# The neuroscience social network project

Jordi Puig, Andrew Perkis
Norwegian University of Science and Technology
jordi@iet.ntnu.no

Philippe Pinel, Alvaro Cassinelli, Masatoshi Ishikawa
The University of Tokyo, Tokyo, Japan
philipinel@gmail.com

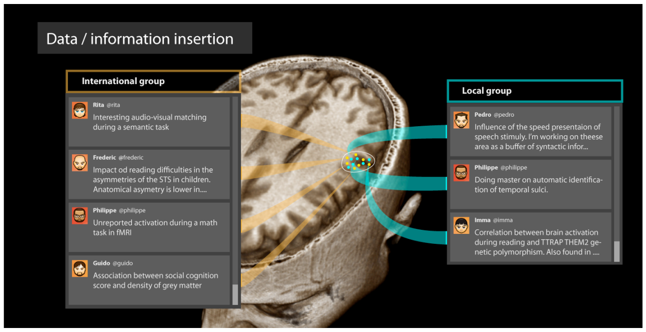


**Figure 1.** *Current discussion on a 3D brain area.*

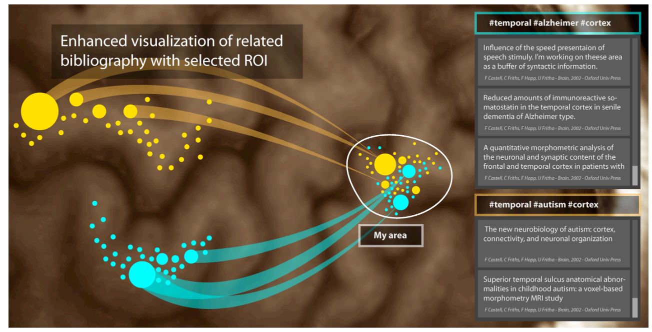


**Figure 2.** *Displaying spatially mapped literature on a region.*

## 1. Introduction

Recent advances in neuroimaging over the last 15 years leaded to an explosion of knowledge in neuroscience and to the emergence of international projects and consortiums. Integration of existing knowledge as well as efficient communication between scientists are now challenging issues into the understanding of such a complex subject [Yarkoni et al., 2010]. Several Internet based tools are now available to provide databases and meta-analysis of published results (Neurosynth, Braimap, NIF, SumsDB, OpenfMRI...). These projects are aimed to provide access to activation maps and/or peak coordinates associated to semantic descriptors (cerebral mechanism, cognitive tasks, experimental stimuli…). However, these interfaces suffer from a lack of interactivity and do not allow real-time exchange of data and knowledge between authors. Moreover, classical modes of scientific communication (articles, meetings, lectures...) do not allow to create an active and updated view of the field for members of a specific community (large scientific structure, international work group...). In this view, we propose here to develop an interface designed to provide a direct mapping between neuroscientific knowledge and 3D brain anatomical space.

## 2. Exposition

The scope of this project has two main research directions. In one hand, we explore visualization techniques to display large datasets and real-time communications. On the other hand, we develop Augmented Reality (AR) and Embodied Interfaces (EI) to place virtual data in the physical space.

The spatial localization of notes and comments stored by researchers in the brain space is crucial for the project. Users are able to locate their findings and to discover, in real-time, other researchers' notes within common areas of interest (see Fig.1). At the same time the application generates semantic gradients on different anatomical areas, organized, for instance, by topic, chronology, related bibliography and others relevant association (see Fig.2).

The application is an extension of previous work [Cassinelli and Ishikawa 2009] [Puig 2013] and it is planned to be used in different platforms. Mobile devices and tablets allow fast and easy data insertion on a daily basis. Furthermore, the application is displayed in AR and TI to enhance face to face discussions between researchers. In that situation, the presentation technique will be e.g. a projection mapping on a 3d printed anatomy of the brain, a tracked surface or a immersive environment projected on a CAVE like room. This versatility is achieved by defining a modular software separating the core functionality from the presentation system.

The software is developed in C++, using Open Source the libraries Openframeworks (OF), Visualization Toolkit (VTK) and the Insight Segmentation and Registration Toolkit (ITK). The code will be released to the public to promote collaboration from the scientific community.

## 3. Features

- The 3D volume is composed of 1x1x1mm voxel. Coordinates (x, y, z) correspond to the Montreal Neurological Institute (MNI) template.
- Researchers' notes are associated with 3D coordinates or brain areas.
- Researcher's areas are normalized to the MNI space and can be uploaded in Analyze format.
- Anatomical queries can use pre-existing anatomical parcellation of the Human brain (Brodmann areas, Automated Anatomical Labeling atlase…) or arbitrary group of voxels.
- Ontology of brain areas is automatically updated by applying inclusion rule onto voxels.
- Possibility to retrieve Pubmed citations with direct links.

## References

YARKONI T., POLDRACK RA., VAN ESSEN DC., WAGER TD. 2010. Cognitive neuroscience 2.0: building a cumulative science of human brain function. *Trends Cogn Sci*.;14(11):489-96.

CASSINELLI, A. AND ISHIKAWA M. 2009 Volume Slicing Display. (*SIGGRAPH ASIA Emerging Technologies)* p.88.

PUIG J., A-me:Augmented memories 2013. *Exhibition at SRTP*. Eindhoven, The Netherlands.