Comparison between SMP motion correction and Siemens prospective online motion correction algorithm (PACE)

944

Siedentopf CM[1], Golaszewski SM[2], Koppelstaetter F[1], Ischebeck A[2], Haala IA[1], Rhomberg P[1], Verius M[1], Felber S[1], Gerstenbrand F[4]

Department of Radiology II [1], Div. of Neuroradiology, University Hospital, Innsbruck, Austria

Department of Neurology [2], University Hospital, Innsbruck, Austria

Neurological Therapy Centre Düsseldorf and St. Mauritius Therapy Hospital Meerbusch [3], Heinrich Heine University, Düsseldorf, Germany

Ludwig Boltzmann Institute for Restorative Neurology and Neuromodulation [4], Vienna, Austria

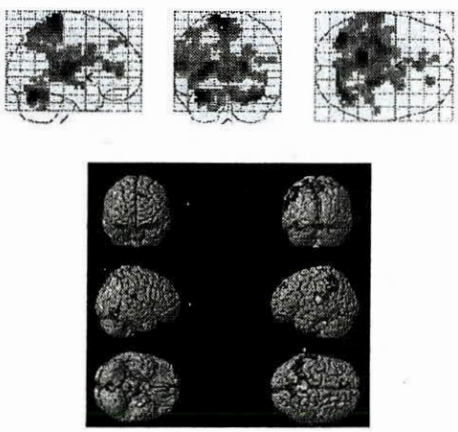
PURPOSE: Motion correction is a very important step in analyzing fMRI-data. Nevertheless, it needs a lot of time and computer resources. To facilitate the analysis of the fMRI data, Siemens implemented a prospective real time motion correction (PACE) on the basis of a rigid-body transformation into the MR-scanner software. The aim of this study was to compare the Siemens motion correction with the motion correction as implemented in SPM.

METHODS: We investigated 10 healthy volunteers (25-45years) using an event-related fMRI-Design with an intermittent vibrotactile stimulation of the foot (for more details see Golaszewski et. al., Poster # I28 T-PM). The experiment consists of one run of approximately 30 min. For each measurement two datasets per functions run were produced the raw fMRI data and the prospective motion corrected fMRI data (moco) form the 1, 5 Tesla MR-scanner (Magentom SONATA, Siemens, Germany). For fMRI, we employed T2*-weighed single shot EPI sequences (TR/TE/n = 0.96ms/90°, matrix = 64x64, voxel dimension = 3.75 x 3.75 x 6.25 mm, 1.25 mm interslice gap, 24 axial slices, 736 volume images).

Post-processing was performed with SPM99. Both datasets from each measurement were analyzed in the exact same way and the same parameter with only one difference, the raw fMRI datasets were motion corrected in SPM, the moco not. Furthermore we ascertain the motion parameters from the moco raw datsets and from the SPM datasets, before and after the realignment procedure. Activations were reported for clusters which surpassed an initial threshold of $p < 0.001$ uncorrected and had a corrected p-value of $p < 0.05$ on cluster level.

RESULTS: Both datasets show comparable activation pattern. The fMRI measurement during vibrotactile stimulation of the right foot revealed brain activation contralaterallly within the primary sensorimotor cortex, bilaterally within the secondary somatosensory cortex, bilaterally within the superior temporal inferior parietal and posterior insular region, bilaterally within the anterior and posterior cingular gyrus, bilaterally within the fusiform gyrus, bilaterally within the thalamus and caudate nucleus, contralateral within the lentiform nucleus and bilaterally within the anterior and posterior cerebellar lobe.

