

Databasing Molecular Neuroimaging

Finn Årup Nielsen

NEUROBIOLOGY RESEARCH UNIT, RIGSHOSPITALET, DENMARK

Positron emission tomography allows for molecular neuroimaging, e.g., for mapping human neurotransmitter systems. Many such studies are performed as either “voxel-based” or “region-based”. Voxel-based studies are usually reported with reference to the Talairach stereotaxic system [1] and appear with tables listing “hot spot” foci indicating the centers of areas with significant difference between two groups of scans. The voxel-based approach is widely used in the cognitive functional neuroimaging literature. Databasing such studies has been advanced with the Brain-Map database (Research Imaging Center, San Antonio, TX). The newest version of this database contains data from over 500 studies, but the interface only allows for preprogrammed access to the data. To allow for a more flexible access we have constructed the Brede database which presently records data from 126 studies. Apart from cognitive studies the Brede database also contains data from molecular neuroimaging studies. The experiments in the Brede database are associated with items in an ontology. The ontology contains items for, e.g., cognitive functions and neuroreceptors. Some of the items are linked with corresponding MeSH terms, items from SenseLab (<http://senselab.med.yale.edu/senselab/>) and other biomedical databases. The items are organized in a directed graph (a causal network) with the most general concepts (e.g., “neuroreceptor”) at the roots of the graph, while more specialized concepts (e.g., the 5-HT_{2A} receptor) are at the leaves. The representation of the hot spots centers in standardized coordinate space together with the ontology enables the statistical modeling of the distribution of the Talairach coordinates conditioned on, e.g., function and neuroreceptor type. So far we have implemented a line of multivariate analysis methods as well as volume-based similarity metrics that work on these distributions [2].

Only few molecular imaging studies are analyzed and reported with respect to the voxel-based Talairach system. Most studies appear as region-based where specific variables, such as the “binding potential”, are reported for a series of brain regions. The regions for which variables are reported will typically vary between studies. To handle this variability we have constructed a second ontology for the description of brain regions. When results from region-based studies are entered they are annotated with items from this ontology. Current development focuses on building tools for the analysis of region-based studies and their integration with the voxel-based studies.

The published database is available as XML files in the Brain Neuroinformatics Toolbox and on the Internet on the address <http://hendrix.imm.dtu.dk/services/jerne/brede/>. The Internet edition also features results from automated web-page generation.

- 1 J. Talairach and P. Tournoux, *Co-planar Stereotaxic Atlas of the Human Brain*, Thieme, New York (1988)
- 2 F. . Nielsen and L. K. Hansen, *Art. Intell. Med.*, 30 141-151 (2004)