Method of Auxiliary Sources Application to the Creation Photonic Band Gape Structures based on Complex (Biisotropic, Chiral or Ordinary) Materials

Investigation of electromagnetic behavior of complex media has gained interest in the last decade.

Many techniques have already been proposed for studying the scattering of electromagnetic waves by bodies composed of complex materials, such as anisotropic, chiral, and bi-isotropic media. However, problems having complicated geometries or large dimensions are still difficult to handle. Therefore, more appropriate and efficient methods need to be designed.

The research team of LAE has been working to extend the MAS for bi-isotropic, chiral and complex materials during the past several years. The key idea of the MAS is to represent the unknown scattered field by a sum of fundamental solutions of the appropriate wave equation named Auxiliary Sources (AS), whose radiating centres are located on some auxiliary surface, shifted outside the area where the field is to be found. Unknown coefficients are determined from the satisfaction of boundary conditions. Relative to widely used established methods, like the Method of Moments, the shifting of the sources sharply reduces the necessary number of unknowns, and gives higher accuracy and faster convergence of the solution.

The objectives of this proposal and **potential results** are:

1. Extension of the developed Method of Auxiliary Sources (MAS) methodology for handling bi-isotropic, chiral and complex materials.
2. Development of a package of computer programs in order to investigate Photonic Band Gap (PBG) structures.
3. Development of numerical models for PBG in high frequencies for antennas and systems that integrate multiple RF components, such as antennas + circulator (integrated RF systems).
4. Design, development, and experimental investigation of prototypes of antennas and integrated RF systems.
5. Development of a program package for educational and research purposes, which can facilitate the research of graduate students and cultivate the computational skill and engineering intuition of senior students in the electromagnetic area.

It could be mentioned, that all topics in this project related with present days new problems and connected with state-of-the-art technology. Hopefully, in near future biisotropic and chiral materials will be used in many systems including in PBG Structures. In order to speed up these processes, it is grate demand to create conditions to new generation students to raise their skill level and intuition in Electromagnetic Phenomena connected with complex materials. Created easy manage as game software package of program as educational version may enable to give a chance to specialize in this subject students and young scientists. Also, this package of program can have potential commercial value as educational software for another Universities, studies and companies, working on this problem.

Proper realization of this project will force to study advantages in High Frequency electronic devices individual and integrate circuits functionalities as well as possibilities to construct new type of PBG based better properties Antenna.