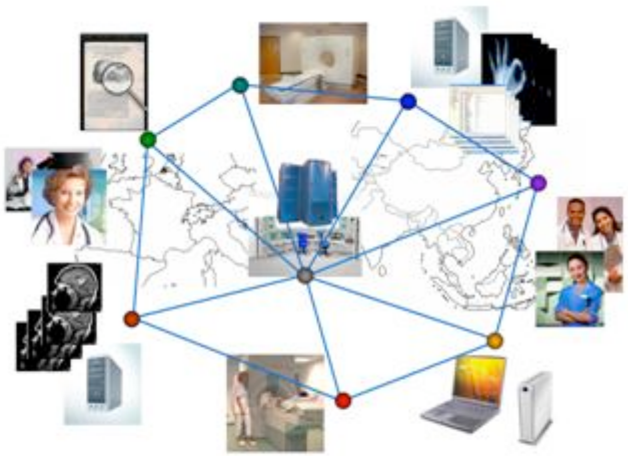
CAMARASU Sorina

Towards a Virtual Radiological Platform Based on a Grid Infrastructure



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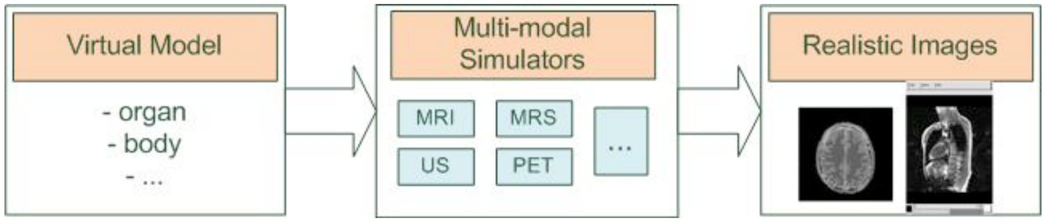
New York

Summary

- ✓ Overview of the VRP
- ✓ Grid Contribution to the VRP
- ✓ Experience Feedback on Application Porting
- ✓ Conclusion
- ✓ Acknowledgments

Overview of the VRP (I)

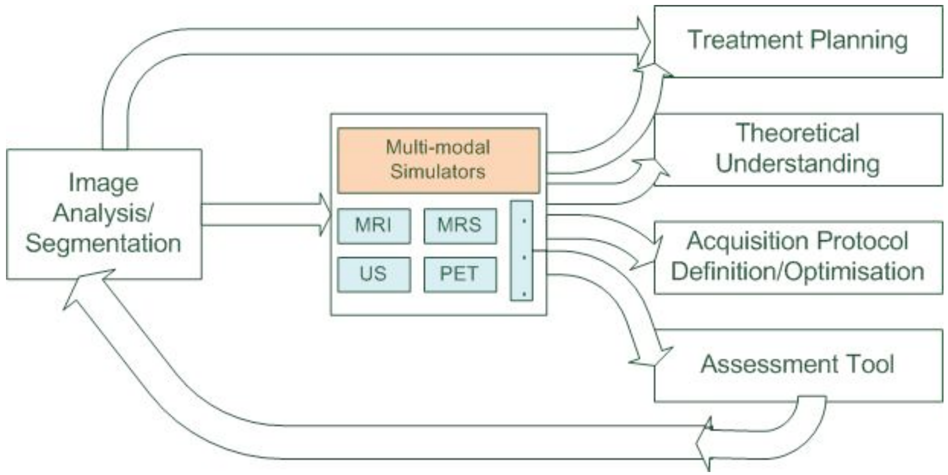
- Aim of the VRP
  - *To provide realistic multi-modal medical images with ‘ground-truth’ knowledge*



- It relies on
  - *Virtual models*
  - *Medical image simulators*
  - *Computer grids for data storage, computing power and sharing algorithms*

Overview of the VRP (II)

