

Use of spectral analysis and Random Field Theory for MEG data analysis

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Butorina Anna

MEG-center, MSUPE,

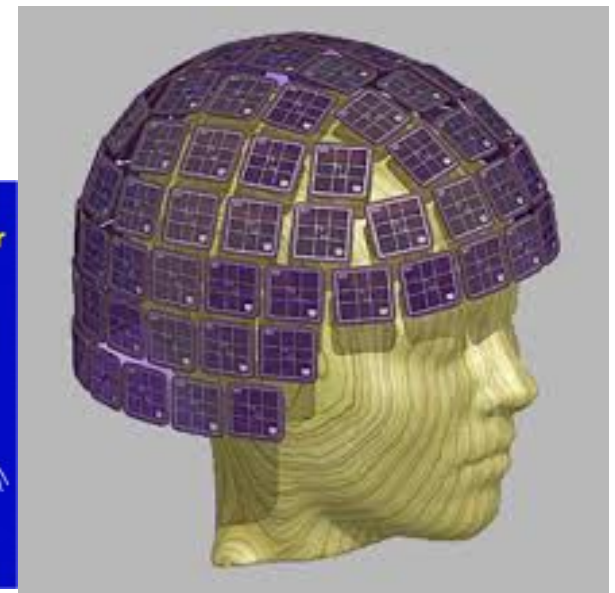
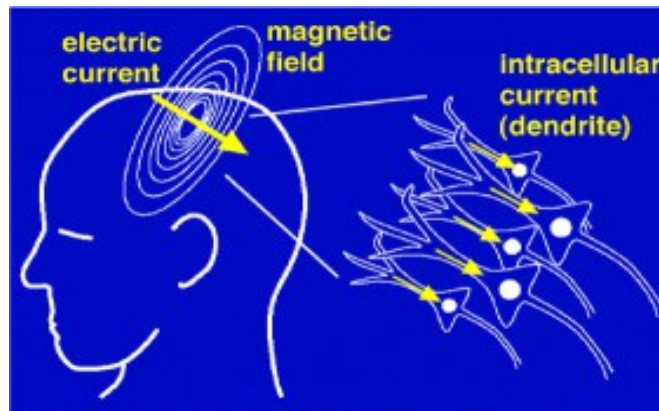
Moscow, Russia

Butorina, A., A. Prokofyev, M. Nazarova, V. Litvak, and T. Stroganova. "The mirror illusion induces high gamma oscillations in the absence of movement."

