Exam of the course
"Biomedical Applications of Mathematics"
(2014/15)

The student has to choose **one** of the three parts of the course, and do what is there requested.

⋆ First part: **Roberto Bonmassari** and **Eleuterio F. Toro**

The procedures for the exam have been described by Prof. Toro [see Toro (Introduction and rules); report about 15 pages (respectively, 20 pages) and oral presentation about 10 minutes (respectively, 20 minutes) for 3 credits (respectively, 6 credits).]

⋆ Second part: **Paolo Manganotti**

The exam consists in a computer slide presentation of one of the following topics [time: about 20 minutes (respectively, 40 minutes) for 3 credits (respectively, 6 credits)]:

- multimodal analysis (EEG, HD EEG, fMRI) for study of the epilepsy
  Related papers:
  - Baillet et al., Electromagnetic brain mapping, IEEE Signal Processing Magazine, 18 (2001), 14–30
  - Wolters et al., Numerical mathematics of the subtraction method for the modeling of a current dipole in EEG source reconstruction using finite element head models, SIAM J. Sci. Comput., 30 (2007), 24–45
- brain stimulation and multimodal analysis
  Related papers:
  - Heller and van Hulsteyn, Brain stimulation using electromagnetic sources: theoretical aspects, Biophys. J., 63 (1992), 129–138
  - Sekino et al., Intensity and localization of eddy currents in Transcranial Magnetic Stimulation to the cerebellum, IEEE Trans. Magn., 42 (2006), 3575–3577
- digital analysis in EEG
  Related papers:
  - Thakor and Tong, Advances in quantitative electroencephalogram analysis methods, Annu. Rev. Biomed. Eng., 6 (2004), 453–495

The quoted papers have to be requested to Prof. Valli

⋆ Third part: **Nivedita Agarwal**

The exam consists in a computer slide presentation of one of the following topics [time: about 20 minutes (respectively, 40 minutes) for 3 credits (respectively, 6 credits)]:

- Diffusion Tensor Imaging (DTI): theoretical basis for the study of water molecules diffusion in the brain tissue
  Related papers:

- Basser et al., Estimation of the effective self-diffusion tensor from the NMR spin echo, J. Magnetic Resonance (Series B), 103 (1994), 247–254
- Basser et al., Diffusion-tensor MRI: theory, experimental design and data analysis. A technical review, NMR in Biomedicine, 15 (2002), 456–467
- Mori et al., Fiber tracking: principles and strategies. A technical review, NMR in Biomedicine, 15 (2002), 468–480
- Westin et al., Processing and visualization for diffusion tensor MRI, Medical Image Analysis, 6 (2002), 93–108

- Functional MRI (fMRI): mapping the brain activity by means of magnetic resonance. From the basis to data analysis
  Related papers:
  - Ogawa et al., Functional brain mapping by blood oxygenation level-dependent contrast magnetic resonance imaging. A comparison of signal characteristics with a biophysical model, Biophys. J., 64 (1993), 803–812
  - Friston et al., Analysis of functional MRI time-series, Human Brain Mapping, 1 (1994), 153–171
  - Friston et al., Statistical parametric maps in functional imaging: a general linear approach, Human Brain Mapping, 2 (1995), 189–210
- Functional connectivity MRI (fCMRI): methods to analyze brain functional connectivity using fMRI
  Related papers:
  - Lowe et al., Functional connectivity in single and multislice echoplanar imaging using resting state fluctuations, Neuroimage, 7 (1998), 119–132
  - Li et al., Review of methods for functional brain connectivity detection using fMRI, Comput. Med. Imaging Graph, 33 (2009), 131–139

The quoted papers have to be requested to Prof. Valli