

GRyCAP

Networking and High Performance Computing Group (GRyCAP)

José M. Alonso

Fernando Alvarruiz

Department of Information
Systems and Computation (DSIC)

Valencia University of Technology (UPV)

Talk Outline

- Introduction
- Research Lines and Technological Capabilities
- Research Projects
- Software Tools Used

Networking and High Performance Computing Group

- <http://www.grycap.upv.es>
- Created in 1986
- Responsible: Vicente Hernández García
(vhernand@dsic.upv.es)
- 20 members
- Developed Doctoral Dissertations: 15
- Ongoing Doctoral Dissertations: 12
- European Projects: 14
- Journal Articles: ~120
- International Congresses: ~220

Institute of Applications of Information Technologies and Advanced Communications



<http://www.itaca.upv.es>

- Our Group is a Member of the ITACA Institute
- Innovation and Technology Transfer to Society
- Composed of
 - Research Groups in the Valencia University of Technology
 - Private Companies
 - Public Administration Bodies
 - Professional Assotiations

Research Lines

- **High Performance Computing Applied to:**
 - Structured Matrices
 - Solution of Sparse Large-Scale Systems of Linear Equations
 - Eigenvalues and Singular Values Computation for Sparse Large-Scale Problems
 - Systems of Non-linear Equations and Optimization
 - Partial Differential Equations and Finite Elements
 - Numeric Algorithms for Process Control
 - Networked Computer Systems
 - Image Graphics Processing

Technological Capabilities

- **Advanced Software**
 - Optimization of Industrial Codes and Software Migration
 - Development of Numerical Computing Software
 - Generation of Highly Realistic Images
 - Internet-based High Performance Computing and E-Commerce Systems
 - Development of Distributed Applications
 - Development of User Interfaces
- **Software applied to Engineering**
 - Development of Environments for Industrial Processes
High Performance Simulation
 - Robust Efficient Accurate Software Tools for Control Engineering

Technological Capabilities

- **Medical Images**
 - High Performance Processing of Medical Images
 - Development of Surgical Simulation Systems
- **Technology Transfer**
 - Hipercosme, Hiperttn, Eutist-m
- **Servicies and Consultancy**
 - High Performance Computing Platforms
 - High Performance Computing Software

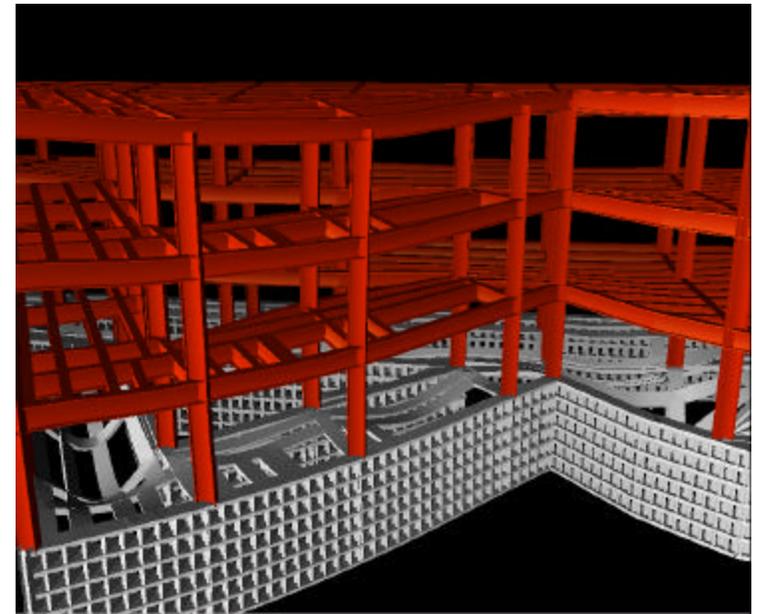
Research Projects

- **Simulation for Engineering**
 - **Construction:** Hipercosme-cs1, Vasses, Gasses, Masses, Easses, Padem, Hiperbuild, Calma3D
 - **Water Supply:** Hiperwater, Powadima, Calnet
 - **Electromagnetic Field:** Fed-com
 - **Plastic Injection:** Hiperplast
 - **Nuclear Energy:** Atrapas, Lambda Modes
 - **Bioelectric:** Camaec, Camav
 - **Ports and Coasts :** Neurebata
- **Medical Sector:** Hipercir, Dismedi, Petri-med, Fed-med, Vrsur
- **Image Visualisation:** Fed-RV, Vre-commerce
- **Control Applications:** Niconet

