

CENTRE FOR
MOLECULAR BIOLOGY
AND NEUROSCIENCE

Neuroinformatics database for visualization and analysis of anatomical data from the rat brain

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1. INTRODUCTION

The management of data collected from serial sections through the brain represents a considerable challenge in many neuroscience projects. We present a novel system for storing, querying and manipulating section-derived data.

The system is prepared for storage of point- and line-coded 3-D data, image data, and associated metadata. Data are co-registered to a common spatial framework, based on local coordinate systems.

An example implementation is the database application *Functional Anatomy of the Cerebro-Cerebellar System in rat* (FACCS). This application holds axonal tracing data from the rat cerebro-cerebellar system, but is extensible to other circuits and other categories of image data.

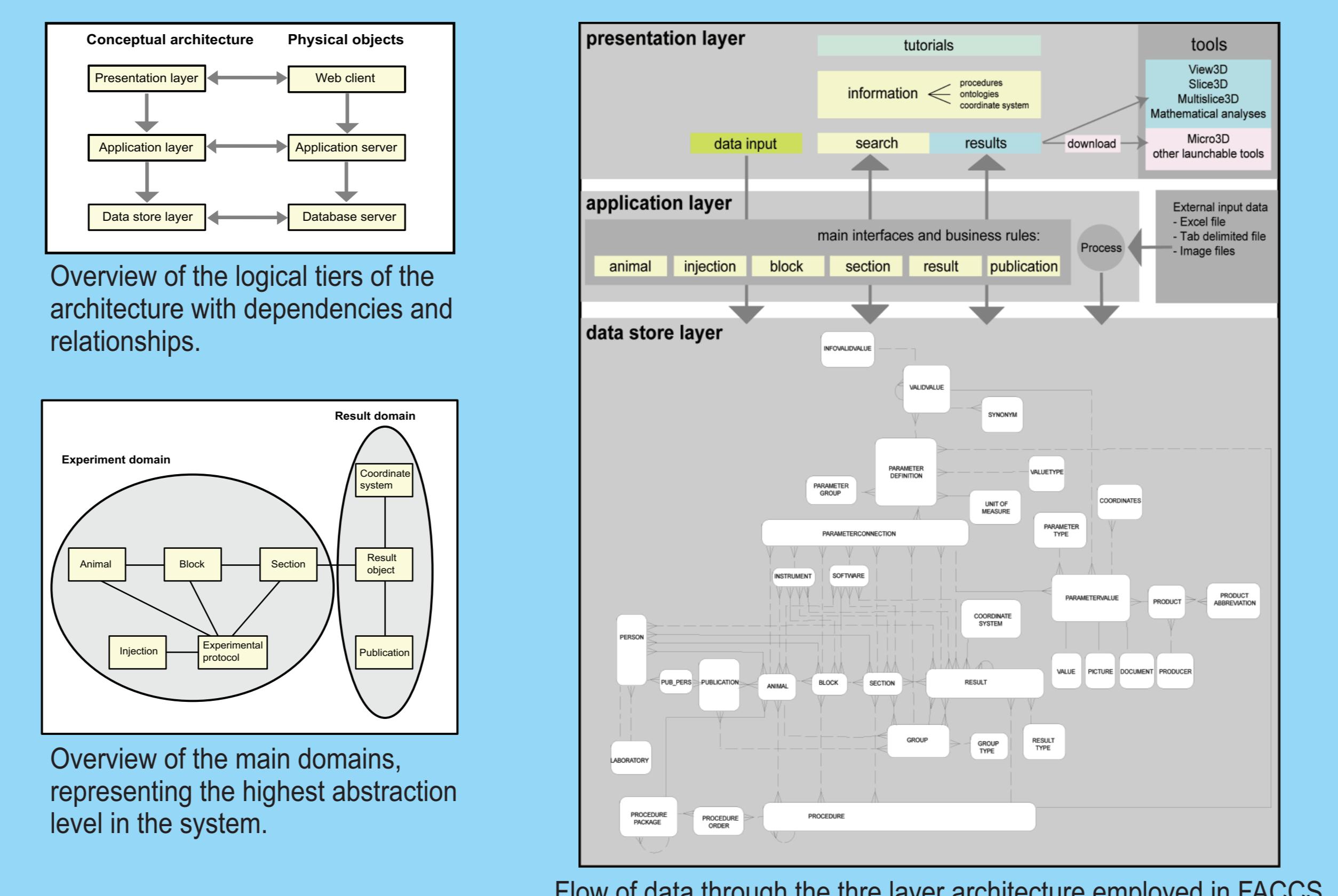
2. DESIGN

The database is built on a three-tier paradigm, providing a web-based interface. An Oracle relational database management system provides a framework for storage and complex querying. A suite of embedded tools (applets) allow users to query, visualize and perform analysis operations.

