MiBraScan Kick-off meeting

Naples, 01/02/2017

Participants: Lorenzo Crocco, Rosa Scapaticci, and Gennaro G. Bellizzi (CNR-IREA), Enrico Tedeschi and Gennaro Bellizzi (UNINA), Francesca Vipiana, Jorge Tobon and Giovanna Turvani (POLITO), Nadine Joachimowicz and Bernard Duchêne (CNRS, SUPELEC).

**Presentation of group skills:**

1st presentation: POLITO

* The objective is to realize a microwave-based system for the monitoring of brain strokes
* Main expertise: 3D EM full wave solver
* Design and prototype of custom printed antenna
* TX/RX system
* Hardware acceleration

2nd presentation: CNR-IREA/UNINA

* Tool for fixing working condition
* Methodology for optimal MWI system design
* Dr. Enrico Tedeschi (neuroradiologist) can support the project by comparing MiBraScan images with the one obtained with standard techniques (e.g. CT) and providing CT images to “extract” the realistic shape of strokes.

3rd presentation: CNRS

* Phantom prototyping
  + 3D printed structure filled with liquid
  + Study of different dielectric properties
  + UWB head phantom
  + Segmentation -> numerical phantoms -> physical phantoms
* Proposal for MiBraScan:
  + 1 - Design & realization of anthropomorphic phantom (with 3 or 4 cavities) Head phantom: Brain phantom (mixture of white/gray matter) surrounded by a CSF layer + bottom cavity filled with a muscle mimicking mixture + anomaly
  + 2 - Possible issue: stroke injection (balloon?) or a 3D printed anomaly (4th cavity)
  + 3 - Computation of electromagnetic fields inside the phantom with and without infarcted tissue mimicking anomaly; influence of the type of anomaly and of the composition of head for a given configuration (frequency, source, coupling medium)
  + 4 - Learn from simulations and 3D printing (waterproof cavities) – Go to 1
  + 5 - Top and bottom holes must be created for the filling of the brain. Theoretically, the bottom part (in concomitance of the jaw) must be filled.

**First steps of the project:**

* State of the art
  + Chalmers University: the limitation is that the system is not able to provide brain images. It consists in a statistical analysis
  + Semenov/Abbosh: the system is not portable
  + Joe LoVetri
* System requirements
  + CNR-IREA:
    - Working frequency < 1.5Ghz
    - Embedding medium [10-50]
    - 7-15 spatial resolution
  + POLITO:
    - Antenna: (0.5 – 3) GHz
    - Number of antennas: 24
    - OK with geometrical dimension
    - Coupling liquid (silicon rubber & carbon powder?)
    - High isolation switches (Keysight components)
    - In a first step: substitute the TX-RX parts with the Keysight network analyser. After, create a custom system.
    - The elaboration of a 2D image is a key point since numerical simulation does not allow us to consider the interferences introduced by the matrix of switches.
* 3D full wave modelling tool
* Segmented head test cases
* Website
  + New website hosted by Politecnico di Torino
  + Logo Contest
  + Email & Forwarding system