Construction Simulation

“High Performance Computing for 3D Analysis of Building Structures” (HIPERBUILD)

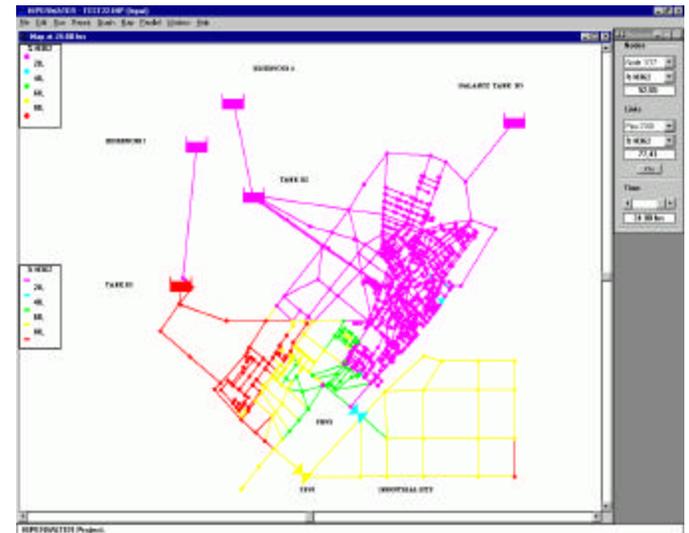
- Objectives:
 - Structural Analysis of Large Buildings
 - High Capacity Visualization
 - Static and Dynamic 3D, Realistic and Rigorous Analysis (6 Degrees of Freedom), Without Simplifications



Hydraulic Simulation

“High Performance Computing in Water Distribution Simulation” (HIPERWATER)

- Objectives:
 - A Tool for the Hydraulic and Water Quality Simulation of Supply Networks
 - A Tool for Leakage Simulation and Minimization
 - A Powerful Tool that Provides the Quickest Response by Using HPCN Technology



Hydraulic Simulation

“Potable Water Distribution Management” (POWADIMA)

- Objectives:
 - Establish the Feasibility and Efficacy of Introducing Real-time Optimal-control for Water Distribution Networks
 - Reducing Operating Costs, Ensuring Service
 - Efficient Tools for Simulation and Optimization

Hydraulic Simulation

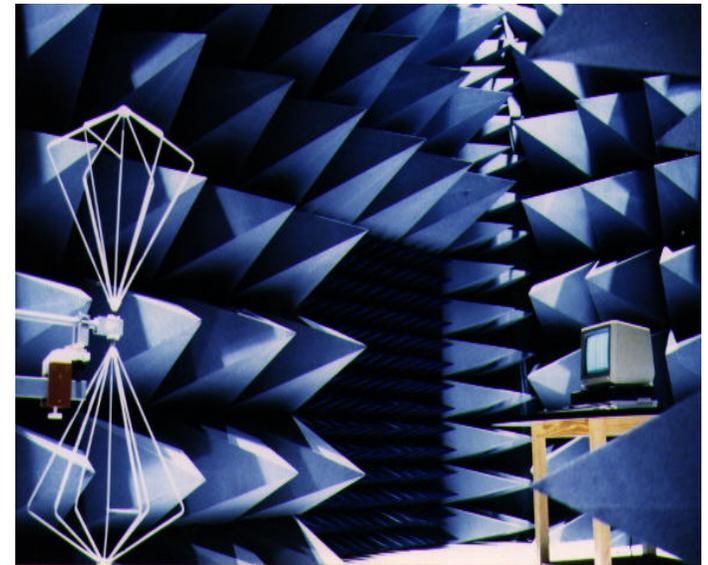
“Calibration and Exploitation of Hydraulic Models for Water Distribution Networks by means of GIS and SCADA Systems Connection” (CALNET)

- Objectives:
 - To Connect GIS and SCADA Systems With Hydraulic Simulator (EPANET)
 - To Make Progress in the Field of the Hydraulic Model Calibration. (Optimization Problem)

Electromagnetism Simulation

“Simulation of Electromagnetic Wave Propagation in Cavities”