3. TECHNOLOGIES

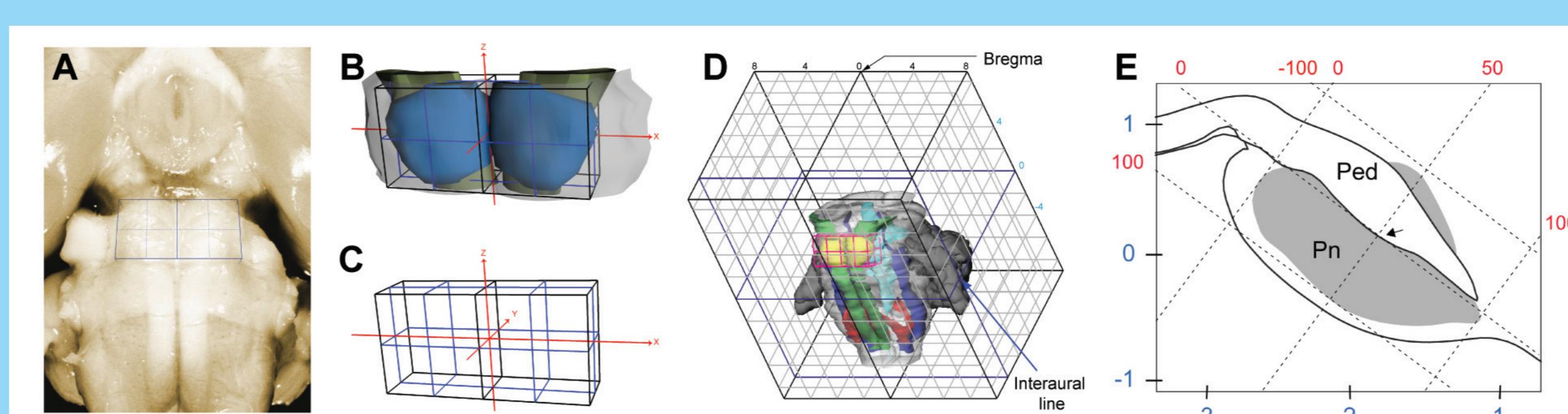
- Oracle Designer database / application design
- Oracle Jdeveloper - integrated development environment
- Oracle 9iAS - applicationserver
- Oracle 9i database
- Database 9i (misc.tools)
- Oracle development framework - BC4J
- Sun's J2EE - Infrastructure
- Log4 logging framework
- MVC Model for structured handling of presentation layers
- Cactus/Junit Automated test-framework

4. DATABASE ARCHITECTURE

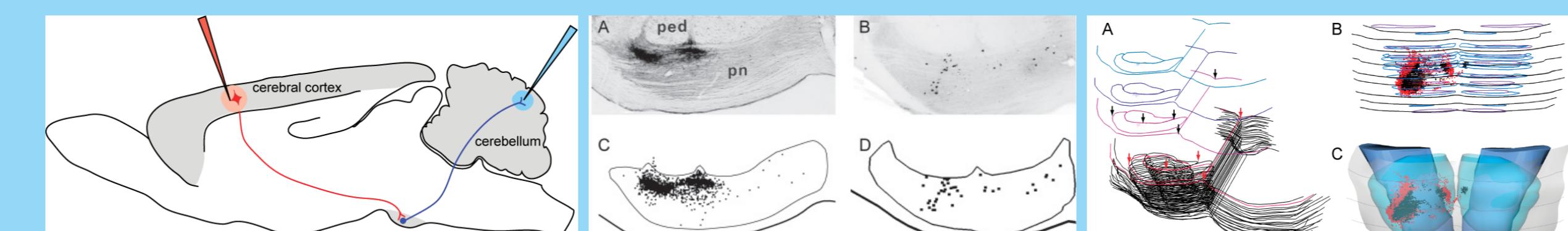


The Oracle relation database management system provides the ability to store a variety of objects, and provides the framework for complex querying of data. The suite of tools is intimately tied into the application infrastructure, allowing the user to not only query and visualize the data, but also to perform analyses.

