

# CAJAL BLUE BRAIN PROJECT

Volume 3, issue 6. December 2011

## 'Alzheimer 3n'

### A CBBP, UPM, CSIC & REINA SOFÍA FOUNDATION INITIATIVE

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#### Special points of interest:

- Alzheimer 3n Proposal
- CBB Main Contribution Contributions
- Technical Training at the CeSViMa

#### "THREE PILLARS THAT SUPPORT THE STUDY OF ALZHEIMER'S DISEASE"

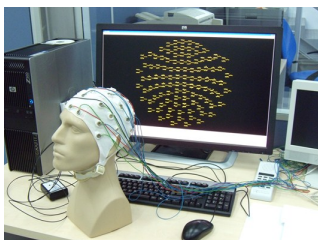
The **Alzheimer - 3n** project aims to adopt an integrated approach to study the disease. Thus, it is necessary to involve the infrastructure, and the technical and human resources, of the **Cajal Blue Brain project**, in conjunction with the Alzheimer's Centre of the Reina Sofia Foundation and the Severo Ochoa Centre for Molecular Biology CSIC-UAM, supported by other institutions, both public and private entities.

The term  $3\pi$  ( $3\pi$ ) refers to the three pillars that will support the research: **Circuits** (gene, molecule, structure, synapses, function), **Computation** (database, data analysis, optimization, visualization, simulation) and **Cognition** (functional neuroimaging, EEG, MEG, neurology, psychiatry, psychology). We expect that the organization of this project will serve as a model for international research into this disease and that our initiative will be adopted in other countries in order to increase the impact of global research to fight this condition.

The very foundation of the project lays on the provision of available clinical data together with related experimental data. It is therefore necessary to establish a means to gather data automatically, efficiently and in a well-organized manner at the following two levels:

- Clinical data from the patients and from the medical tests performed on them, including drug treatments, therapies and also the monitoring of their evolution.
- Data from brain tissue samples, ranging from biomolecular and genetic information to neuroanatomical data..





## 'Alzheimer 3π' Advanced Equipment and Technology

### VIRTUAL REALITY

The UPM has a virtual reality cave that is shared between the Centre for Integrated Home Automation (CeDInt) and the Centre for Supercomputing and Visualization in Madrid (CeSViMa). This facility was developed in collaboration with T-Systems and it consists of a 5-wall immersive three-dimensional projection system, unique in Southern Europe.

This infrastructure is a valuable resource to develop fully-monitored virtual environments in which psychological tests can be performed on patients at early stages of the disease.

### MICROSCOPY

The Cajal Blue Brain project is equipped with the most advanced optical and electron microscopes to study brain

tissue. The Cross Beam NEON 40 EsB Zeiss microscope is an advanced dual-beam microscope that was first used by members of this project to study the brain in 2010.

### MEG

The Biomedical Technology Centre (CTB) has one of the two magnetoencephalography units available in Spain. This equipment allows us to capture the magnetic field emitted by the brain as a result of the current flow generated by neurons. It is a non-invasive and repeatable technique that can be performed on the same subject in whom neural activity is measured directly.

### MAGNETIC RESONANCE

The Alzheimer's Centre of the CIEN Foundation has a 3.0 Tesla MRI apparatus to obtain a variety of images in vivo, such as conventional and diffusion ten-