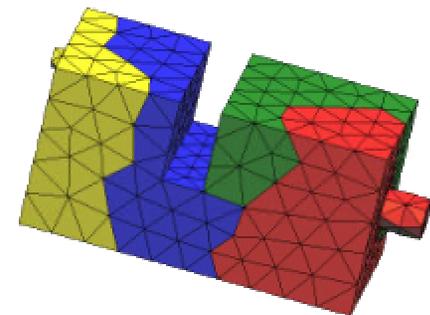
- Applications:
 - Microwave Oven Design
 - Domestic Scope
 - Industrial Scope
 - Anecoic Chamber Design
 - Electromagnetic Compatibility
 - Pre-certification



Simulation of Materials

“HPCN Reinforced Plastic Injection Simulation” (HIPERPLAST)

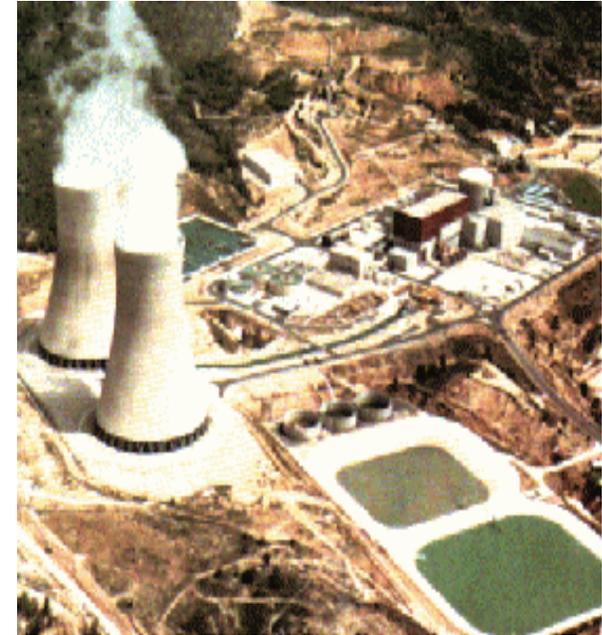
- Objectives:
 - Simulation for Short Fiber Reinforced Thermoplastics Injection Processes
 - Toy Industry
 - Designing More Easily Plastic Pieces
 - Replacing Stainless Steel or Aluminum Pieces by Plastic Ones



Nuclear Engineering Simulation

- **ATRAPAS**

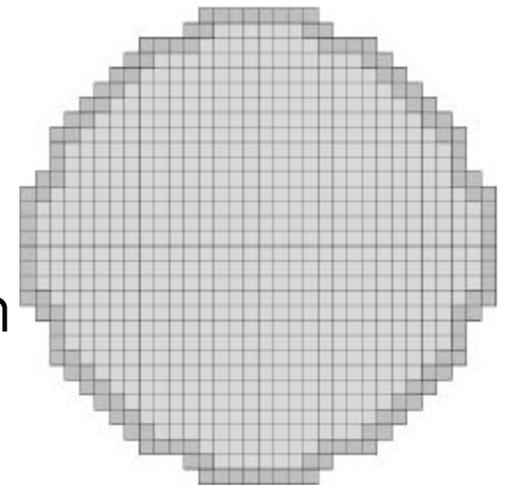
- TRAC-BF1 Code Parallelization
- TRAC is a 3D simulator for the analysis of nuclear thermo-hydraulic Transients
- TRAC Simulates the behavior of a nuclear plant model.
- TRAC is commonly used for Accident analysis, Transient Analysis, Licensing or Fuel recharge



Nuclear Engineering Simulation

- **Lambda Modes Calculation**

- Analysis of Neutrons Diffusion Within a Reactor Core
- Reactor 3D Model
 - Axial Levels
 - Cells
- Discretization: Eigenvalue Problem
- Analysis of Control Bars Insertion
 - Homotopy Techniques



- **Mammography**

- Early Diagnostic of Breast Tumors

Other Simulations

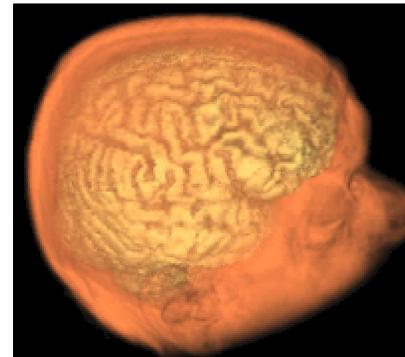
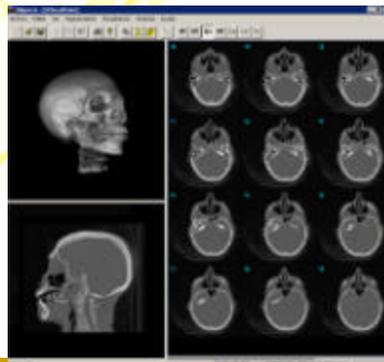
- **Advanced Computation of Electrical Heart Activity (CAMAEC)**
- **Analysis of Runup, Overtopping and Optimal Crest Freeboard of Mound Breakwaters Using Neural Network Models (NEUREBATA)**
- **Computational Fluid Dynamics for Airflow Between Turbine Blades (ATHENA)**