5. LOCAL AND GLOBAL RAT BRAIN COORDINATE SYSTEMS



Conceptual overview of local (pontine nuclei) coordinate system (A-C) in relation to a standard global (skull based) coordinate system for the rat brain (D, Paxinos and Watson, 2005). The diagram in E defines the translation between the local and global coordinate systems. The local coordinate system is applied using histological critiera. Data are co-registered to a common spatial framework using affine transformation procedures.



Experimental procedures: (Left) Axonal tracers are injected in the cerebral cortex and / or cerebellar cortex and give rise to labeled fibers and cells in the pontine nuclei. (Middle) The labeling is visualized in sections through the pontine nuclei, and coded as points, together with lines representing various landmarks. (Right) The digitized sections are aligned and assembled into a 3-D reconstruction. The local pontine coordinate system is applied, and the data submitted to FACCS

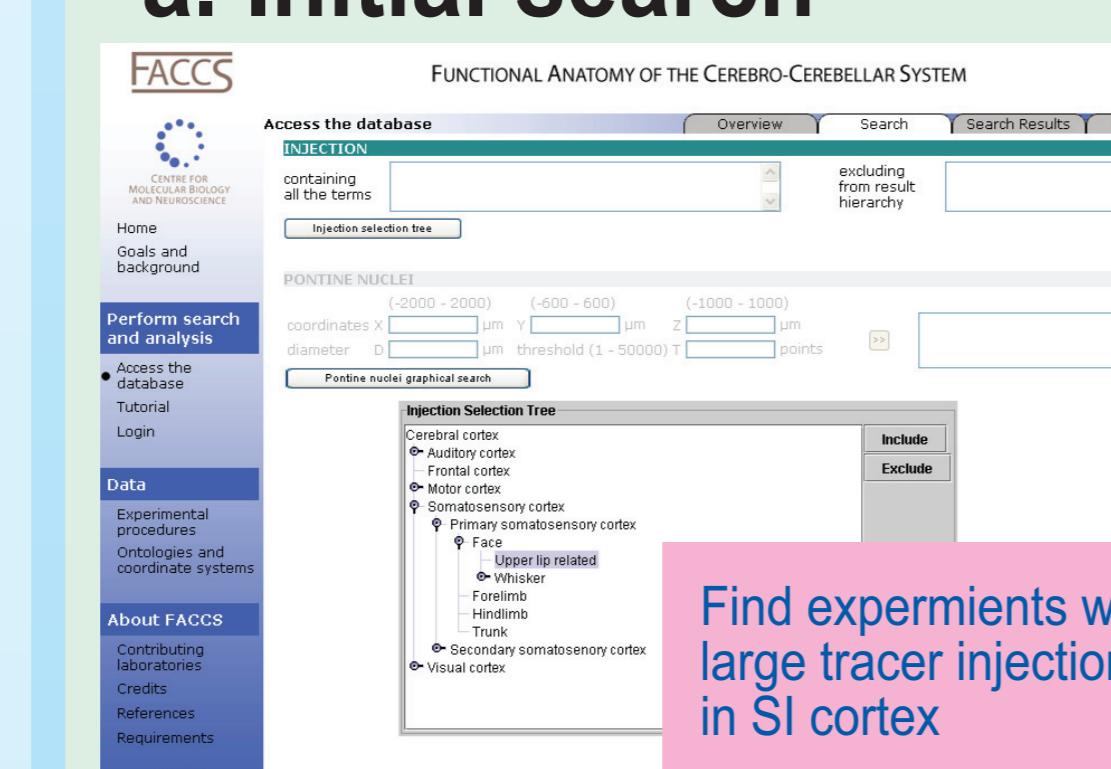
6. EXAMPLE SEARCH, VISUALIZATION AND ANALYSIS USING FACCS

Q1: What is the size and location of projections from the entire SI cortex?