NeuroImage 103 (2014): 181-191

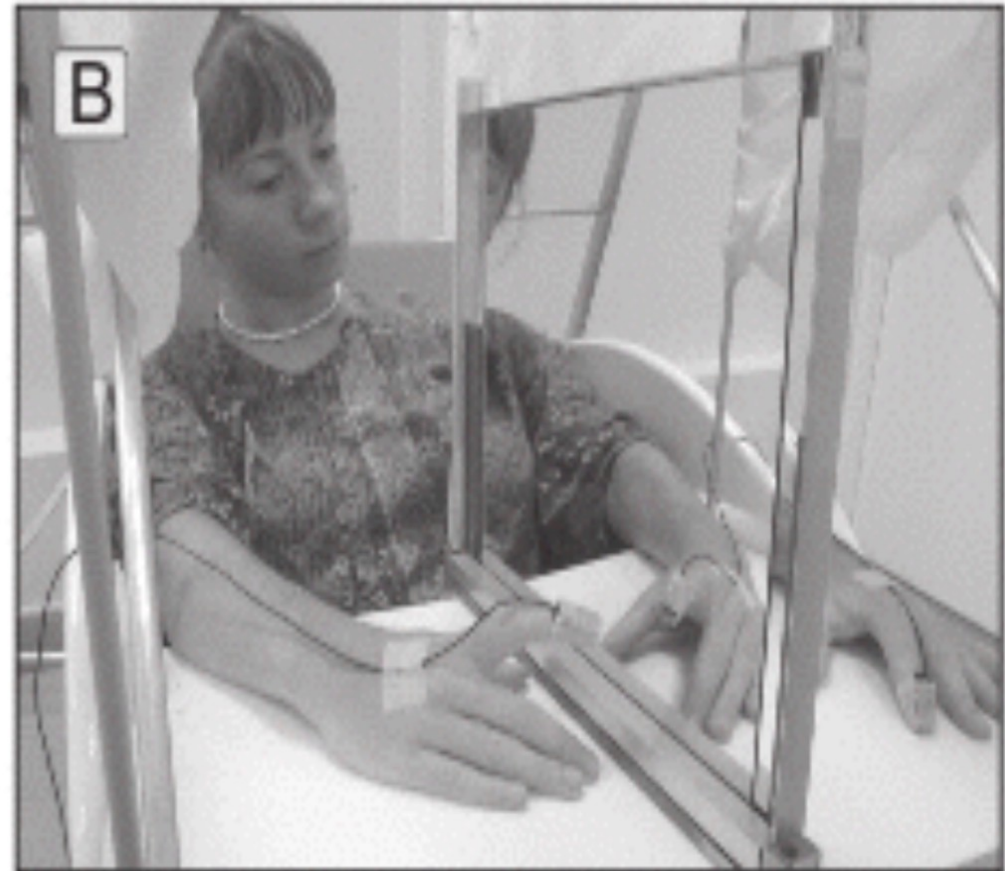
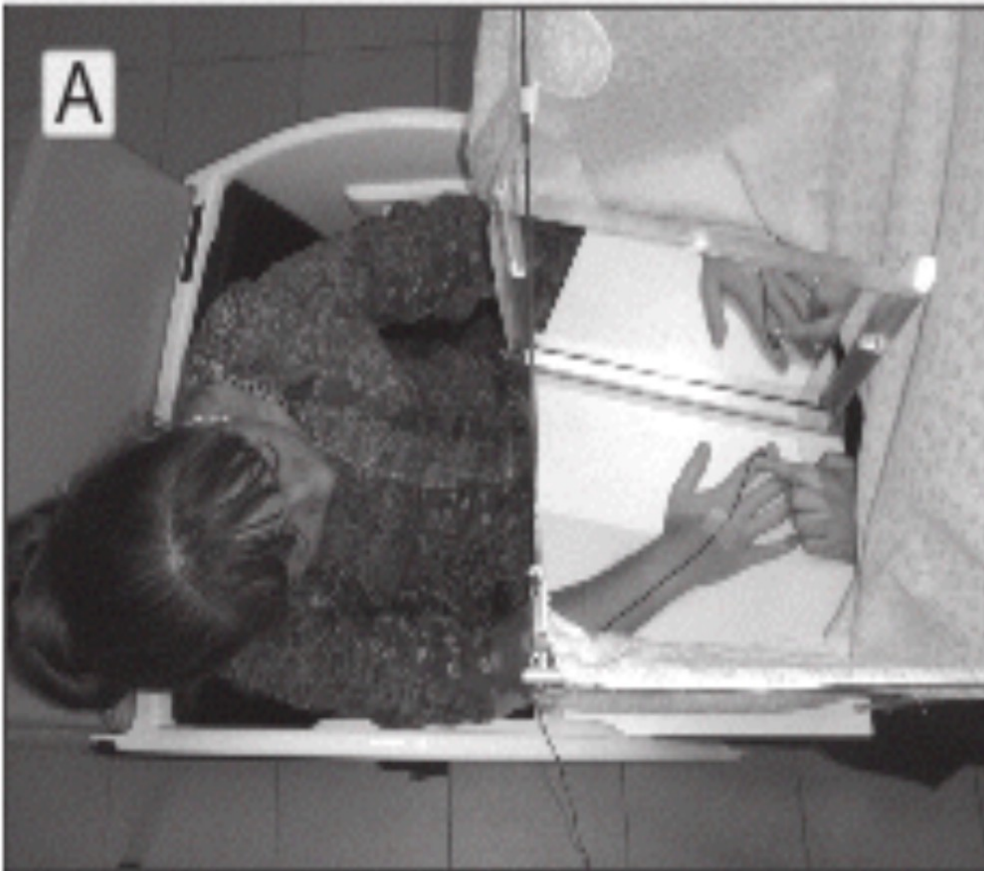
Magnetoencephalography

