

Pharmacokinetics on Contrast Agents in Abdominal Cancer

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www.eu-egee.org

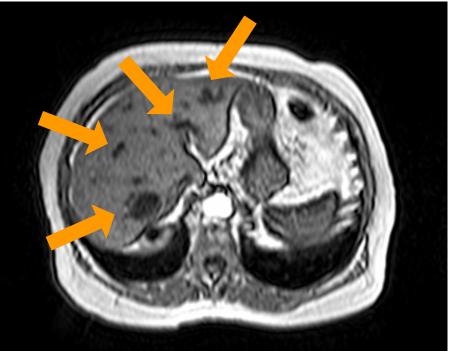
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- Short Introduction of the Problem and Motivation.
- Brief Details of the Application.
- Live Demo.
- Analysis of the Results and Performance.
- Questions and Answers.

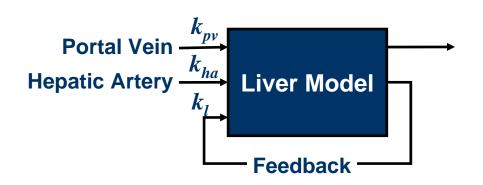
CGCC Analysing the Nature of Tumours Enabling Grids for E-sciencE

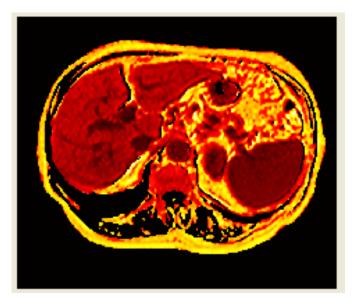
- A Lesion is Detected in an MRI Study of a Patient.
- Malignant and Benign Lesions have Similar Appearance in Medical Images and It is Difficult to Conclude with a Diagnosis with High Degree of Sensitively and Accuracy.
- The Final Analysis is the Biopsy.
- But Biopsy is Traumatic.
- This Delay in the Diagnosis Causes Patient Anxiety in Cases with Reasonable Uncertainity.



CGCC Alternative: Virtual Biopsy Enabling Grids for E-sciencE

- Characterization of the Tissular Nature by the Analysis of the Evolution of Contrast in a Time Series.
- Tumours Generate the Growing of Vessels Around the Tumoural Mass.
- Different Tissues Define Different Constants for Recycling and Flow Rate of the Physical Models.
- Those Constants can be used for the Creation of Parametric Images.





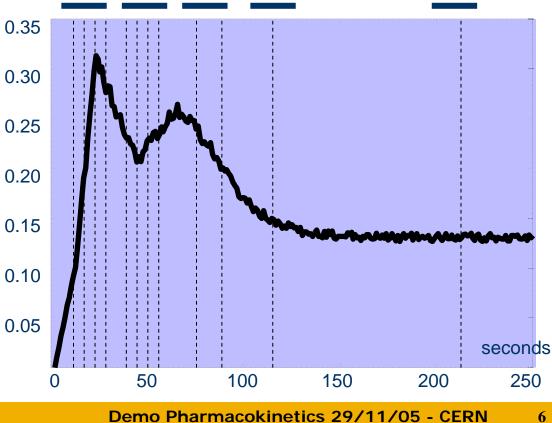
CGCC Long-Term Vision

- Pharmacokinetics in Contrast Evolution is a Hot Topic in Medical Research (845 Articles for Liver in PubMed).
- The Work is a Result of a Collaboration Among Four Research Groups (Radiologists, Chemical Engineering and Medical Informatics).
- The Problem is User-Driven with a High Interest by the Industry.
- The Objective is to
 - Validate the Theory of the Model.
 - Work in 3D.
 - Demonstrate the Relation of the Constants and the Tissular Nature.
 - Create a New Image Modality.
- The Model can be Used, with the Proper Tuning, to Other Areas where Vessel Growing is Significant (such as Infertility).

