16 17-19 OHBM 2010

Organization for
Human Brain Mapping

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HBM2010
BARCELONA, SPAIN

16th Annual Meeting of the Organization for Human Brain Mapping

abstracts

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1

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Anatomical Studies, *continued*

1473 WTh-AM
Relationship between age and brain structure in a large, elderly, population based sample
Richard Beare, Thanh Phan, Velandai Srikanth, Monash University, Melbourne, Australia

1475 WTh-AM
Finding Stable Sulcal Subunits : a Group Analysis of Primal Sketches of the Cortex Mean Curvature
Grégory Operto, Jean Régis, Olivier Coulon, Jean-François Mangin, Denis Rivière, Arnaud Cachia, LNAO / NeuroSpin / I2BM / CEA, Gif-sur-Yvette, France

1477 WTh-AM
Self reported physical activity is related to anterior hippocampal and parahippocampal volume
Traute Demirakca, Wencke Brusniak, Nuran Tunc-Skarka, Isabella Wolf, Carsten Diener, Gabriele Ende, Central Institute of Mental Health, Mannheim, Germany

1479 WTh-AM
In vivo Imaging of the cortical architecture of the frontal lobe
Daniel Barazany, Ory Levy, Yaniv Assaf, Tel Aviv University, Tel Aviv, Israel

1481 WTh-AM
Stochastic Neurography
Sylvain Jaume, Martin Loepprich, Ehud Schmidt, Ron Kikinis, Massachusetts Institute of Technology, Cambridge, United States

1483 WTh-AM
Selection of registration parameters with diffeomorphic registration for TBM studies on ADNI data
Matias Bossa, Ernesto Zacur, Salvador Olmos, University of Zaragoza, Zaragoza, Spain

1485 WTh-AM
Comparing the patterns of cortical correlation and fibre tract connectivity across the human brain
Gong Gaolang, Zhang Chen, Yong He, Alan Evans, McConnell Brain Imaging Center, Montreal Neurological Institute and Hospital, McGill University, Montreal, Canada

1487 WTh-AM
Lifespan stability of structural covariance in human cortex assessed using voxel-based morphometry
Jonathan Peelle, Richard Henson, Rhodri Cusack, MRC Cognition and Brain Sciences Unit, Cambridge, United Kingdom

1489 WTh-AM
Brain sub-structure atrophy in multiple sclerosis measured by automated tissue-lesion segmentation
Navid Shiee, Pierre-Louis Bazin, Peter Calabresi, Dzung Pham, Daniel Reich, Johns Hopkins University, Baltimore, United States

1491 WTh-AM*
Subpial Pathology as a Substrate for Cortical Thinning in Multiple Sclerosis: a 7T MRI study (O-Th2)
Caterina Mainero, Julien Cohen Adad, Doug Greve, Thomas Benner, Andre' van der Kouwe, Bruce Fischl, R Kinkel, Bruce Rosen, Massachusetts General Hospital, Charlestown, United States

1493 WTh-AM
Cortical gyrification and the underlying axonal connectivity in 22q11 deletion syndrome
Marie Schaer, Marie-Christine Ottet, Leila Cammoun, Djalel Meskaldji, elda fischi, Patric Hagmann, Jean-Philippe Thiran, Stephan Eliez, University Hospital Zürich, Switzerland, Zürich, Switzerland

1495 WTh-AM
Functional Anatomy of the Human Massa Intermedia
Patrick Schweder, Peter Hansen, Alex Green, Gerardine Quaghebeur, Tipu Aziz, University of Oxford, Department of Neurosurgery, Oxford, United Kingdom

NEUROANATOMY

Pharmacology

1497 WTh-AM
Methylphenidate (MPH) Effects on Response Inhibition Networks: the Role of Attentional Capture
Astrid Pauls, Owen O'Daly, Mitul Mehta, Institute of Psychiatry, London, United Kingdom

1499 WTh-AM
Combined glucose and caffeine effects on neural activity: an fMRI study
Josep M Serra-Grabulosa, Ana Adan, Carles Falcon, Nuria Bargallo, University of Barcelona, Barcelona, Spain

1501 WTh-AM
Scopolamine Reduces Response Selectivity in Visual Cortex during Selective Attention: an fMRI Study
Elana Hoffman, Wayne Drevets, Maura Furey, National Institutes of Mental Health, Bethesda, United States

1503 WTh-AM
Modulation of limbic system reward processing after methamphetamine challenge
Javier Bernacer, Philip Corlett, Pranathi Ramachandra, Brady McFarlane, Luke Clark, Trevor Robbins, Paul Fletcher, Graham Murray, University of Cambridge, Cambridge, United Kingdom

1505 WTh-AM
Segregation of Cortical Layers by Differential Responses of Dopamine D1 and D3 Receptors
Bruce Jenkins, Joseph Mandeville, Yin-Ching Chen, Amy Newman, Ji-Kyung Choi, MGH, Charlestwon, United States