- MEG data were collected at MEG-center, Moscow
- Elekta Neuromag
- 306 independent measurement channels
- Organized in channel-triplets n 102 silicon chips:
 - two planar gradiometers
 - one radial magnetometer



Mirror hand illusion

Ramachandran, V.S., Altschuler, E.L., 2009. The use of visual feedback, in particular mirror visual feedback, in restoring brain function. Brain 132, 1693–1710.



A lot of activation

TMS: Garry, M.I., Loftus, A., Summers, J.J., 2005. Exp. Brain Res. 163, 118–122.

ЭЭГ/МЭГ:

- *Praamstra, P., Torney, L., Rawle, C.J., Miall, R.C., 2011. Cereb. Cortex 21, 1935–1940.*
- *Tominaga, W., Matsubayashi, J., Deguchi, Y., Minami, C., Kinai, T., Nakamura, M., Nagamine, T., Matsushashi, M., Mima, T., Fukuyama, H., Mitani, A., 2009. NeuroImage 46, 500–504.*
- *Touzalin-Chretien, P., Dufour, A., 2008. J. Neurophysiol. 100, 19–23.*
- *Touzalin-Chretien, P., Ehrler, S., Dufour, A., 2009. J. Cogn. Neurosci. 21, 2207–2216.*
- *Touzalin-Chretien, P., Ehrler, S., Dufour, A., 2010. Cereb. Cortex 20, 2007–2016.*

And no specificity

- *Fadiga, L., Craighero, L., Olivier, E., 2005. Opin. Neurobiol. 15, 213–218.*
- *Gazzola, V., Keysers, C., 2009. Cereb. Cortex 19, 1239–1255.*

A cue...

- The functional response properties of high- gamma activity are distinct from ERD and ERS of mu-rhythm in lower alpha (8–13) and beta (15–30) frequencies.

(Pfurtscheller, G., Graimann, B., Huggins, J.E., Levine, S.P., Schuh, L.A., 2003. Clin. Neurophysiol. 114, 1226–1236.)

- In ECoG high gamma power (60–90 Hz) responses were found to occur in a more focal topographical pattern.

(Crone, N.E., Miglioretti, D.L., Gordon, B., Lesser, R.P., 1998. Brain 121 (Pt 12), 2301–2315.)

- Somatotopically defined regions on the basis of high gamma oscillations in the sensorimotor cortex were consistent with maps generated by cortical electrical stimulation.

(Muthukumaraswamy, S.D., 2010. J. Neurophysiol. 104, 2873–2885.; Gaetz, W., Cheyne, D., 2006. NeuroImage 30, 899–908.)

MEG recording

- 24 healthy right-handed volunteers
- 3 experimental tasks:
 - BILATERAL** — self-paced brisk extensions of both index fingers without mirror
 - MIRROR** — **right hand** movements **with mirror**
 - NOMIRROR** — movements were performed with the right hand index finger alone. without mirror
- In all the three conditions the subjects were asked to keep their eyes open and to gaze to the left at the left hand index finger
- the results recorded from 204 planar gradiometers were used for analyses

Navigation in sensor space and frequency

SPM12 toolbox (<http://www.fil.ion.ucl.ac.uk/spm>, Litvak et al., 2011)

BILATERAL condition



Spectral analysis for each channel (using Multitaper)