- VRP Usage



- VRP Requirements
  - *Simulators interoperability*
  - *Easy plug-in of new simulators*
  - *Making simulators accessible to everyone*

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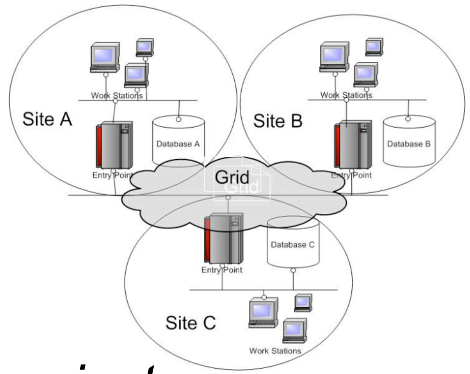
Why use grids behind the VRP?

- Two major advantages/reasons
  - *Collaborative platforms*
    - The possibility to share algorithms and data
  - *Computing power*
    - The possibility to run computing intensive simulations elsewhere than on the personal computer
    - Ex: 900 CPU hours for ‘ThIS’ (Therapeutic Irradiation Simulator)

Collaborative Platforms

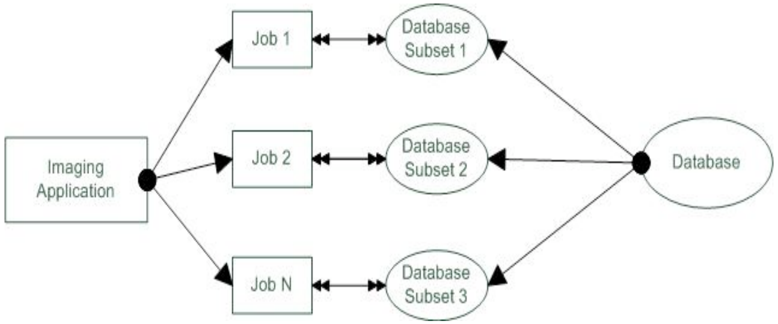
- MammoGrid Project [Amendolia2005]
  - *International mammogram database*
  - *Connected sites from Udine, Geneva, Cambridge and Oxford*
  - *AliEn (**Ali**ce **En**vironment) middleware*



- The MAGIC-5 Project [Bellotti2007]
  - *Dedicated AliEn Server*
  - *Images acquired in any site available to the project*
  - *Data stored on local resources and recorded on a common service (Data Catalogue), together with the related information (metadata).*

Intensive Computing and Parallelization

- Grid advantage: jobs can be executed in parallel
  - *Idea: split long simulations into parallel jobs*
    - Processing and/or database partitioning



- Scalability
  - *User scalability*
  - *Multi-modality simulation => VRP usage diversity*

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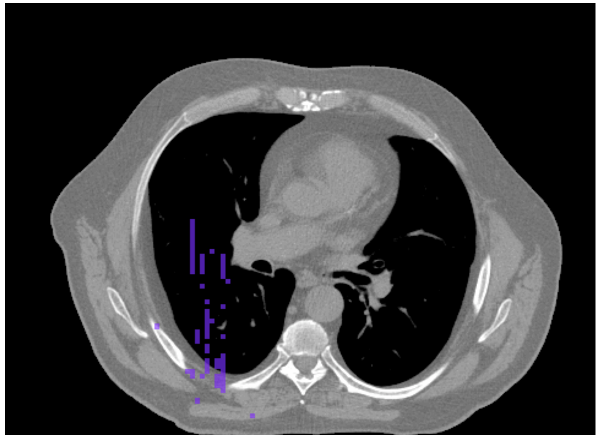
Experience Feedback on Application Porting

- Basic adaptability
  - *Successful execution*
- Intermediate adaptability
  - *Application parallelization*
- Advanced adaptability
  - *Advanced tools for*
    - *Parallel job submission, monitoring and retrieval*
    - *Middleware compatibility*
    - Integration into service platforms
- End-User adaptability
  - *High level interface*