GGEC Pharmacokinetics: Problem

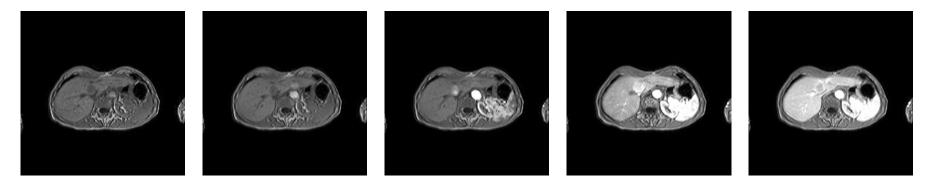
- Description
 - The Process Requires Obtaining a Sequence of MRI Volumetric Images.
 - Different Images are Obtained in Different Breath-holds.
 - The Movement of the Abdomen is Unavoidable and Relevant when Voxels have
 Sub-millimetrical
 0.35
 - Before Analyzing the Variation of each voxel, Images Must be Co-registered to Minimize Deformation due to Different Breath Holds.

Bright 0.05 (Concentration)

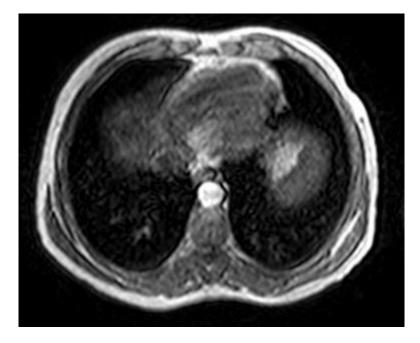


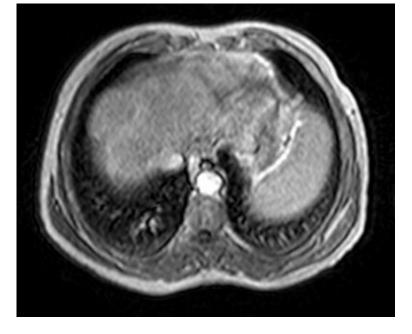
CGCC Pharmacokinetics: Problem II

- The Area of the Abdomen Requires the use of Deformable Registration Methods.
- Much More Computationally Intensive than Rigid Affine Registration.
- Moreover, Registration Must be Very Accurate to Reduce the Artefacts on the Interpolation, Leading to Test Different Parameters.
- The Total Computational Cost of a Clinical Trial of 20 Patients is Around 100 CPU Days.













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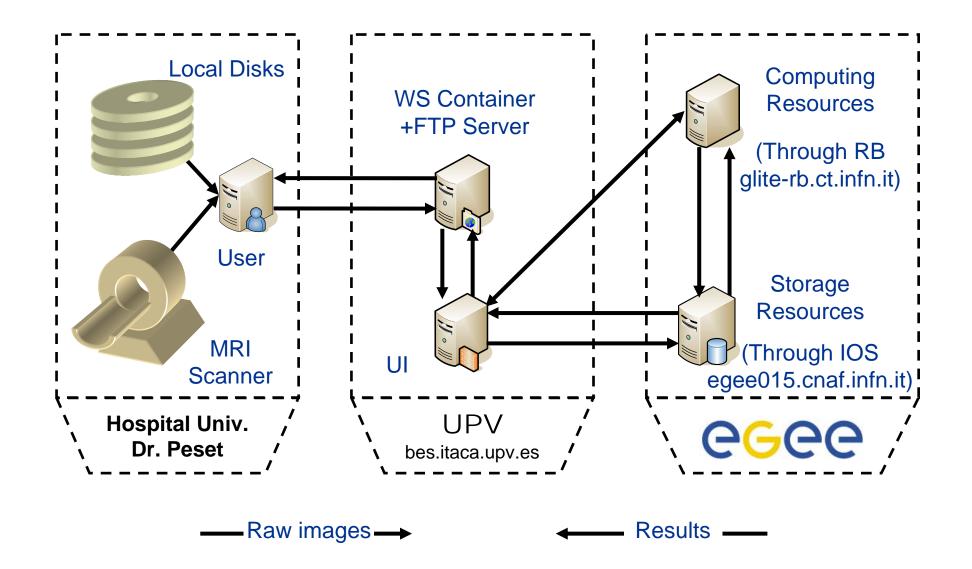
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CGCC Objectives of the Grid Application

