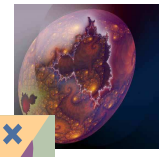
UCDAVIS UNIVERSITY OF CALIFORNIA **Hydrologic Sciences Graduate Group Presents**

Special Colloquium Series, Spring & Fall 2005:

Between Nature and Science:
Advanced Modeling Concepts for Environmental Sciences






Christian Jacob
University of Calgary, Canada

Ants and Genes: Lessons from Collective Intelligence From Social Insects to Gene Regulatory Systems

Thursday May 26th
4:00-5:00pm
PES 3001
Light refreshments provided

We are surrounded by a natural world of massively parallel, decentralized biological 'information processing' systems, a world that exhibits fascinating emergent properties in many ways. In fact, our very own bodies are the result of emergent patterns, as the development of any multi-cellular organism is determined by localized interactions among an enormous number of cells, carefully orchestrated by enzymes, signalling proteins and other molecular 'agents.' What is particularly striking about these highly distributed developmental processes is that a centralized control agency is completely missing. This is also the case for many other biological systems, such as termites which build their nests – without an architect that draws a plan, or brain cells evolving into a complex 'mind machine' – without an explicit blueprint of a network layout.

First, I will present examples of how to use evolutionary computing to breed swarm behaviours, which shows an easy way to program, or rather breed, collectively intelligent systems. By example of an agent-based model of a gene regulatory system, I will expand the notion of swarm intelligence to the simulation of processes within a bacterial cell, which makes highly complicated biological processes much more accessible to computer-based investigations. If time permits, we will also look at a highly visual model of the immune system reactions in response to a viral attack. The talk will be concluded by demonstrations of *SwarmArt*, an exploratory art project which utilizes swarm intelligence and evolution.

Dr. Jacob *received his Ph.D. in Computer Science from the University of Erlangen- Nuremberg, Germany. In July 1999, he joined the Department of Computer Science (Faculty of Science) at the University of Calgary. Since August 2003, he also holds a joint appointment with the Department of Biochemistry & Molecular Biology (Faculty of Medicine), where he is the Director of Bioinformatics in the Bachelor of Health Sciences Program. Dr. Jacob leads the Evolutionary & Swarm Design (E&SD) research group of the Artificial Intelligence Laboratory and is currently establishing a Unit for Computational Modeling, Experimental Design & Analysis within the Faculty of Medicine. Dr. Jacob and his research group are investigating how to apply evolutionary, swarm and collective intelligence techniques in various application domains. So far, the E&SD research group has built mathematical models, computer simulations and visualizations of traffic systems, army ants, neuron growth, biomolecular systems, and gene regulatory systems. Some of the projects are described in detail at the ESD website:* http://www.swarm-design.org .

Upcoming Speakers:

2-Jun **Jim Crutchfield** "Multiagent Dynamical Systems"

Sponsored By: John Muir Institute for the Environment, Computational Science and Engineering Center, Department of Civil and Environmental Engineering, Department of Land, Air, and Water Resources, Department of Chemical Engineering and Materials Science, Soil Sciences, Atmospheric Sciences, and Hydrologic Sciences Graduate Groups, College of Agriculture and Environmental Sciences, U.C. Cooperative Extension