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Diffusion tensor imaging (DTI) and Transcranial magnetic stimulation (TMS): an integrated approach

Ludovico Magaudda[1], Antonio Duca[1], Angelo Quartarone[2], Carmelo Milazzo[1], Gianluigi Vaccarino[1] and Angelo Favaloro[1]

[1] Dipartimento di Biomorfologia e Biotecnologie. Università degli Studi di Messina, Messina, Italy
[2] Dipartimento di Neuroscienze, Scienze Psichiatriche e Anestesiologiche. Università degli Studi di Messina, Messina, Italy

In present study we adopted an innovative approach, integrating the "Diffusion Tensor Imaging tractography (DTI)" technique with navigated transcranial magnetic stimulation (nTMS). In this way it is possible to improve accuracy of motor fiber reconstruction by positioning the fiducial seeding from DTI reconstruction, over the motor areas localized by nTMS. This will allow a direct comparison between the density of the motor map obtained with nTMS with the related axonal density obtained with DTI.

DTI uses anisotropic water diffusion like test to study in vivo white matter anatomy in order to reconstruct tri-dimensional fiber bundles improving the practical 1 mm. MRI scanning resolution. Therefore we used the appropriate acquisition and reconstruction DTI techniques in order to study local cerebral pathways. Related acquisition must be done following resonance protocol and varying the magnetic gradient, in order to have the following steps: DWI acquisition; tensor calculation; scalar maps; 3d visualization; fiducial seeding. DTI technique can exploit two different classes of fiber tracking algorithms: "deterministic" or "probabilistic" tracking higher-order integration schemes. The deterministic one, allows to calculate the directions of streamline propagation, and reveals only, presence or absence of a connection. On the other hand a probabilistic tracking approach is achieved: starting from a basic point, fibers are propagated multiple times through the tensor field while varying, in a stochastic way, the estimated fiber orientation along the traversed voxels.

In addition nTMS is a newly evolving technique for in vivo investigating human motor system combining spatial information from high-resolution MRI with the functionality of non-invasive cortical stimulation. In this way it is possible to target motor areas more precisely obtaining a discrete motor maps of facial, hand and leg muscles.

This innovative approach will indeed provide a new tool in neuroscience for an in vivo direct correlation between anatomical circuits and electrophysiological data.

Keywords: DTI, nTMS, fiducial seeding, in vivo.