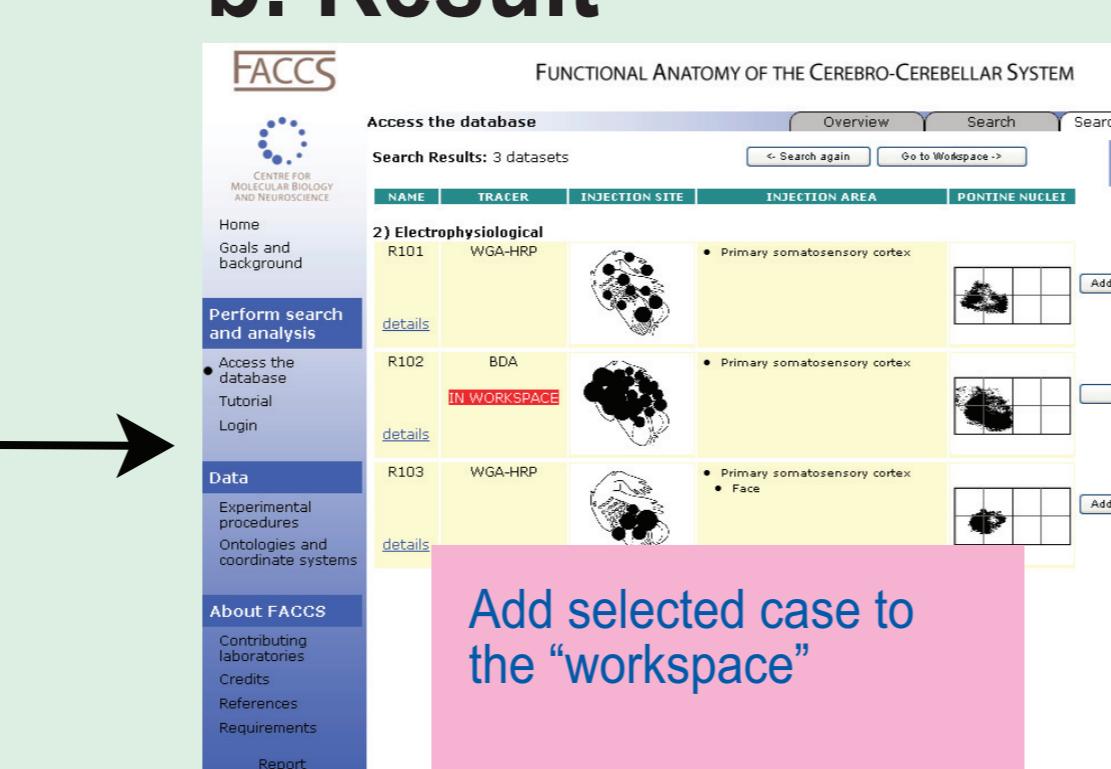
Q2: What is the size and location of projections from the SI upper lip representation?

Q3: How do they compare?

