Due to the emergence of Grid computing, numerical simulations are becoming more and more complex — it is not uncommon to find different models and codes coupled. Our purpose is to analyse, to design and to develop a software environment for steering distributed parallel simulations from the visualization. This computational steering environment should be integrated with the visualisation. The simple integration of an existing simulation should allow the end user to visualize the intermediate results and to directly interact with the simulation during its execution.

Context and Crucial Issues
Parallel & distributed numerical simulations
* Among the most common codes (C/C++/Fortran with MPI/PVM)
* Each step of a simulation can generate very huge data
Parallel scientific visualization
* Complex and heterogeneous visualization processing
* Providing evolvement of the parallel visualization (clustering, tiled display)
* The coupling of parallel simulations and parallel visualization systems leads to several open and crucial issues.
  * How to transfer data distributed on a parallel application directly to another parallel application?
  * EPISN uses a grid-based redistribution library (e.g. RedGRID locally developed).
  * How to assign specific data on a complex simulation (e.g. meshed shapes)?
  * EPISN uses a hierarchical task model of the parallel simulations.
  * How to ensure the steering treatments to occur at the same date in all the parallel processes without strongly synchronizing them?
  * EPISN schedules the treatments with a weak synchronisation and the parallel applications execute them independently.

Architecture
Communication Infrastructure based on CORBA
  * Support of heterogeneous distributed simulation platforms
  * CORBA server encapsulated in a thread
  * Use of CORBA TLI hides the end-to-end networking

Simulation
Application fields
  * Molecular simulations of solids and fluids
  * Complex molecular systems: docking, steered simulation
  * Environment: population dynamics, epidemiology and prophylaxis
Supported simulations
  * Parallel grid applications
  * Complex simulations: multiple tasks/loops, nested tasks/loops
  * Distributed complex data: data fields, generic block decomposition, partitioned data, unstructured meshes

User Interface
Visualization
  * Data collection for the on-line visualization of intermediate results
  * Generic client adapted to any simulation
  * AVS/Express (sequential) or VTK (parallel) data source modules
  * EPISN client API to develop customized user interfaces
Interaction
  * Remote control of the simulation execution (play/stop)
  * Modification of parameters and data on-the-fly
  * Invocation of actions in the simulation code

Prospects
  * Massive parallel and distributed applications
  * Grid 5000 deployment
  * Evolution to parallel CORBA objects (ParOo — PARSEC project)
  * Definition of high-level interaction objects and associations with 3D widgets
  * Virtual reality environment: haptic sensors, tile display wall

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Publications