Bridging the gap between Method of Moments and Iterative Physical Optics: A new fast numerical method for high frequency domain

**Beginning:** October 2016  
**Duration:** 36 months  
**Locations:** Half time in Italy at the University of Siena and the other half in France at the University of Nantes (IETR laboratory). The candidate must be a European citizen and it will be possible to obtain a double PhD diploma by defending the PhD thesis both in France and Italy.

**Context and overview of the problem:**  
The control of electromagnetic signatures is generally an important challenge which contributes to the superiority of our armed forces. Indeed, most armament programs are concerned by R&T efforts, technical studies, simulations, measurements and tests for several domains dealing with the Radar signature of a system: electronic warfare, Radar stealth, electromagnetic detection, localization and identification, etc. In order to improve the electromagnetic stealth of a military system, the Radar Cross Section (RCS) computation is mandatory as soon as the conception phase begins. Some of the main contributors to overall electromagnetic signatures of aircrafts are the cavities made by the air ducts (large and complex cavities) which can be very strong contributors and, therefore, must be taken into account. Studies led in order to decrease and optimize the electromagnetic signatures, are necessarily based on numerical simulations. But, the rigorous solving of the Maxwell equations for such complex and large problems can be unadapted, in particular for the first test designs. This has motivated the emergence of an asymptotic numerical method: the Iterative Physical Optics (IPO). This method is very well-adapted for large structures in which multiple reflections occur, for example the RCS computation of large cavities, and can be seen as a trade-off between rigorous numerical method (as the Method of Moments for example) and asymptotic methods based on Shooting and Bouncing Rays. Nowadays, by the help of recent works mainly led in Spain, USA, Italy and France, the IPO has reached a very mature implementation. But, even though it can be applied for any large problems (example: RCS computation of an aircraft), the method can suffer from divergence and bad results for some specific cases.

In this PhD thesis, based on various ideas inherited from the Method of Moments (MoM), we propose to modify deeply the IPO method in order to develop a new fast numerical method.

**Candidate profile:**  
The PhD candidate should hold a Master degree in electrical engineering, physics or an equivalent title. In particular, he should master electromagnetic theory and mathematics. A good level of spoken and written English is required.

**Supervision:**  
- **French supervision:**  
  - Dr. Christophe Bourlier (HDR) – CNRS Research Director– IETR laboratory (Remote sensing Team): PhD thesis supervisor - Email: christophe.bourlier@univ-nantes.fr  
  - Dr. Gildas Kubickle – In charge of the « Expertise in electroMagnetism and Computations » at the DGA (Electromagnetic Signatures Department): PhD thesis co-supervisor  
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  - Dr. Philippe Pouliguen (HDR) – Head of the scientific domain « Acoustic and Radioelectric waves » at the DGA (Office for advanced research and innovation): PhD thesis supervisor  
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- **Italian supervision :**  
  - Pr. Matteo Albani – Professor – University of Siena – DIISM laboratory: PhD thesis supervisor  
    Email: matteo.albani@dii.unisi.it

**Application:**  
Interested candidate should send a CV and motivation letter by email to the 4 supervisors.