- Performance
 - Use of the Grid to Provide the Computational Power.
 - >> Use a Large Grid Infrastructure
- Usability
 - Reduce the Complexity of Grids by Using a Friendly Interface.
 - Provide an Interface Open to its Integration in Other Applications.
 - >> Implement a Web-Services Based Portal.
- Security
 - Deal With the Risks of Using Remote Resources.
 - >> Anonymise and Access Control.
- Reliability
 - Production Capability.
 - >>Provide Intelligence on Selecting the Sites.



CGCC Application Structure



CGCC Application Tasks Enabling Grids for E-sciencE

- A Graphical User Interface has Been Created.
- The GUI Calls the Web Services to Implement
 - Creating the Proxy on the Grid.
 - Transferring the Data into the Grid Storage Area.
 - Select the Ranges of the Parameters to Test:
 - Maximum Step Length for the Gradient Descent Optimisator.
 - Maximum Number of Iterations for the Optimiser.
 - Initial Scaling Factor.
 - Initial Angle for Deformation.
 - Create the JDLs and Define the Arguments for the Scripts of Each Job
 - One Job per Registration and Per Combination of Parameters.
 - Monitoring of the Evolution of a Set of Jobs.
 - Downloading the Output of All the Jobs in a Group with a Single Click.

CGCC Evolution of the Application

- First Development of a Version on LCG
 - Good Performance and Large Scale.
 - Need for Improved Privacy on the Data.
 - Testing Lead to the Improvement of the Site Selection.
 - Final Version runs on LCG 2.4.0 2.6.0.
- Evolution to a Version on gLite
 - Shares the Same Interface and 90% of the Code.
 - Migration of Commands and Inclusion of Access Control.
 - Inclusion of Configuration Files.
 - Evolution from gLite 1.3 to gLite 1.4.







Demo Pharmacokinetics 29/11/05 - CERN 13

CALCED Step 1: Entering in the System

• Password for Accessing a Pre-loaded Certificate.

👙 gLite Registration Launcher	
Session	
LoginTab	
Please, Choose your user certificate Ignacio Blanquer Espert Password: Virtual Organisation:	
OK Cancel	

GGCC Step 2: Uploading Data

- Uploading Reference and Deformable Medical Studies in Analyze Format.
- Register the Files on the Grid and Stores the LFN for the Scripts Creating the Jobs.

CG Registration	Launch	ner						
Upload Data	Param	eters Profiles	Deform	able Reg	gistration	Out	put	_
				_				
Reference Ima	ige HDR	: 0210000001 ₋	red.hdr		D	elete		
		Upload Comp	lete					
Reference Ima	ige:	0210000001_	red.img		D	elete		
		Upload Comp	lata					
		opioau comp	iete					
Files to regist	er:							
Add		File /home/iblanqu	o (Pocio		Completed Completed			
		/home/iblangu					-	
Delete		/home/iblangu						
		/home/iblangu					1000	
		/home/iblanqu						
		/home/iblangu					-	
							•	

GGCC Step 3: Creating the Jobs

- Both the JDL Files and the Necessary Scripts to Copy Locally the Input Data and Start the Co-registration.
 K LCG Registration Launcher
 Upload Data Parameters Profiles Deformable Registration Output Deformable registration narameters:
- Create All the Instances Necessary for the Combination of Parameters.
- The Executable File is Easily Upgradeable to Test Different Methods.