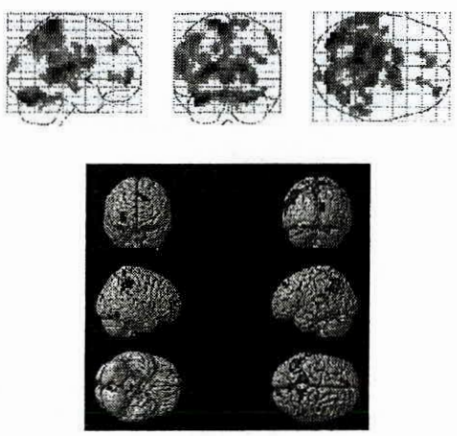
SPM Motion Correction



Statistics: *volume summary (p-values corrected for entire volume)*

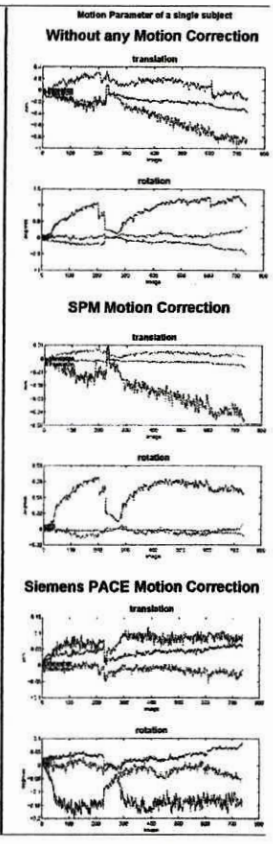
set-level		cluster-level			voxel-level				x,y,z (mm)
p	c	$p_{corrclu}$	k_E	$p_{uncorrclu}$	$p_{corrvox}$	T	(Z_δ)	$p_{uncorrvox}$	
0.000	7	0.000	1319	0.000	0.000	8.84	(Inf)	0.000	-16 -40 76
					0.000	7.49	(7.47)	0.000	-28 -20 12
					0.000	6.89	(6.86)	0.000	20 -24 16
		0.000	248	0.000	0.000	6.59	(Inf)	0.000	-36 -56 -24
					0.000	7.20	(7.19)	0.000	36 -64 -24
					0.000	5.81	(5.80)	0.000	24 -72 -28
		0.007	31	0.001	0.001	5.33	(5.32)	0.000	0 28 12
		0.013	27	0.002	0.046	4.59	(4.59)	0.000	16 44 8
		0.024	23	0.004	0.385	3.96	(3.96)	0.000	-12 52 44
					0.462	3.83	(3.83)	0.000	-4 36 44
					0.809	3.38	(3.36)	0.000	-16 36 40
		0.033	21	0.005	0.387	3.94	(3.94)	0.000	32 -48 32
					0.547	3.80	(3.79)	0.000	24 -44 28
		0.024	23	0.004	0.461	3.87	(3.87)	0.000	40 -32 24
					0.631	3.71	(3.71)	0.000	36 -24 20

Siemens PACE Motion Correction



Statistics: *volume summary (p-values corrected for entire volume)*

set-level		cluster-level			voxel-level				x,y,z (mm)
p	c	$p_{corrclu}$	k_E	$p_{uncorrclu}$	$p_{corrvox}$	T	(Z_δ)	$p_{uncorrvox}$	
0.000	8	0.000	248	0.000	0.000	8.18	(Inf)	0.000	-40 -76 -28
					0.000	7.66	(7.64)	0.000	-28 -80 -24
					0.000	6.82	(6.80)	0.000	+36 -60 -20
		0.000	1195	0.000	0.000	7.74	(7.72)	0.000	-8 -44 68
					0.000	7.54	(7.52)	0.000	-20 -36 12
					0.000	7.18	(7.17)	0.000	-20 -40 72
		0.002	40	0.000	0.006	5.04	(5.03)	0.000	32 56 0
					0.545	3.82	(3.81)	0.000	20 36 4
		0.003	38	0.000	0.031	4.65	(4.65)	0.000	-16 36 36
					0.040	4.59	(4.59)	0.000	-4 48 48
		0.001	44	0.000	0.037	4.63	(4.62)	0.000	52 -40 52
					0.117	4.33	(4.33)	0.000	60 -36 40
					0.665	3.71	(3.71)	0.000	32 -48 40
		0.001	47	0.000	0.046	4.57	(4.57)	0.000	40 -32 24
					0.096	4.38	(4.38)	0.000	28 -44 32
					0.268	4.08	(4.08)	0.000	32 -40 32
		0.003	38	0.000	0.185	4.20	(4.20)	0.000	8 -48 -28
					0.220	4.15	(4.14)	0.000	-4 -40 -24
					0.648	3.73	(3.73)	0.000	0 -32 -20
		0.050	19	0.008	0.322	4.02	(4.02)	0.000	16 -92 24



Conclusion: To get the exact activation maps of the fMRI data analysis, the datasets need to be aligned perfectly. It is already known that only small chances in the execution of the motion correction can have great influence on the result. We were able to demonstrate that both datasets show comparable but not exactly the same activations with a small advantage for SPM with higher maximal t-values and at the other hand a small advantage for PACE with more significantly activated clusters. This result was also confirmed for single datasets with extreme movements (> 3mm). Our results indicate, that the prospective motion correction algorithm PACE (Siemens) is widely comparable with the well accepted motion correction method of SPM99. Because of the fact that PACE is working online and in real time, the analyses of fMRI-data can be abbreviated and is more comfortable for the user.

Contact: Christian M. Siedentopf, Innsbruck, Austria: Christian.Siedentopf@fmri-easy.de http://www.fmri-easy.de

NeuroImage

Supports open access

11th Annual Meeting of the Organization for Human Brain Mapping

(OHBM 2005)

12-16 June 2005 • Toronto, Ontario, Canada • Philips Medical Systems, GE Healthcare, Siemens Medical Solutions, Elsevier, Baycrest Centre for Geriatric Care, National Institutes of Mental Health, National Institute of Health, and John Wiley and Sons

Edited by K. Zilles, J.-B. Poline, C. Grady
Volume 26, Supplement 1,
Pages 1-104, e1 (2005)

ISSN: 1053-8119

TORONTO 2005

Final Program and Abstracts

11th Annual Meeting

of the Organization for Human Brain Mapping

June 12-16, 2005

NIH National Institutes of Health

Turning Discovery Into Health

Organization for Human Brain Mapping

(OHBM 2005)

12-16 June 2005 • Toronto, Ontario, Canada • Philips Medical Systems, GE Healthcare, Siemens Medical Solutions, Elsevier, Baycrest Centre for Geriatric Care, National Institutes of Mental Health, National Institute of Health, and John Wiley and Sons