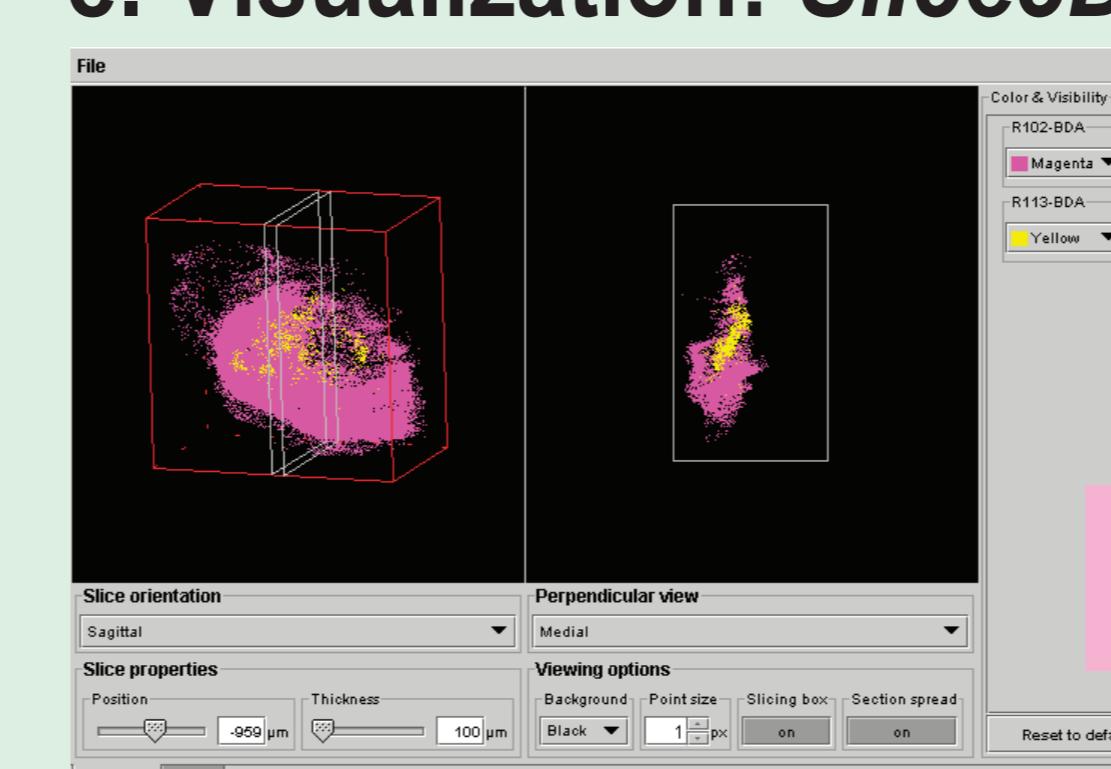
a. Initial search



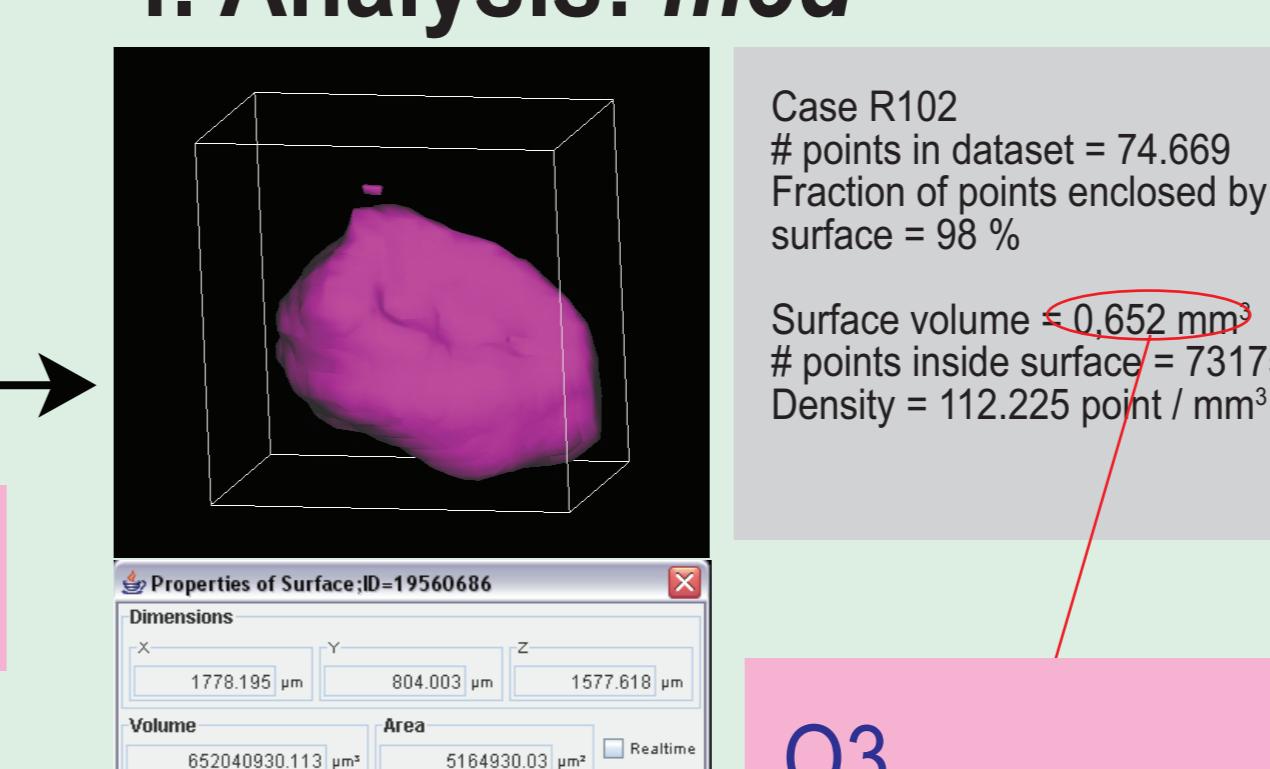
b. Result



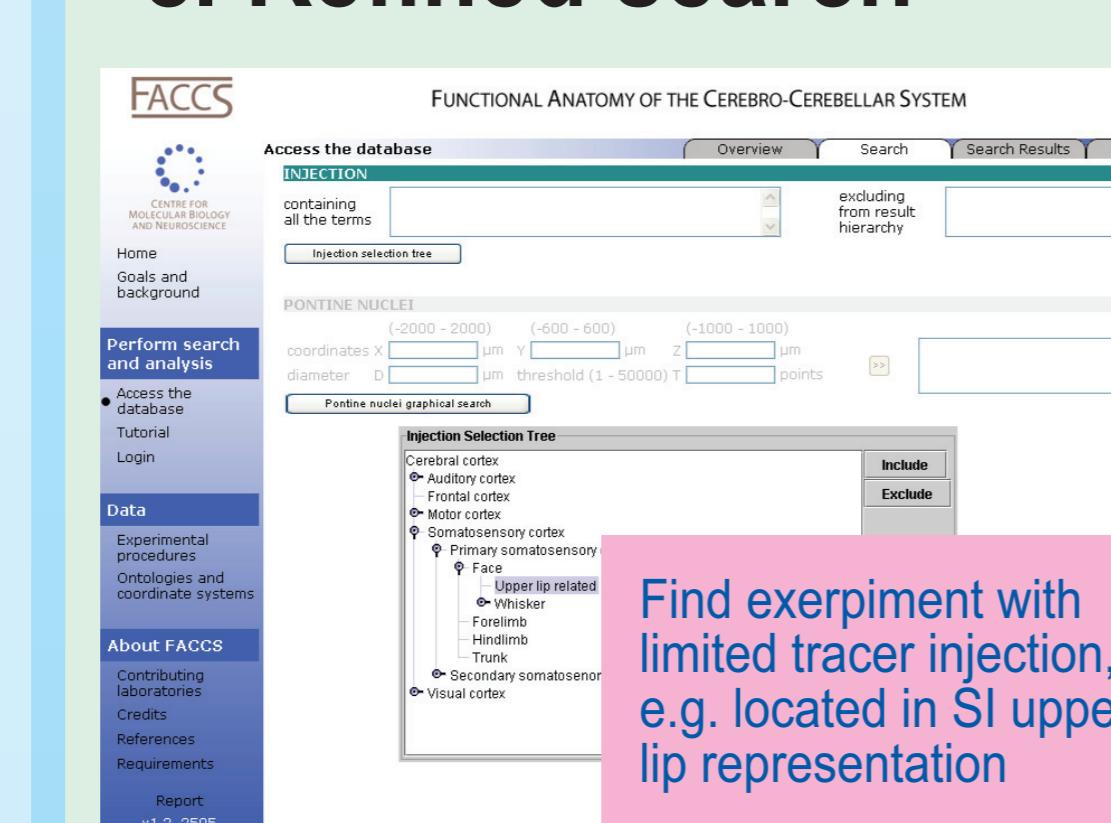
e. Visualization: Slice3D



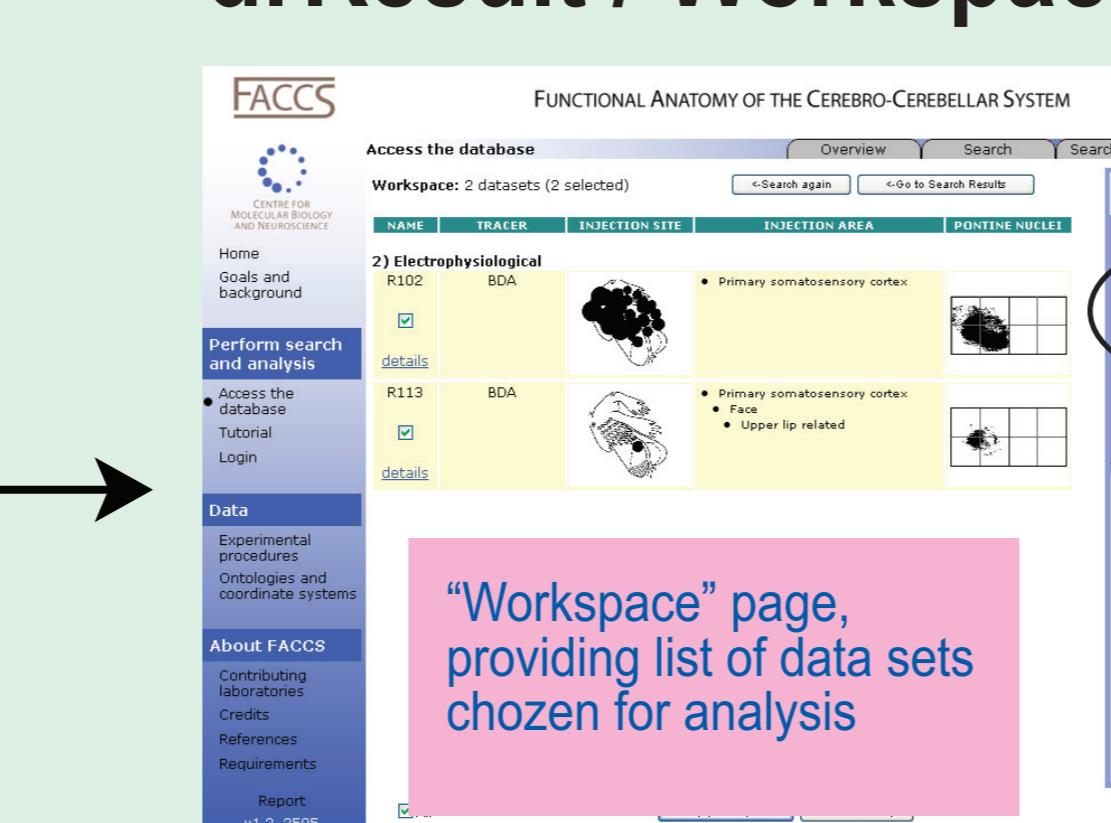
f. Analysis: m3d



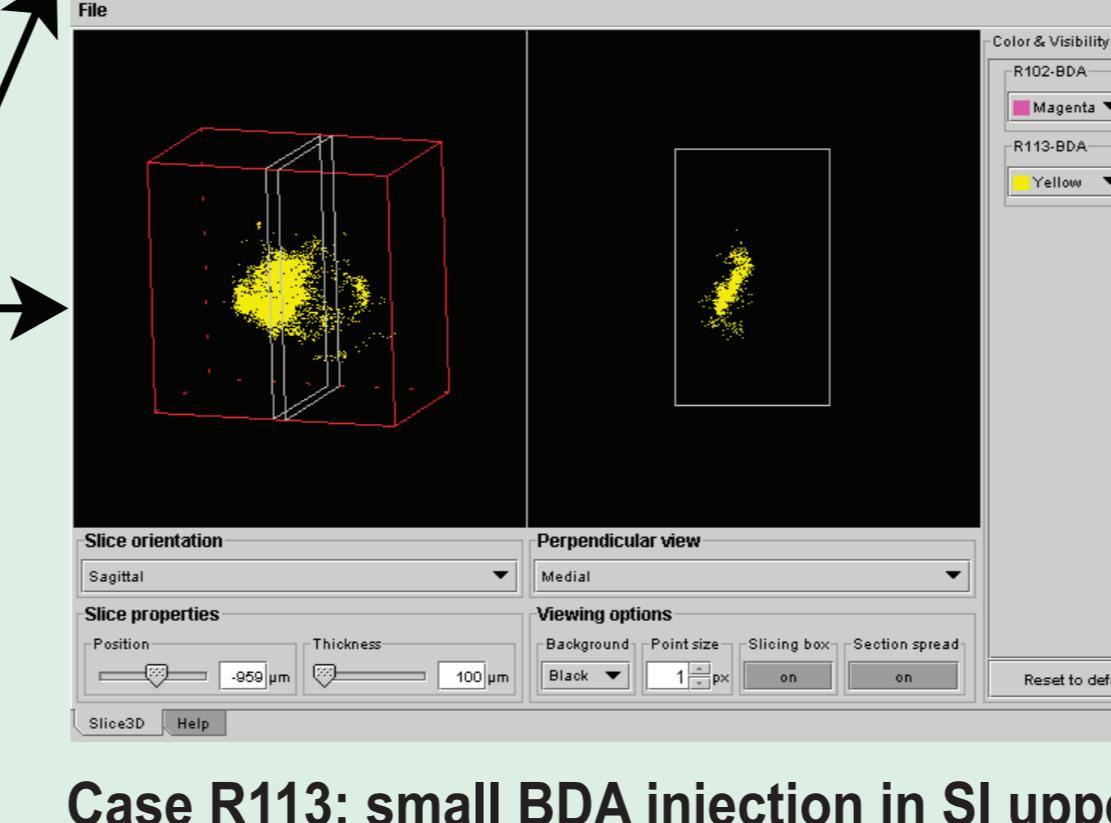