Selection of registration parameters with diffeomorphic registration for TBM studies on ADNI data

Abstract No:

3161

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Introduction:

Tensor-based morphometry (TBM) is a technique where anatomical information is characterized by means of the spatial transformations mapping a customized template with the observed images. Therefore, accurate inter-subject non-rigid registration is an essential prerequisite. Statistical analysis on the spatial transformations is performed to highlight voxel-wise differences. Most of previous TBM studies did not explore the influence of the registration parameters, such as the parameters defining the deformation and regularization models.
In this work stationary velocity field (SVF) diffeomorphic registration [1] was used in a TBM study on data from ADNI study. A wide range of values of the registration parameters were explored. Performance was compared with a previous study [2] based on non-linear elastic registration.

Methods:

The same subset of 120 subjects from ADNI study was used as in [2]: 40 healthy elderly individuals (Nor), 40 individuals with amnestic MCI and 40 probable AD patients, matched in terms of age and sex. An independent second group of normal subjects (denoted as Nor2), age- and gender-matched to the first group of controls, was selected to test whether analysis techniques correctly detects no differences when comparing the two independent groups of normal subjects.
Diffeomorphisms are smooth and invertible mapping that can be obtained by integrating non-stationary velocity fields. Stationary velocity field parameterization has been proposed in order to reduce computational complexity. SVF diffeomorphic registration has two main parameters α and σ that controls the smoothness and the amount of regularization respectively.
An unbiased atlas was estimated from the control group images by minimizing the deformations between the atlas and the observed images. Later, the atlas was non-linearly registered to all individual brains.
Voxel-wise Student's t-test was performed on the log of the Jacobian determinant of the mappings to assess local volume differences between patient groups. The spatial distribution of the t-statistic is denoted as brain atrophy statistical map. A summary of a t-map is given by the supra-threshold volume (STV) curve S(t), which is the number of voxels where t-values are larger than a given threshold t. The STV curves of the t-map illustrate the sensitivity to detect significant brain volume changes between patient groups when using different values of the registration parameters $\{\alpha,\sigma\}$.
Multiple comparison correction was performed controlling family wise error rate (FWE). For each values of the parameters, a random permutation test was performed to estimate the t_p-threshold that controls FWE with significance level p. The 100(1-p)-th-percentile of the distribution of the maximum of t-statistic was estimated using 10000 permutations.

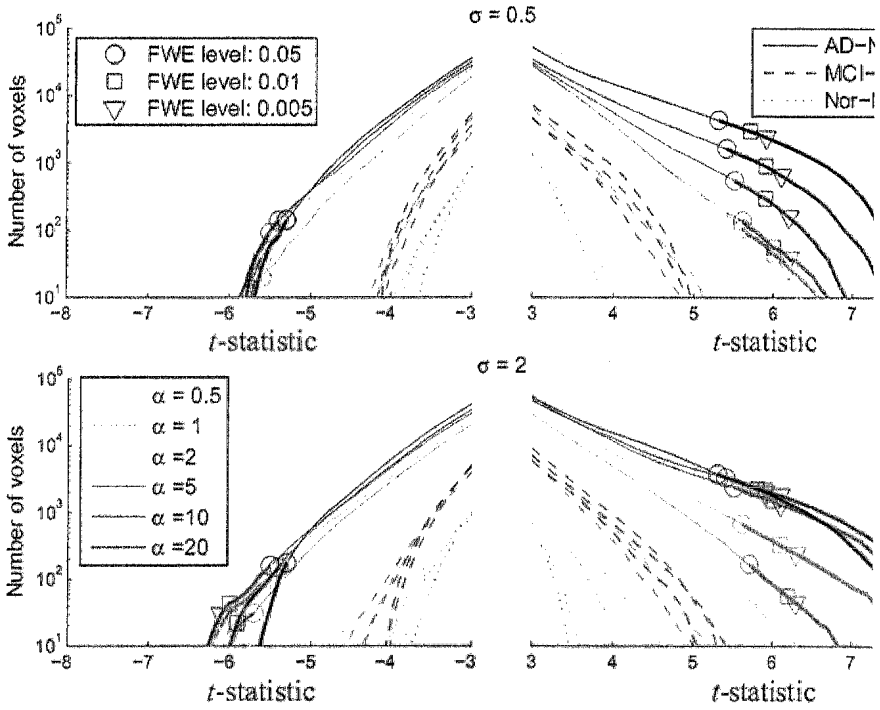
Results:

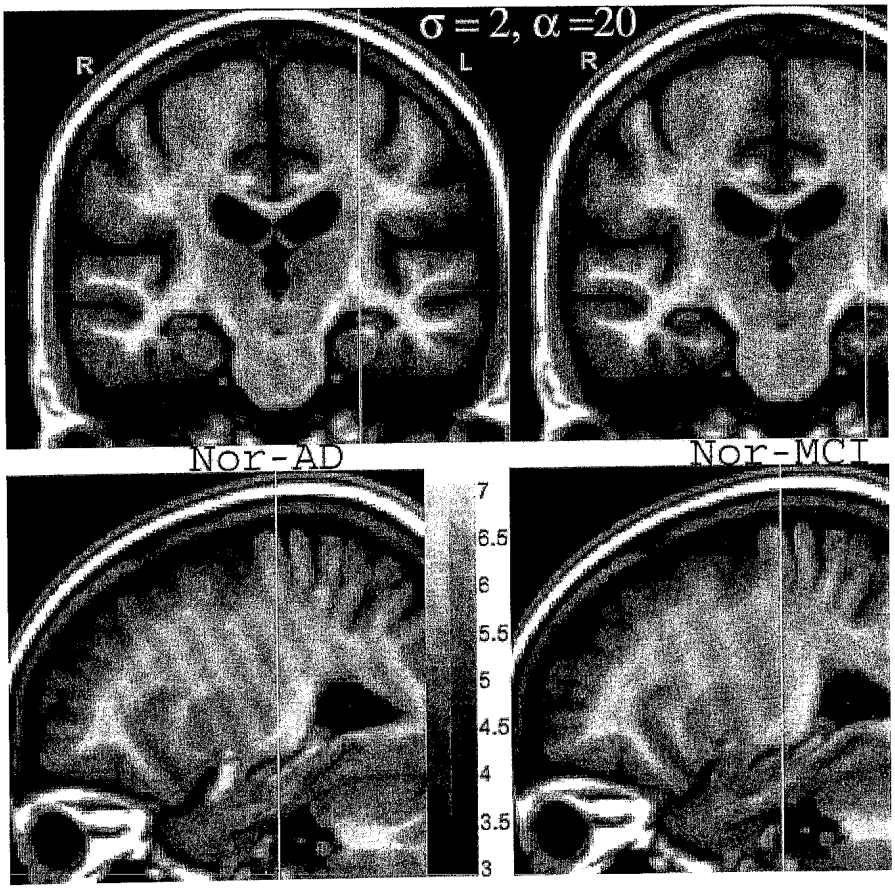
Fig. 1 shows the STV curves for AD-Nor and MCI-Nor comparisons with different values of the registration parameters $\{\alpha,\sigma\}$. As only large values of the t-statistic are of interest, either positive for atrophy or negative for expansion, the horizontal axis shows values $|t|\geq 3$. The values of t_p controlling FWE are illustrated in Fig. 1 for p=[0.05,0.01,0.005]. All STV curves of the AD-Nor group comparison showed FWE-corrected significant voxels at level p=0.05.
An important asymmetry between atrophy and expansion can be observed in Fig. 1. For large enough values of the smoothing parameter α, the number of voxels with significant atrophy is larger than for expansion with the same significance level. Most of the STV curves for AD-Nor group comparison show an increasing sensitivity to detect brain volume changes when increasing the value of the smoothing parameter α. The values of the registration parameters yielding voxels with larger t-statistic are $\{\alpha=[5,10],\sigma=2\}$.
Brain atrophy maps are shown using three parameter values that represent different conditions: low-level smoothing with small regularization $\{\alpha=0.5,\sigma=0.5\}$ (Fig. 2), large smoothing with large regularization $\{\alpha=20,\sigma=2\}$ (Fig. 4) and a point with intermediate smoothing $\{\alpha=5,\sigma=2\}$ (Fig. 3). These working conditions are a representative sample of the different performance of STV curves

illustrated in Fig. 1.
Fig. 3 show regions with sharp boundaries in agreement with anatomical structures affected by dementia, while the statistical map in Fig. 4 is blurred (see the boundaries of the parahippocampal gyrus). Other structures with significant atrophy, such as the frontal part of the insula, are better represented when using {α=5,σ=2} than {α=20,σ=2}. When comparing AD-Nor versus MCI-Nor patient groups, AD group showed larger areas with stronger significance affected by brain atrophy. Significant atrophy was found at structures known to be affected by AD and with a detailed anatomical resolution.

Conclusions:

Stationary velocity field (SVF) diffeomorphic registration seems to be an appropriate choice for TBM studies, at least on ADNI data, as it yields statistical maps with strong significance and very detailed anatomical resolution. These results can be directly compared to [2] where the statistical maps could not show anatomical details.
Selection of appropriate values of the registration parameters is an important issue. In general, the larger the value of the the smoothing parameter α, the larger the region with significant differences between groups. However, too large values of α may produce smoothed statistical maps, limiting the accuracy for localizing detailed morphometry differences.





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Hua, X. (2008), '3D characterization of brain atrophy in Alzheimer's disease and mild cognitive impairment using tensor-based morphometry', *Neuroimage*, vol. 41, no. 1, pp. 19-34.

Categories

- Alzheimer and Dementia (Disorders of the Nervous System)
- Anatomical Studies (Neuroanatomy)