LCG Registration Launcher								
Upload Data	Param	eters Profiles	Deformable Reg	istration Output				
Deformable registration parameters:								
Optimizator dependant. Check the ones you need.								
Format: InitialValue:Increment:FinalValue								
	P1:	0.05 : 1	: 0.05	🗹 Enabled				
	P2:	1.5 : 1	: 1.5	🗹 Enabled				
	P3:	1.5 : 1	: 1.5	🗹 Enabled				
	P4:	20 : 1	: 20	🗹 Enabled				
	P5:			🗌 Enabled				
	P6:		:	Enabled				
				Submit				
Last submitted job:								

CGCC Step 4: Submitting and Monitoring

- Submit all the JDLs Instances Through the RB and Monitoring the Jobs.
- Use a High-Level Name Identifier for the Jobs of a Group.

pload Data 🕺 Paramet	ers Profiles	Deformat	ole Registration	Output
ob Group (Execution)	Click to refresh			e state
Alias	Da		ID	
prueba_otra (Deforma			/home/registracio	
Pisa-pre demo (Defor				
test-santiago2 (Defor			/home/registracio	
test-pisa (Deformable)	Thu Oct 13 1	.8:21:04	/home/registracio	n/w
 Bibbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb				
	Get Grou		Cancel Gro	
Sub jobs:	Get Grot	up Ou	Canter Gri	Jup
LCG Job ID	Param	eters	Job Status	
	Param fn:0000021			
https://egee-rb-01.c				
https://egee-rb-01.c Error		1000000	Aborted Not submitted	
https://egee-rb-01.c Error https://egee-rb-01.c	lfn:0000002	1000000 1000000	Aborted Not submitted	
https://egee-rb-01.c Error	lfn:0000002	1000000 1000000	Aborted Not submitted Running	
https://egee-rb-01.c Error https://egee-rb-01.c	lfn:0000002	1000000 1000000 1000000	Aborted Not submitted Running	

CALCED Step 5: Retrieving the Output

• Retrieve the Output Files from a Group of Jobs.

×	LCG Registration I	Launcher				
	Upload Data	Paramete	ers Profiles	Deformat	le Registration	Output
					ine negistration	output
	Job Group (Exe	cution)		c	lick to refresh th	e state
	Alias	oformo	Da Wed Oct 05		ID /home/registracio	in hu
	Pisa-pre demo				/home/registracio	
	test-sar 🗶 Save	e				
	test-pis		ciente3			
	Save I	in: Pa	Liences		▼ 4	
	no 🗖					
	Sub job	utput				
	https://	X Please	e wait			
	Error					
	https://c https://c	Plea	ase wait: G	etting resu	ilts	
	int(ps.//					
	File			_		
	File					
					D5	
					Save	Cancel
	Get Outpu	at	view r		Cancer	