c. Refined search



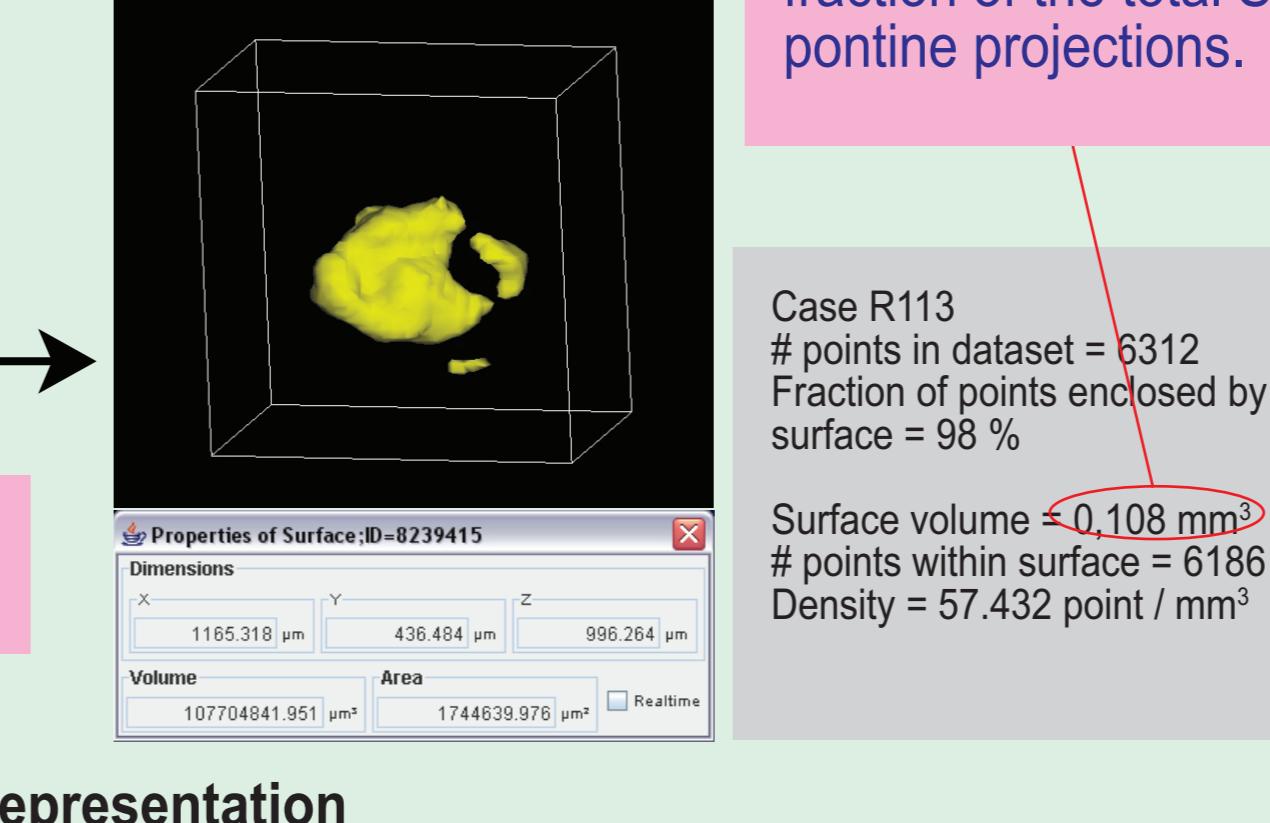
d. Result / Workspace



Q1



Q2



MORE INFORMATION

URLs: www.rbwb.org, www.nesys.uio.no

PDF copy of poster is available at www.nesys.uio.no
Extensive documentation of underlying concepts and requirements are provided at www.rbwb.org.

To contribute data, please contact:

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Literature:

Bjaalie et al. (2005) Neuroscience, In Press

Paxinos and Watson (2005) The rat brain in stereotaxic coordinates
Academic Press, San Diego

Original publications of contributed data:

Leergaard et al. (2000), J Comp Neurol 422:246-266

Leergaard et al. (2000), J Neurosci 20: 8474-8484

Leergaard et al. (2004), J Comp Neurol 478:306-322

Odeh et al. (2005), J Neurosci 25:5680-5690

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