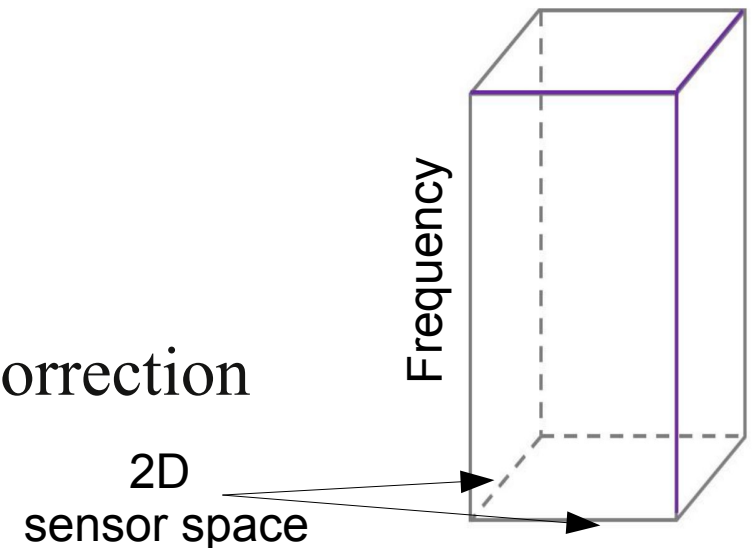
baseline normalization, log-rescale



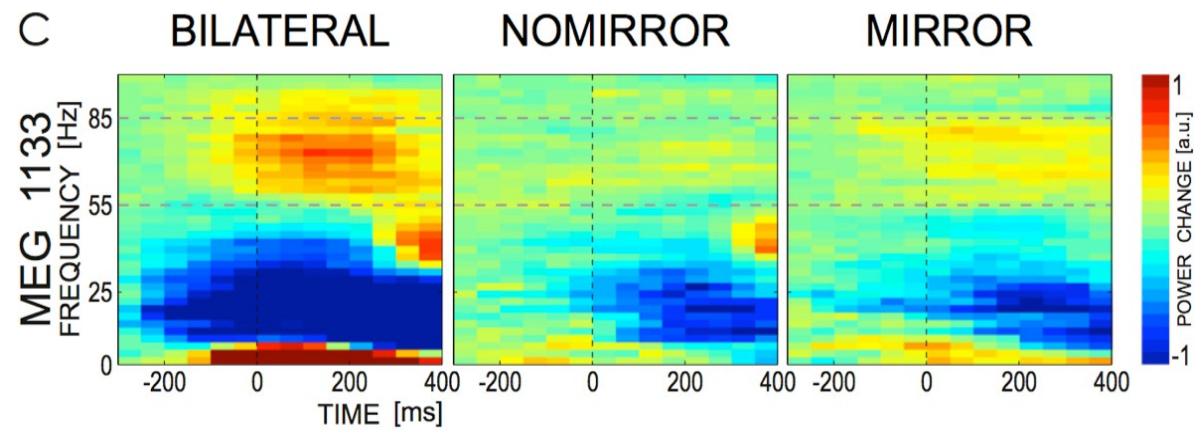
