INTERACTION BETWEEN BRAIN ACTIVITY AND LIMB OSCILLATION DURING PARKINSONIAN RESTING TREMOR AND VOLUNTARY MOVEMENTS

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Parkinson's disease in humans is a movement disorder which covers a broad spectrum of symptoms, including predominant resting tremor (t-subtype). The frequency of classical resting tremor lies between 4 and 7 Hz [1]. Resting tremor is centrally generated, whereas reflexes play only a marginal role for the generation of tremor. The pathophysiology of Parkinsonian resting tremor still remains rather unclear. The presence of bidirectional coupling between subthalamic nucleus (STN) activity and contralateral hand oscillations was shown in [3].

To study further the dynamical mechanism which generates Parkinsonian resting tremor, we perform analysis of directional couplings between brain activity (represented by local field potential recordings from different areas of STN) and limb oscillations (represented by accelerometer signals from four limbs). Also, we compare quantitative characteristics of coupling for the regimes of spontaneous resting tremor and voluntary movements (tapping).

To estimate directional couplings, we apply the phase dynamics modeling technique, which is based on fitting an empirical model in the form of phase oscillators to the measured data. As an auxiliary characteristic, we estimate mean phase coherence.

The analysis was performed in four Parkinsonian patients. We observed that brain-to-hand interaction is stronger for posterior part of STN for the three of the four patients.

Also, we performed analysis of couplings between STN and contralateral hand during resting tremor and voluntary movements. We observed bidirectional coupling between STN activity and limb oscillations for both regimes. But the brain-to-hand coupling during resting tremor appeared stronger than for the opposite direction.