Basic Adaptability

- Aim: successful application execution on the grid worker nodes
- Methods
  - *Distant grid node environment customization*
    - Limited access rights
    - Download input files, create folders, define environment variables…
  - *Application customization*
    - Shared libraries non existing on the node
      - Copy needed libraries with executable
      - Re-build dependencies and link statically



ThIS Application

- Results
  - *Obtained with the application 'ThIS' (Therapeutic Irradiation Simulator)*
  - *Static building and linking to the Geant4 and CLHEP libraries*
  - *Successful execution: 5% -> 80%*

Intermediate Adaptability

- Aim: parallelize the application
- Methods and examples
  - *MPI (Message Passing Interface)*
    - Transparent to the end user
    - The application can be executed on the personal computer, parallel machines, clusters, etc.
    - Needs to be taken into account at the application development phase
    - Example: Simri (IRM Simulator)
  - *Split the simulation into independent jobs (Monte Carlo simulations)*
    - Can be done with generic tools
    - Is flexible
    - Depends on the application
- Results
  - *'ThIS' -> Monte Carlo simulator -> ~50M particles split in 100 jobs*
  - *Global speed up difficult to estimate*
    - Problem: failures among the 100 jobs of a same simulation

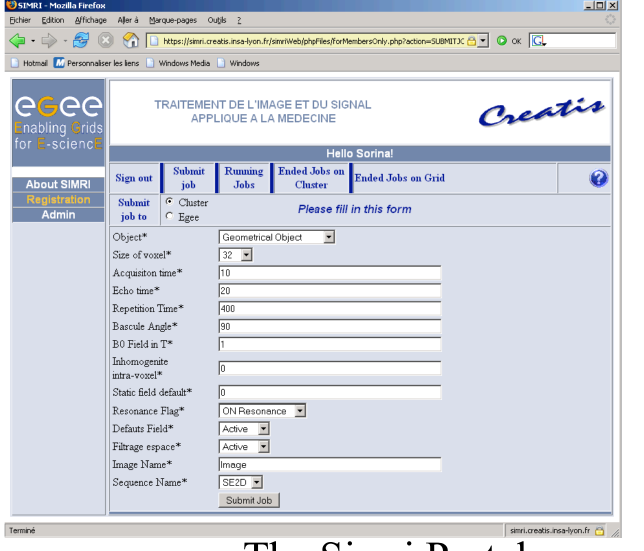
Advanced Adaptability

- Aim: automation of the submission and parallelization process
- Methods
  - *Grid middleware integrates basic tools*
    - Submission, result retrieval…
    - Example: the WMS (Workload Management System) in gLite
  - *More advanced tools exist*
    - Java Job Submission (JJS)
      - Optimized submission, but no splitting management
    - Ganga [Moscicki2004] and Diane [Maier2007]
      - Splitting oriented
  - *Wrappers for integration into a service platform*
    - GEMSS project [Gemss2005] mentions application descriptors
- Results
  - *'ThIS' executed on the grid with a new master-agent approach with Ganga & Diane*
  - *Global result at 100%*
    - At least 3 times faster

End-User Adaptability

- Aim: a high level interface for users with no grid knowledge

- Methods: graphical interfaces
  - *Web portals*
    - Generic portals: Genius, GridSphere
    - Home made solutions: the *Simri* portal [Bellet2006] for the *Simri* simulator
      – A 3 layer architecture portal developed in Java and PhP
    - Challenge: a more generic tool
      – A portal easily re-configurable for similar applications



The Simri Portal

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Conclusion

- VRP aim
  - *Facilitate the integration of medical simulators into the grid environment*
- Grids are VRP promising architectures
  - *Medical imaging simulations already running on the grid*
- Grid issues still exist
  - *Complex architectures*
    - Not straightforward to use => limits the type and number of users
- Perspectives
  - *VRP architecture definition including WebServices and generic workflow and dataflow models*

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Thank you for your attention!

Questions?