Medical Area

“High Performance Medical Image Diagnosis in Cluster of PCs” (HIPERCIR)

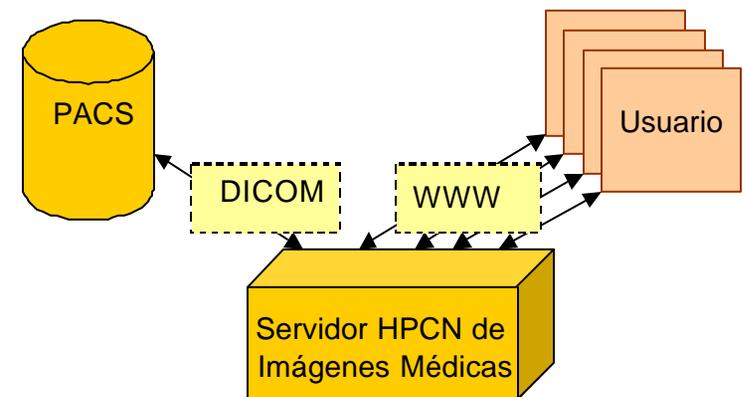
- Objectives:
 - Medical Image Diagnosis in PCs
 - Images From TAC, Magnetic Resonance, etc.
 - Cost Reduction With Regard to Commercial Equipment
 - Oriented to Small Hospitals
 - Needed Parallelism to Obtain Similar Performance (Better in Many Cases)



Medical Area

“Distributed High Performance Processing of Medical Images. A New Component in Advanced PACS” (DISMEDI)

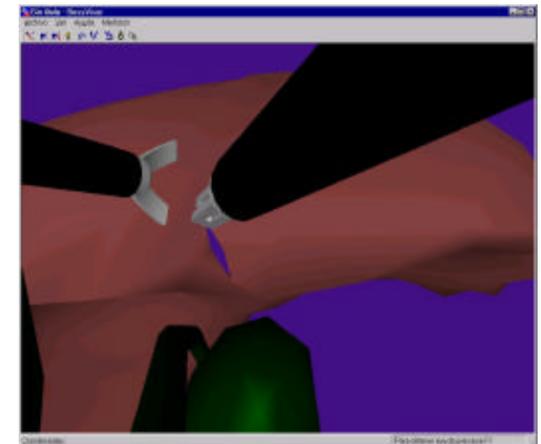
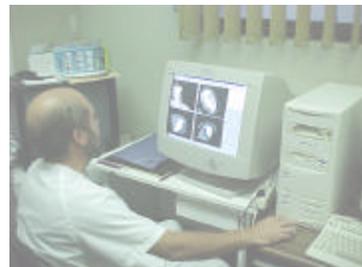
- Objectives:
 - Distributed System Development for Computer-Aided Image Diagnosis



Medical Area

“Virtual Reality Surgery Training System” (VRSUR)

- Objective:
 - Design and Implementation of a Laparoscopic Surgery Training System