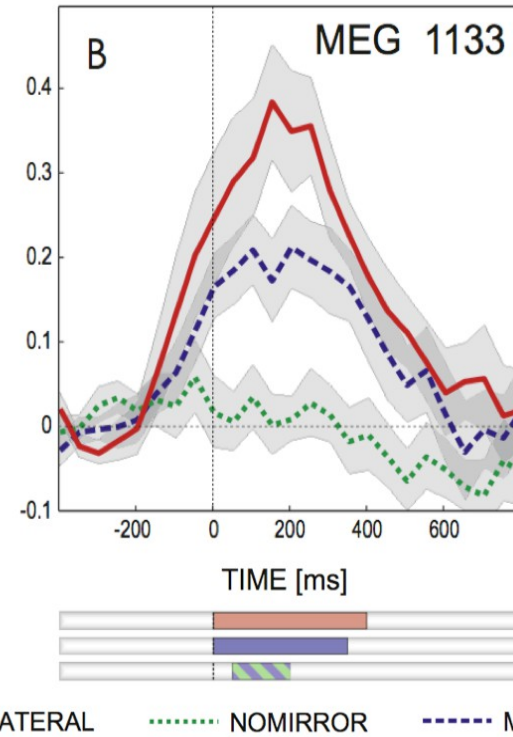
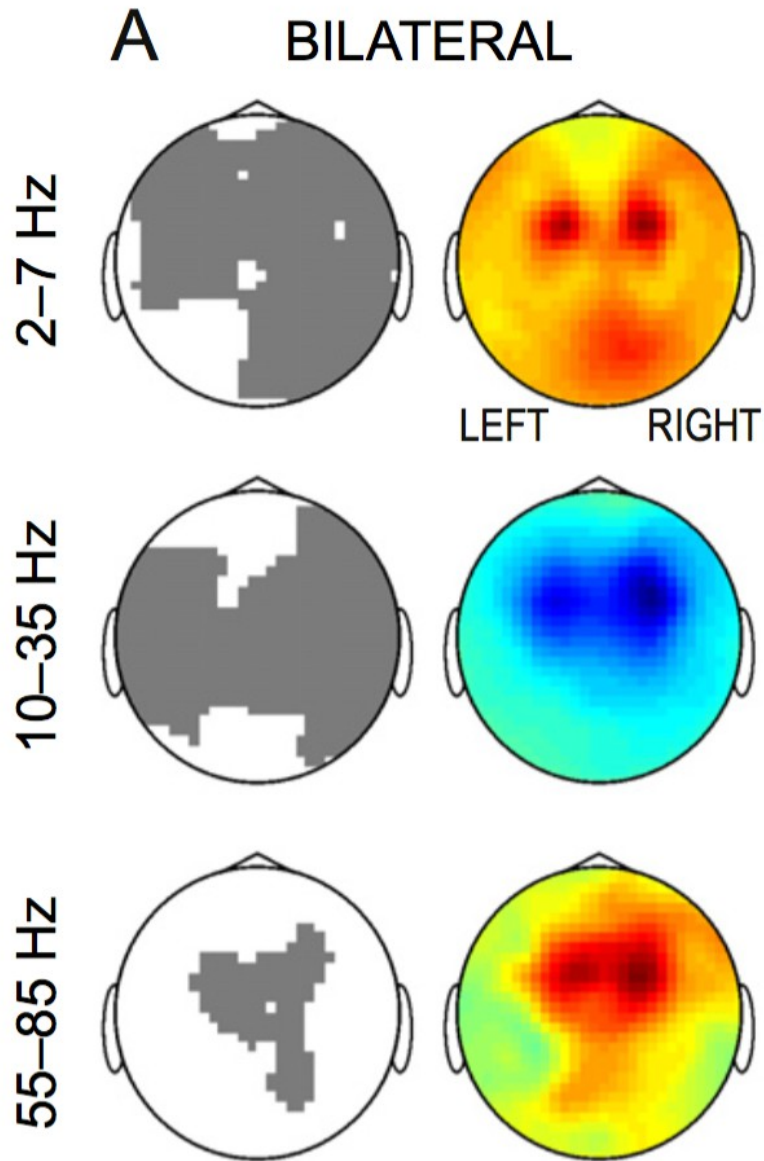
3D space-frequency array



