SHORT COURSE PROPOSAL TO EuCAP 2014, The Hague, THE NETHERLANDS

Course title: Metamaterial Cloaking: Basic Principles and Applications in Antenna Systems

The course aims at giving the basic principles of cloaking and electromagnetic invisibility. The main differences between cloaking and other common techniques used in microwave and radar technologies and based on radar absorbing materials and structure shaping (i.e. stealth aircrafts) are first remarked and carefully addressed. Then, the course will briefly present the main techniques recently presented in the literature to achieve electromagnetic invisibility: transformation electromagnetics, scattering cancellation, transmission-line cloaks, corrugated surfaces, etc. Proper figures of merit to describe the effectiveness of an invisibility cloak will be presented and discussed. A comprehensive comparison among the main cloaking techniques will be presented in order to show what is the best cloaking approach, depending on the application and the requested performances. The scattering cancellation approach to cloaking will be presented with further details and two typical implementations (i.e. plasmonic cloaks and mantle cloaks) will be discussed. Finally, possible applications of the scattering cancellation approach in antenna systems will be presented and discussed with the help of several examples (e.g. cloaking a metallic rod, reducing antenna blockage, cloaking a sensor, cloaking a half-wave dipole, reducing the mutual coupling and the mutual blockage effect between two antennas, etc.)

Requested pre-requisites (e.g. the participants should have followed a Masters level course on Electromagnetics, or they should be able to use a given software): Master level in electromagnetics.

List of chapters (typically between 5 and 10 chapters):

1. Definition and general concepts
2. Comparison between electromagnetic invisibility and other low-observability techniques
3. Brief summary of the main techniques used to achieve electromagnetic invisibility
4. Figures of merit to describe the effectiveness of a cloaking device
5. Critical comparison among the different approaches to cloaking
6. Scattering cancellation: principles and design techniques
7. Scattering cancellation based on volumetric metamaterials (plasmonic cloaking)
8. Scattering cancellation based on metasurfaces (mantle cloaking)
9. Applications: cloaking passive objects (metallic or dielectric rods and general obstacles)
10. Applications: cloaking objects with some functionalities (sensors, antennas)