Finding related functional neuroimaging volumes

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IMAGE RETRIEVAL

- Image based retrieval systems typically extract features, such as texture and color and/or surrounding text (Rui et al., 1999; Djeraba and Bouet, 1997).
- QBIC, commercial system by IBM (Flickner et al., 1995), example at http://www.hermitagemuseum.org.
- Web-based image retrieval systems
  - AltaVista, text-based search
  - WebSEEk (Smith and Chang, 1996a; Smith and Chang, 1996b)
- Medical image retrieval
  - CT-scans, query image with "stroke" or "acute blood" (Liu and Dellaert, 1998a; Liu and Dellaert, 1998b)
  - Other (Ford et al., 2001; Comaniciu et al., 1998)

FINDING RELATED VOLUMES

Figure 1: A processing scheme for finding related BrainMap experiments based on volume comparisons.

- Finding related functional neuroimaging volumes (Nielsen and Hansen, 2002; Nielsen, 2001).
- Data
  - Point data as "Experiments" from BrainMap with set of activation.
  - Volumes, small set from a cluster analysis in PET (Balslev et al., 2002).
- Point data voxelized with Gaussian kernel on a coarse grid (8mm).
- Compute distances between volumes.
- Generation of static web-pages with sorted list of similar volumes and with links to BrainMap and Pubmed.
- http://hendrix.imm.dtu.dk/services/jerne/.

FINDING RELATED VOLUMES

- What cost function?
- Consider changes with distance Δ with two points convolved with a Gaussian
  - Sum of the product (similarity)

$$\Gamma \propto \exp(-\Delta^2) \tag{1}$$

  - Kullback-Leibler (distance)

$$K(p||q) = -\int_{-\infty}^{\infty} p(x) \ln \frac{q(x)}{p(x)}\, dx \propto \Delta^2. \tag{2}$$

- Correlation coefficient: Volumes does not need to be normalized, negative activations can be handled.
- Optimization: Number of voxels typically much larger than the number of experiment and the number of point smaller than the number of experiments
  - Compute the distance in a subspace with the size of the experiment.
  - If only points are considered: Compute a distance between the points.

EXAMPLE

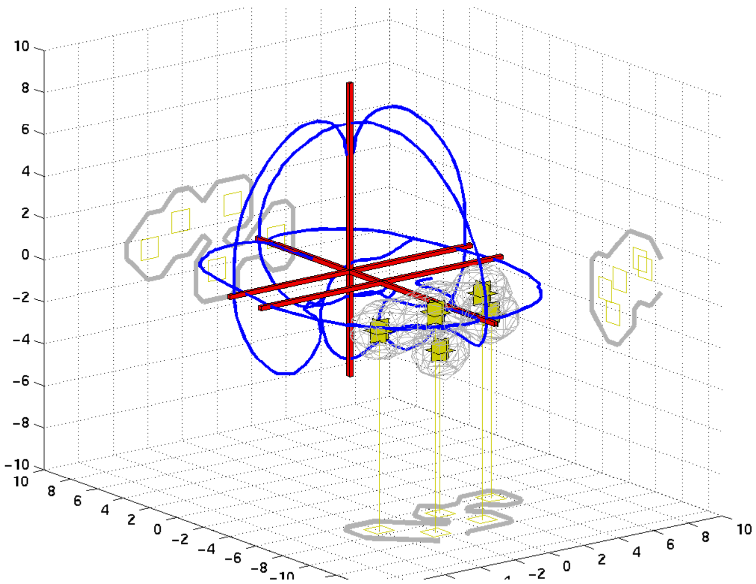


Figure 2: Query volume formed from (Sergent et al., 1992) — a letter and object (visual) processing paper with the 5 original points and an isosurface in the volume.

(3) Positron emission tomography study of letter and object processing: Empirical findings and methodological considerations
Sergent J, *Cerebral Cortex* **2**:68−80

Related volumes

(168) Neural correlates of category−specific knowledge
Martin A, *Nature* **379**:649−652

- (168*8) [BrainMap : paper | exp]

(114) Neuroanatomical analysis of functional brain images: validation with retinotopic mapping
Grabowski T J, *Human Brain Mapping* **2**:134−148

- (114*2) [BrainMap : paper | exp]

(189) Topographical representations of mental images in primary visual cortex
Kosslyn S M, *Nature* **378**:496−498

- (189*2) [BrainMap : paper | exp]

(12) Retinotopic organization of human visual cortex mapped with positron−emission tomography
Fox P T, *The Journal of Neuroscience* **7**:913−922

- (12*1) [BrainMap : paper | exp]

(12) Retinotopic organization of human visual cortex mapped with positron−emission tomography
Fox P T, *The Journal of Neuroscience* **7**:913−922

- (12*2) [BrainMap : paper | exp]

(3) Positron emission tomography study of letter and object processing: Empirical findings and methodological considerations
Sergent J, *Cerebral Cortex* **2**:68−80

- (3*2) [BrainMap : paper | exp]

(36) Area V5 of the human brain: Evidence from a combined study using positron emission tomography and magnetic resonance imaging
Watson J D G, *Cerebral Cortex* **3**:79−94

- (36*1) [BrainMap : paper | exp]

Figure 3: Result list: All vision experiments.

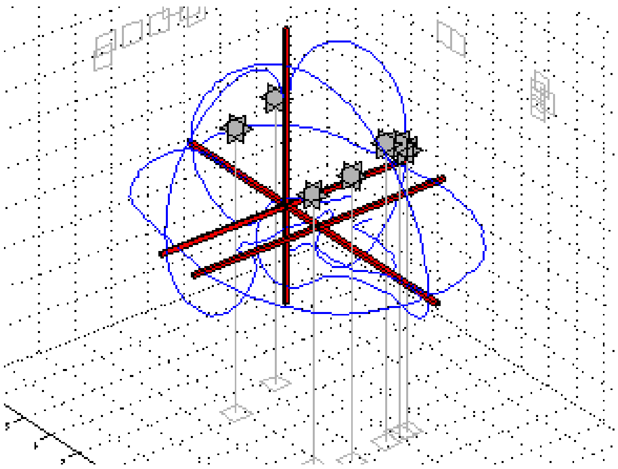
EXAMPLE

Related volumes

Jerne > Neuroinformatics > Related volumes > 100

(100) Shift R in R vis. field
A PET study of visuospatial attention.
Corbetta M, *Journal of Neuroscience* **13**(3):1202–1226, PMID: 8441008
[BrainMap : paper 29 | exp 12]

x	y	z
-25	-52	38
27	-52	43
23	-52	47
-23	6	45
14	-55	51
-8	-59	45
7	16	45



Related volumes – correlated

(99) Shift L in R vis. field
A PET study of visuospatial attention.
Corbetta M, *Journal of Neuroscience* **13**(3):1202–1226, PMID: 8441008
[BrainMap : paper 29 | exp 11]

(98) Shift R in L vis. field
A PET study of visuospatial attention.
Corbetta M, *Journal of Neuroscience* **13**(3):1202–1226, PMID: 8441008
[BrainMap : paper 29 | exp 10]

(296) Saccades/anti-prostimulus
Role of the human anterior cingulate cortex in the control of oculomotor, manual, and speech responses: a positron emission tomography study.
Paus T, *Journal of Neurophysiology* **70**(2):453–469, PMID: 8410148
[BrainMap : paper 108 | exp 10]

Figure 4: Result page with automatically generated corner cube visualization (Corbetta et al., 1993). Two cluster of activations.

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