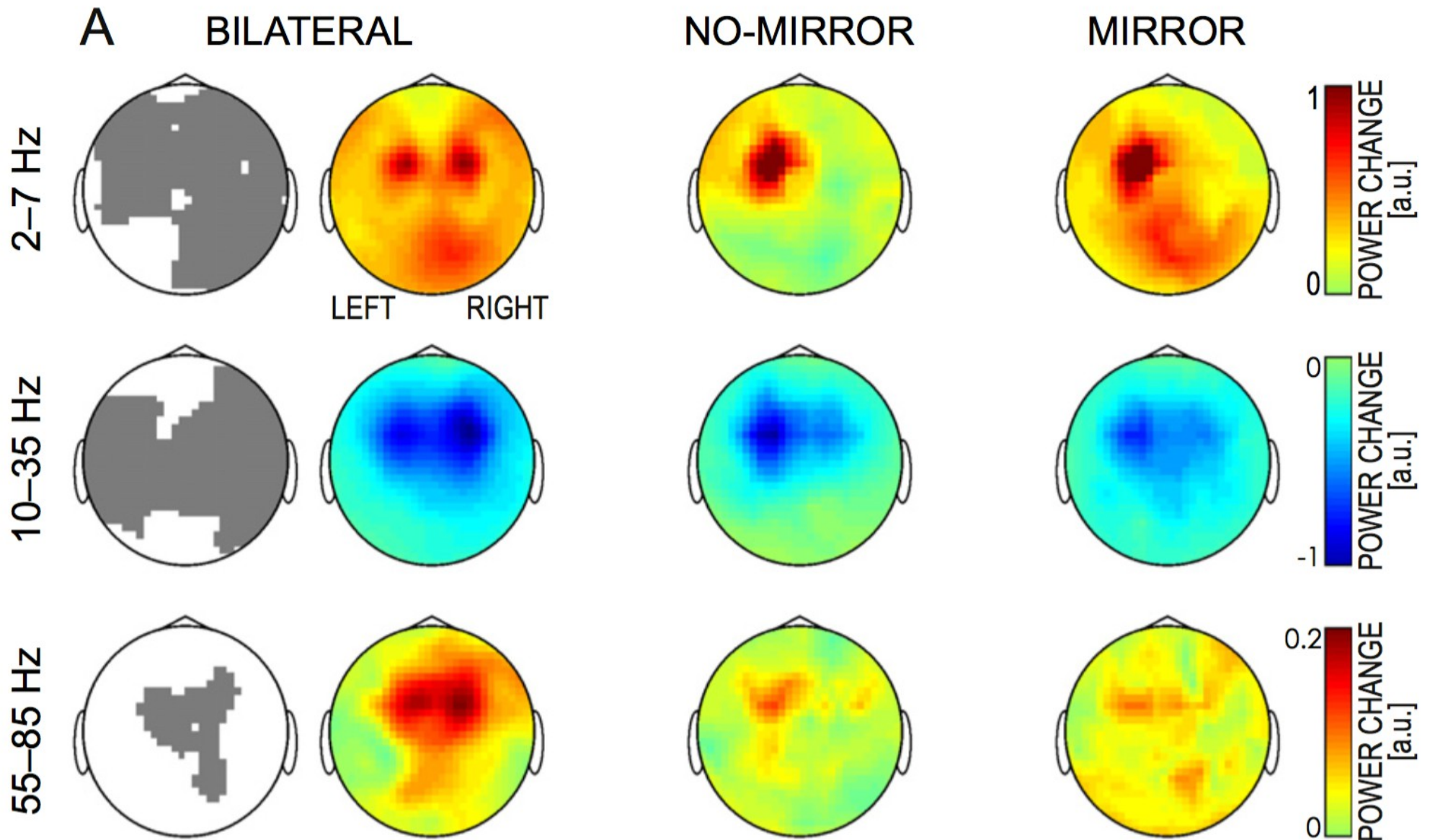
Statistics with RFT multiple comparisons correction



Spatial-frequency analysis



Spatial-frequency analysis



Where it comes from?

- We can hypothesise the existence of wide cross-modal net.
- Nodes:
 - - Frontal neocortex
 - - Sensory-motor area
 - - Visual area
 - - Parietal lobe