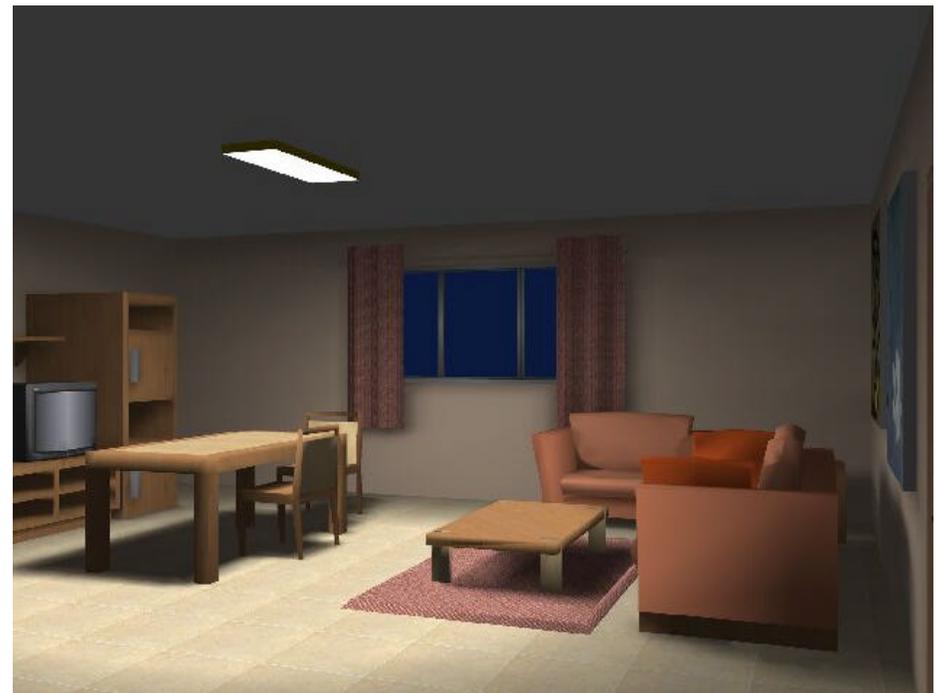


Realistic Synthetic Images Generation

“High Performance Virtual Reality Distributed Electronic Commerce: Application for the Furniture and Ceramics Industries”

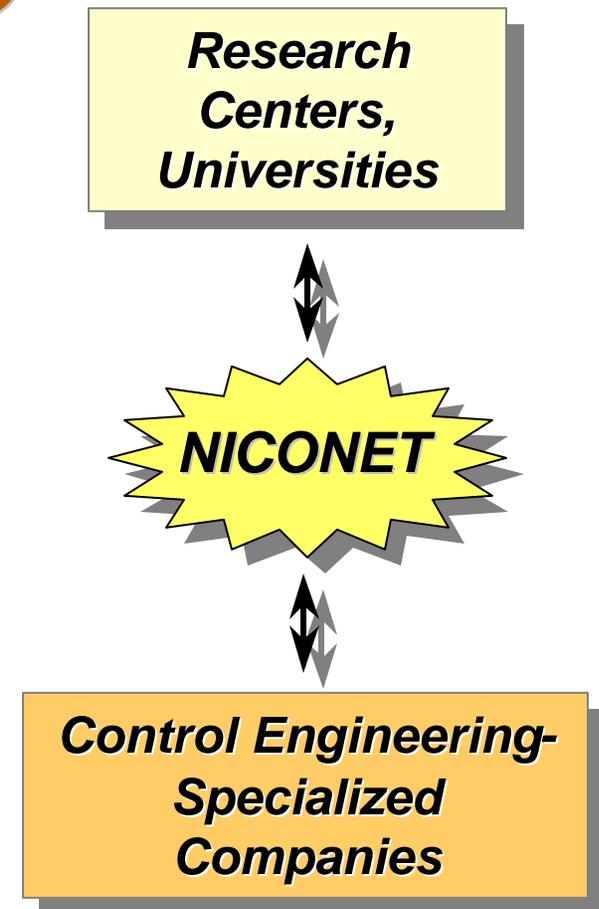
(VRE-Commerce)

- Objectives:
 - Realistic Synthetic Images Generation for Furniture and Ceramics Industries
 - Used Technologies:
 - Parallel Computing
 - Lighting Algorithms
 - Network Computation



"Numerics In COntrol NETwork" (NICONET)

- Objectives:
 - Coordination of all European Initiatives on Numerical Control Software Development. (Network with 17 Partners)
 - Development of the SLICOT Software Library for Control Problems (Software Library In COntrol Theory)



Software Tools Used

- Dense linear algebra
 - ScaLAPACK
- Solution of sparse linear systems of equations
 - (Direct Methods) SuperLU, PSpases
 - (Iterative Methods) PETSc, AZTEC, SPARSKIT, P-SPARSELIB
- Solution of nonlinear systems of equations
 - SUNDIALS
- Optimization
 - FSQP
- Eigenvalue problems
 - ARPACK, BLZPACK, PLANSO, TRLAN

Software Tools Used

- Simulation of ODE and DAE systems
 - SUNDIALS, COLNEW, TWPBVP, ODEPACK, DASL, DASPK, GELDA, RADAU5
- Communication libraries
 - MPI, PVM