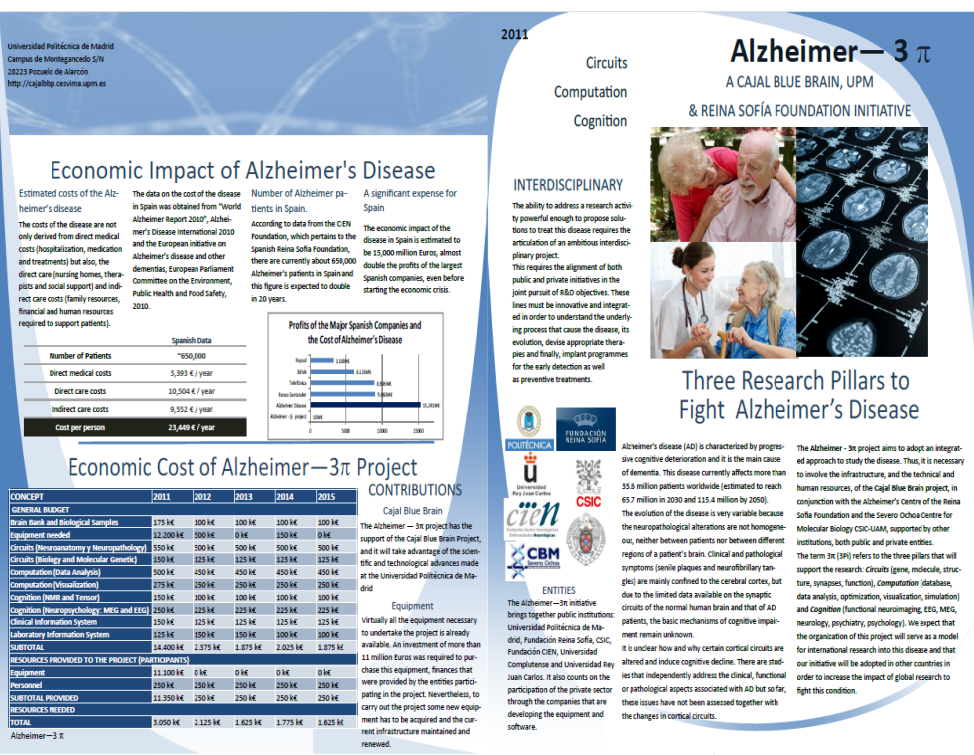
sor magnetic resonance images (MRI) to analyse fibre tracts.

### EEG

The Electroencephalography (EEG) equipment, available at the CTB of the UPM, enables us to carry out this functional technique to record electrical brain activity. This technique is non-invasive and relatively easy to perform. The project proposes designing virtual scenarios in the immersive environment of the virtual reality cave and to collect the brain activity of subjects with mild cognitive impairment.

### SUPERCOMPUTING

The UPM has the second most powerful computer in Spain, the Magerit system at the CeSViMa. It has more than 3000 IBM Power processors for storage, analysis and simulation.



## Cajal Blue Brain 2011 Main Contributions

### JOURNAL PAPERS

Elston G, Benavides-Piccione R, Elston A, Manger P and Defelipe J (2011). Pyramidal cells in prefrontal cortex: comparative observations reveal unparalleled specializations in neuronal structure among primate species.. *Front. Neuroanat.* 5:2. doi: 10.3389/fnana.2011.00002

López, PL, Bielza C, Larrañaga P, Benavides-Piccione R, DeFelipe J (2011) Models and simulation of 3D neuronal dendritic trees using Bayesian networks. *Neuroinformatics* (in press).

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Morales J, Alonso-Nanclares L, Rodríguez J-R, DeFelipe J, Rodríguez Á and Merchán-Pérez Á (2011) ESPINA: a tool for the automated segmentation and counting of synapses in large stacks of electron microscopy images. *Front. Neuroanat.* 5:18. doi: 10.3389/fnana.2011.00018

D. Vidaurre, C. Bielza, P. Larrañaga (2011). On nonlinearity in neural encoding models applied to the primary visual cortex. *Network: Computation in Neural Systems*, 22 (1-4), 97-125.

R. Armañanzas, P. Larrañaga, C. Bielza (2011). Ensemble transcript interaction networks: A case study on Alzheimer's disease. *Computer Methods and Programs in Biomedicine*. In Press.

D. A. Morales, Y. Vives-Gilabert, B. Gómez-Ansón, E. Bengoetxea, P. Larrañaga, C. Bielza, J. Pagonabarraga, J. Kulisevsky, I. Corcuera-Solano, M. Delfino. (2011). Predicting dementia development in Parkinson's disease using Bayesian network classifiers. *Psychiatry Research: Neuroimaging*. Under review with answers for reviewers.

