From neurological research to clinical praxis: a European e-Service to support the early diagnosis of neurodegeneration

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DECIDE at a glance

- Submitted to EC Call: FP7-INFRASTRUCTURES-2010-2 – Virtual Research Communities
- Started on the 1st September 2010
- Duration: 24 Months
- Requested EC contribution: ~2.4 M€
- GARR provides overall coordination
- COMETA does the technical coordination
- The DECIDE Scientific Coordinator is the neuGRID Principal Investigator
- Involves 13 European Partners + a European network of major reference centres in Neurology, and patient advocate societies all across Europe
- All stakeholders involved, from the network layer to end-users
DECIDE Partners

A vertical approach to e-Health, targeting the needs of neuroscientists community through the provisioning of an e-Infrastructure aimed at supporting them in the daily execution of the diagnosis.

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The DECIDE project goals

- To provide the Neuroscientific and Medical community with a dedicated e-Infrastructure
  - relying on GEANT, EGI and NeuGrid
- To deploy a secure and user-friendly service for the early diagnosis and research on dementia and other brain diseases
  - linking large distributed DBs of multi-modal neuro-images
- To validate the e-Infrastructure and the services
  - with real patients in day-by-day clinical practice
- To propose a long-term vision for the sustainability of the infrastructure of the project
  - and its extension to new communities and pathologies
- To disseminate the results and provide training programmes
  - promoting the adoption of the DECIDE infrastructure and services.
## DECIDE Workplan

| Networking Activities | Overall coordination of the project (NA1)  
|                      | Creation stable liaisons with relevant stakeholders in the scientific and e-Infrastructure domains (NA2)  
|                      | Dissemination of results and reaching out to the medical community, (NA3)  
| Service Activities   | Network and GRID provisioning and management (SA1)  
|                      | Exposing the medical database to the applications running on the e-Infrastructure (SA2)  
| Joint Research Activities | Porting of the diagnostic algorithms (JRA1)  
|                        | Design of the diagnostic service (JRA2)  
|                        | User validation and Testing (JRA3)  

Strategic actions

- Widening the access to highly specialized tools and techniques
  - CIVET/ADABoost – RMI images
  - GridSPM – PET/SPECT images
  - EEG patterns

- Building a European reference e-Service
  - Including its own e-Infrastructure
    - Progressive uptake of the e-Science paradigm in the domain of neurology

- Providing the European Virtual Research Community with powerful diagnostic tools
  - Currently available only to a restricted number of clinicians.
DECIDE layered structure

SA1 - Installation and maintenance of the enabling network and grid infrastructure
SA2 - Exposure of and access to the reference databases

JRA1 - Porting of the diagnostic algorithms
JRA2 - Design of the Diagnostic Service
JRA3 - User Validation and Testing

GLOBAL Internet
Network infrastructure

GÉANT

MRI
PET/SPECT
EEG

APPS layer
Grid infrastructure
DECIDE reference pillars

- Designed with NeuGRID as a reference infrastructure both for middleware and structure;
- MRI-based algorithms developed within NeuGRID will be endorsed by DECIDE:
- OutGRID will act as the external gateway to liaise to other international infrastructures (e.g. LONI and CBRAIN):
  - Both OutGRID and NeuGRID will also provide their outcomes w.r.t. data access policies, user requirements and standards;
  - Osmosis of results among projects will be eased by their expected time scales;

- GridSPM algorithm, PET/SPECT based, is already deployed as diagnostic pilot at national scale.
DECIDE Applications

- **GridSPM**: specifically designed for SPECT and PET neurological clinical images provides an SPM analysis for the early diagnosis of Alzheimer Disease;

- **GridANN4ND**: concerns the analysis of PET biomarkers in Neurological and Psychiatric Disorders and provides a classification of suspected patients through an Artificial Neural Network;

- **GridMRISeg**: implements an automatic algorithm for the subcortical segmentation of MRI brain images for hippocampal volume estimation, using the auto context model (ACMAAdaboost) developed by LONI;

- **GridEEG**: implements EEG processing algorithms with the aim of detecting early symptoms of Alzheimer Disease and distinguishing different forms of degenerative impairment.
DECIDE service architecture
Service actors

- Liferay
  - Enterprise. Open Source. For Life.
- gLite JAVA API
- WS
- enigmframe
- JAVA API
- Robot server
- GRID
Neurologist

- Neurologist can upload images on the Grid and ask an Expert to run the analysis with the specified parameters;
- In order to do this, file uploaded will be shared with Expert user in charge for the analysis;
- Once the analysis is completed the Neurologist can download the results.
Neurologist workflow
Neurologist workflow cont.

1. Gender
2. Age
3. Server with Robot
4. SE
Expert

- He/she is able to run the analysis using that data previously uploaded by the neurologist;
- He/she can also upload his/her own data;
- Once the execution will be completed, he/she notifies the neurologist.
Training activities

- **Training for application developers and diagnostic algorithm experts**, where trainees will work in close collaboration with Grid tutors and learn how to interface their applications and algorithms with the services and run them on DECIDE infrastructure. These kinds of training will help speeding up the process of application porting.

- **Training for end-users**, that will provide a comprehensive introduction to the DECIDE infrastructure and service and a stepwise tutorial for their exploitation.

- **Training for Expert Qualification**, that will provide advanced courses for specialists able to use the DECIDE Gridified software and data to extract neuroimaging markers. At the end of the course, the candidates will submit to a final examination to testify they can correctly use the DECIDE Diagnostic service.
Network Level collaboration with GEANT and the European NRENs
  - Community requirements

European Grid Initiative (EGI) infrastructure and European Middleware Initiative (EMI)
  - Standards

US-ADNI (US Alzheimer’s Disease Neuroimaging Iniziative) and NEST-DD (Network for Efficiency and Standardization of Dementia Diagnosis)
  - Medical Data Collection compliance with common standards

EADC, neuGRID, LONI, Brain Tuning, CBRAIN, outGRID, NEST-DD and ADDNEUROMED projects
  - Further add other diagnostic algorithms
NeuGRID, CBRAIN, LONI and OutGRID
- North American/European standards
- Legal/ethical issues
- Discovery/validation of neuroimaging markers

PHARMACOG (the largest European project on the study of Alzheimer's disease)
- State-of-art studies on neuroimaging AD markers
- Huge neuroimaging database
Expected DECIDE exploitation

DECIDE AUP approval/authorization procedure

Ethical & legal, business model & extension

Scientific international Collaboration

Medical Data Collection

Harmonization with EGI-EMI standards

GÉANT collaboration & support

DATA & EXPERTISE

Experts in Medical Physics, Mathematicians, Neurologists, etc.

neuGRID, LONI, CBRAIN, outGRID, EADC, PHARMACOG

US-ADNI, NEST-DD MEDICAL PHARMACOG DATA COLLECTION

EGI AND EMI STANDARDS AND COMMUNITY REQUIREMENTS

GEANT & NRENs = EUROPEAN PLATFORM FOR RESEARCH

Algorithms, database, Grid repository, users

Data collections

Infrastructure and middleware standards

Network access

Expected DECIDE exploitation

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Thank you for your kind attention!

For further information please contact

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(DECIDE project coordinator)

and/or visit

www.eu-decide.eu