Integrative properties of the pontine nuclei: exploring the architecture of pathways from somatosensory cortex to the cerebellum with use of a database application

Trygve B. Leergaard and Jan G. Bjaalie, NeSys, CMBN & Anatomy, University of Oslo, Norway

1. BACKGROUND

The recently published database ‘Functional Anatomy of the Cerebro-Cerebellar system (FACCS)’ holds previously published data from 78 axonal tracer injections in the cerebrocerebellar cortex and cerebellar cortex. 3-D computer-reconstructed data representing labeled corticopontine terminal fields and pontocerebellar cell bodies have been mapped into a common spatial framework based on a local coordinate system for the pontine nuclei.

We have combined data from three previous investigations to 1) provide further methodological validation, 2) re-investigate aspects of brain map transformations from the 2-D somatotopic map in SI cerebral cortex to the more complex 3-D maps in the pontine nuclei, and 3) explore the spatial relationship between corticopontine axons and pontocerebellar neurons.

2. METHODOLOGICAL VALIDATION

Query using FACCS

Validation 1

Graphical user interface showing the search results. The search facilities in FACCS are used to identify data sets with similar (SI) injection parameters.

Validation 2

Viewer applet displaying three individual datasets. The similar distributions of labeling (points) result from near identically sized and positioned SI-whisker tracer injections.

3. TOPOGRAPHIC ORGANIZATION OF SI-CORTICOPONTINE PROJECTIONS

Background

We previously demonstrated a 3-D topographic relationship among SI projections from SI upper lip and whisker representations (Leergaard et al., 2000a).

Background

In two other studies, we investigated the organization of corticopontine projections from individual SI whisker barrels (Leergaard et al., 2000b; 2004).

Here, we use FACCS to combine data from three different investigations to provide a direct comparison of SI whisker projections with projections from SI face and trunk.

After refined search in the database, we selected eight individual datasets for visualization and analysis using digital re-slicing.

4. CORTICO-PONTO-CEREBELLAR CONGRUENCE

Dot map analysis

Distribution of pontocerebellar neurons projecting to the A2 face region of the paramedian lobule (PML) and face-related SI-pontine projections. How do pontocerebellar neurons relate to SI projections from other body representations?

Nearest neighbor analysis

This quantitative comparison (based on data lumped together from multiple animals) shows that the PML face projecting cells are primarily located close to the SI projections originating in upper lip and whisker representations close to the upper lip. With increasing distances from the pontocerebellar cell bodies, proximity to other SI projections is also observed.

5. SUMMARY AND CONCLUSIONS

We here demonstrate that in computo experiments provide reproducible results and that accumulation of published data in a database provides novel opportunities for testing multiple interpretations of data distributions. This approach, in turn, allows better planning of future experiments.

We further demonstrate potential integrative properties of the pontine nuclei:

Corticopontine projections from different aspects of the SI somatosensory body map are topographically organized, but do also have close spatial relationships at several locations in the pontine nuclei.

Pontocerebellar neurons projecting to the A2 face representation in the paramedian lobule, are distributed in close proximity to pontine afferents from SI upper lip and whisker representations. Pontine projections from other SI body representations are distributed at gradually increasing distances.

MORE INFORMATION

URLs: www.rbwb.org / www.neysys.uio.no
To contribute data, please contact j.g.bjaalie@medisin.uio.no
PDF copy of poster is available at www.neysys.uio.no
Database technical solutions are presented at poster 687.15 on Tuesday Nov 15, 9AM at board WW8

Related publications:
Leergaard et al. (2000a) J Comp Neurol 422:346-266
Leergaard et al. (2009b) J Neurosci 29:4744-4750
Bjaalie et al. (2005) Neuroscience, In Press

Supported by The Research Council of Norway and EC