piranha is a system that allows processes of a parallel application to be created dyamically (for example on newly-idle LAN nodes) and removed dynamically (for example, when an owner resumes work at his node) while the computation as a whole continues without interruption. The Piranha system poses a number of monitoring and control problems: it requires that the current idle/busy and "idleness criteria" status of all nodes be maintained, that predictions be developed with respect to likely future idleness patterns of each node in the pool, that the status of all Piranha applications and their behaviors be maintained and that Piranha jobs be assigned to particular idle nodes, among other issues. The problem was a good test bed for the sensor/actuator LAN trellis because it required actuator and not just sensor capability, it was inherently distributed and required LAN capacity, and it was inherently a significant, interesting problem. The Piranha-trellis we developed

worked sufficiently well to suggest that the entire Piranha system (and not just monitor-control functions) might be structured as a trellis. A trellis-structured wide area Piranha system is our next research goal.

## Publications


N. Carriero, E. Freeman, D. Gelernter and D. Kaminsky, "Adaptive Parallelism." *IEEE Computer* (to appear).

N. Carriero, E. Freeman and D. Gelernter, "Adaptive Parallelism on Multiprocessors: Preliminary Experience with Piranha on the CM-5," in 6th Ann. Languages and Compilers for Parallel Computing Workshop Springer-Verlag (Feb. 1994).

D. Gelernter, M. Jourdenais and D. Kaminsky, "Piranha Scheduling Strategies and Implementation." *Int. Journal of Parallel Programming* (to appear).

S. Ahmed and D. Gelernter, "A CASE Environment for Parallel Programming," in *Proc. Fifth Int. Workshop on Computer-Aided Software Engineering,* July 1992.

D. Gelernter and D. Kaminsky, "Supercomputing out of Recycled Garbage: Preliminary Experience with Piranha." in *Proc. 1992 ACM Int. Conf. Supercomputing,* July 1992.

Donna Edwards, Michael Factor, Scott Fertig, David Gelernter and Joseph Harris, "Realtime Data Fusion for Climate Monitoring, via Process Trellis," in *Proc. of the International Space Year Conf. on Earth and Space Science Info. Sys.*, Feb. 1992.