A. Gracia, S. Gonzalez, V. Robles, A. Sanchez and M. Rubio (2011). MedVir: Representation of multidimensional medical data with Virtual Reality, *BMC Bioinformatics*. In progress

LaTorre, A., Muelas, S., Peña, J. M., Merchán-Pérez, A., & Rodriguez, J. R. (2012). A robust approach for the detection of synaptic vesicles. *Journal article*. In progress.

### CONFERENCES CONTRIBUTIONS

A. LaTorre, Muelas, S., Peña, J. M., Santana, R., Merchán-Pérez, A., & Rodriguez, J. R. (2011). A differential evolution algorithm for the detection of synaptic vesicles. In 2011 IEEE Congress on Evolutionary Computation, CEC 2011 (pp. 1687–1694).

D. Morales, C. Bielza, and P. Larrañaga (2011). Spatial clustering analysis of functional magnetic resonance imaging data. *Conference on Mathematics of Medical Imaging*

R. Santana, C. Bielza, P. Larrañaga (2011). An ensemble of classifiers approach with multiple sources of information. *International Conference on Artificial Neural Networks (ICANN-2011)*.

J. Morales, A. Rodríguez, J. R. Rodríguez, J. de Felipe y A. Merchán-Pérez. "Characterizing and extracting the synaptic apposition surface for the analysis of synaptic geometry" 5th Workshop on Data Mining in Functional Genomics and Proteomics: current trends and future directions, J. M. Peña y F. Famili (Eds.), pp. 63-72 Atenas, Grecia. Sep., 2011

J. Morales, J. G. Peña, J. Fernández y A. Rodríguez. "Towards a scalable ESPINA for neuroscience data analysis" ASME 2011 World Conference on Innovative Virtual Reality, WINVR/2011", Accepted, in press (10 pp.). Milán, Italia Jun., 2011





## CONTACT DETAILS

**CeSViMa**  
**Edificio CeDInt-CeSViMa**  
**Parque Científico UPM**  
**Campus de Montegancedo s/n**  
**28223 Pozuelo de Alarcón**  
**Madrid. Spain.**

E-mail: [info@cajalbbp.com](mailto:info@cajalbbp.com)



## CeSViMa

The Cajal Blue Brain Project is hosted by the Universidad Politécnica de Madrid (UPM) in the Scientific and Technological Park of Montegancedo Campus. Computational needs and support infrastructure required by CajalBBP are provided by two of the Research Centers of the Park, the Centro de Tecnología Biomédica (CTB) and the Centro de Supercomputación y Visualización de Madrid, CeSViMa, which is focused on the massive storage of information, high-performance computing and advanced interactive visualization.



**More information: [www.cesvima.upm.es](http://www.cesvima.upm.es)**

## TRAINING ACTIVITIES:

### Visualization and Real Virtuality

The RES (Spanish Supercomputing Network) coordinated by BSC and CeSViMa in cooperation with the University of Zaragoza will organize the technical training titled **Virtualization and Real Virtuality**.

### Objectives:

Researchers and companies can access to the RES resources and develop their research. A good way of showing the results in order to let the experts improve their knowledge and experience and to make it more understandable for the general public will be the Virtualization and Real Virtuality construction of models showing their outcome.

This seminar will be a workshop in which the different node technicians will learn the operation of a Virtualization and Real Virtuality (V&RV) device recently available to the RES community.

The attendance could also be useful to researchers because they will learn about the V&RV device and they will be able to consider the usefulness and applications of the simulations that can be developed.

### Target group:

The seminar is specialized and is aimed at all the RES nodes technical teams but any of the current RES users or potential users will be more than welcome.

### Date:

Wednesday, 14 December, 2011 (All day) to Thursday, 15 December, 2011 (All day)

### Venue:

CeSViMa – Parque Tecnológico de la UPM  
Campus de Montegancedo  
28223, Pozuelo de Alarcón, Madrid.

## Sponsorship