Before Co-registration

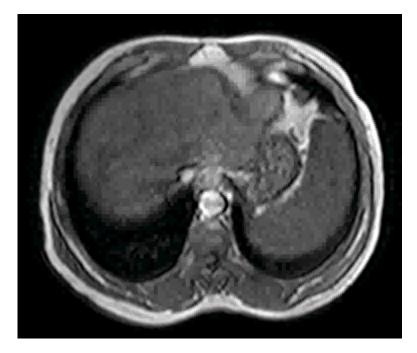


After Co-registration

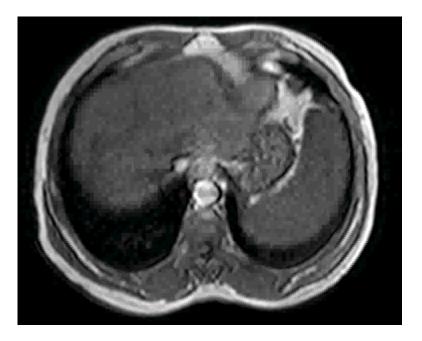




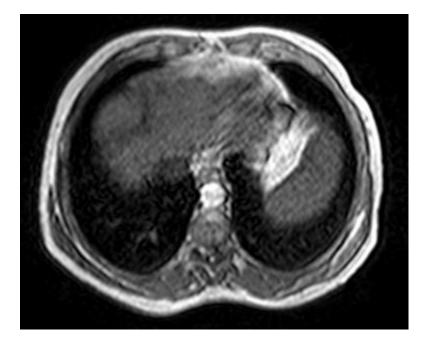
Before Co-registration

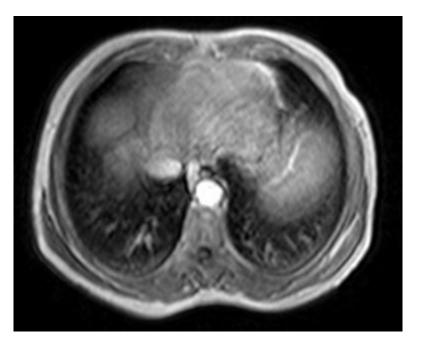


After Co-registration







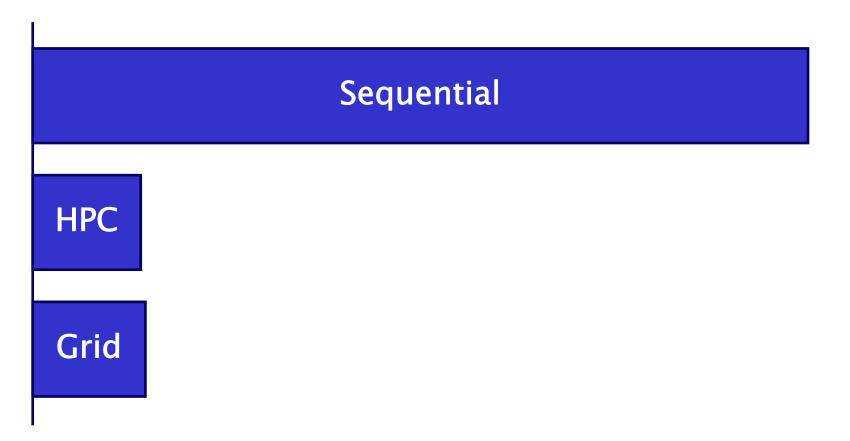






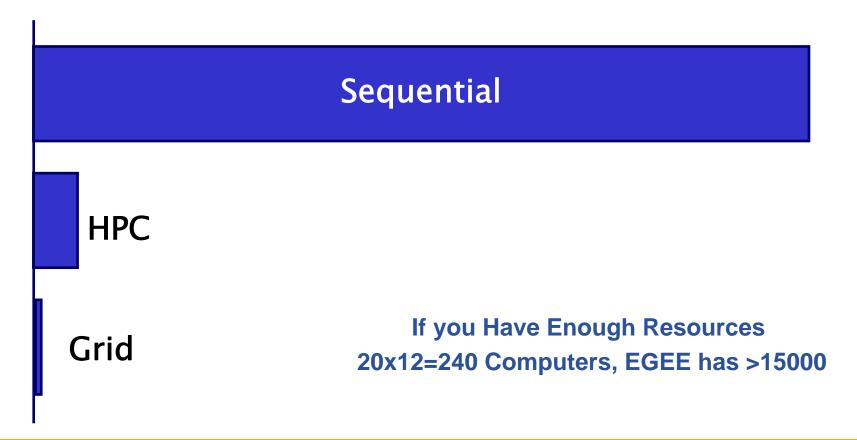
CALCED Results: Performance Enabling Grids for E-sciencE

- Cost of One Patient: 61h 08m.
- Cost Using a 20-Procs Computing Farm: 2h 30m.
- Computational Cost Using the Grid: 3h 10m.



CGCC Results: Performance Enabling Grids for E-sciencE

- Cost of 20 Patients: 2331h 22m.
- Cost Using a 20-Procs Computing Farm: 132h 50m.
- Computational Cost Using the Grid: 17h 35m.





- Need for the Grid
 - The Computing Requirements for a Reduced Clinical Trial of 20 Patients Exceeds the Conventional Computational Capabilities of Either a Hospital or a Research Team.
 - The Need for Computing is Not Flat and Only After the Trials.

Added Value of EGEE

- Need for a Production Platform 24x7 (Users).
- Outstanding Improvement in the State-of-the-art Knowledge on Grid Technologies (Developers).

Added Value of gLite

- Need for Access Control in Data and MetaData.
- Rich MetaData Management.
- Batch-Oriented Jobs.
- Easy to Use Interface: No Need for Grid Knowledge.
- Usable From Any Computer Through a Web Service.