A window on Information Communication Technology

Edoardo Calia

An example of joint research between Europe and Australia

Mobility of researchers is a more and more frequent practice in present days. Even if resources are difficult to be raised, there are many opportunities in this sense. One of the organizations more active in funding research is the European Commission, which in the 7th Framework Program (7FP) and in particular in the Marie Curie Action: "International Outgoing Fellowships for career development (IOF)", dedicates significant economical resources to this kind of actions.

As stated also in the People Work Program1, the Marie Curie Action funding scheme aims to reinforce the international dimension of the career of European researchers by giving them the opportunity of being trained and acquire new knowledge in a high-level research organization in third countries, i.e. those neither a Member State nor an Associate Country to the European Union. This is realized by financial support to individual mobility projects lasting up to 3 years.

In this context, Ladislau Matekovits (ladislau.matekovits@polito.it), Assistant Professor of Electromagnetic Fields and Antennas at the Politecnico di Torino (http://www.polito.it), one of the leading technical universities in Italy, presented a proposal entitled Analysis of Low-cost Original Holographic Antenna: Theoretical OveRvIew, NOtes, StudY, DesigN, and EasY Implementation (ALOHA TORINO-SYDNEY) having as host institution the Centre for Electromagnetic and Antenna Engineering (CELANE) at the Macquarie University, Sydney. The aim of the project is the theoretical study, numerical validation and experimental characterizations of holographic antennas, a class of antennas in which the radiating aperture is formed by a conductive metallic pattern, realized with microstrip technology, over a grounded (multi)layer dielectric material, where surface-waves propagate.

The EC has decided to fund this proposal that includes a two years period at Macquarie University and one year of return at Politecnico di Torino. The start of this mobility program is scheduled for July 2009.

At the outgoing institution, the person in charge of the scientific and technical/technological aspects in this project is Prof. Mario Orefice (mario.orefice@polito.it), the research group leader and Director of the Antenna and EMC Laboratory (LACE) where Prof. Matekovits is carrying out his research activity. The same role at the host institution is covered by Prof. Karu Esselle (esselle@ics.mq.edu.au).

The implementation of the project has started with administrative issues related to the stipulation of a Grant Agreement between European Commission and Politecnico di Torino. This has been followed by a second Partnership Agreement between Politecnico di Torino and Macquarie University.

The technical aspects of the projects extend from the definition of the application scenarios to prototypes and their experimental characterization. Starting form a theoretical analysis, modification / integration of the existing computer codes (both integral formulation and finite differences based) of the two research groups will be implemented, with the aim of allowing the study of the holographic antennas, based on quasi-periodic structures in microstrip technology. Multi-objective optimization techniques will be considered to increase the antenna performances. The numerical analysis of large and finite dimensions structure requires a considerable numerical effort both in terms of computer memory requirement and computational time; their reduction represent challenging issues for the today's scientific community working in computational electromagnetics.

Studies of holograms have been started at optical frequencies to obtain virtual images as a result of interference of two polarized electromagnetic waves. The first applications of holograms at microwave frequency are date back to 70es, but nowadays the topic is of high interest of the scientific community. The hologram is obtained by recording the resulting interference between two polarized electromagnetic waves at the air-substrate interface. Exciting the hologram with only one of these two waves, the second one is generated.

1 European Commission C(2007)562 of 26.02.07.

Realization of the holographic surface strongly depends on the frequency range where it will be employed. Here we are interested in the GHz band and the overall geometry is based on a periodic arrangement of a small dimension unit cell. A modulation inside the unit cell gives a further degree of freedom in controlling the frequency response. The novel structure which is proposed for this purpose has been submitted to be patented.

The hologram is viewed as a variable surface impedance: its synthesis is realized by the width modulated microstrip lines. The periodic arrangement of such structures allows the generation of a substrate that supports slow waves, mandatory for the coupling between the surface and space waves. The control of the phase velocity, i.e. the surface impedance, is achieved by adequately varying the width of a microstrip line inside the unit cells.

In Electromagnetics, materials with such properties but of different realizations were first employed at optical frequencies but, more recently, various applications at millimeter waves make use of them. Antennas based on this principle present various advantages: the most important is the polarization purity of the radiated field. The absence of the feeder in the front of the antenna eliminates the blockage; hence a higher gain and better performances can be achieved. Substrates for printed structures for antenna miniaturization or bandwidth enhancement, surface-wave coupling reduction between antennas, reduction of scattering from circular struts to reduce blocking in reflector antennas, generation of surfaces transparent to the electromagnetic field, etc. represent other possible application of the structure. Holographic surfaces were recently considered at microwave frequencies since they offer new potentialities in the field of antennas.

The proposed low cost microstrip technology is widely employed in aerospace applications as well, because of the reduced dimensions of the antennas and the possibility to build conformal configurations.

The Personal Career Development Plan defined in accordance between the two coordinators and Ladislau Matekovits, defines the steps to be followed to reach the aforementioned goals of the grant. Publications of scientific articles and participation at workshops, courses, technical conferences on the subjects of the project will contribute to increase the visibility of the ongoing work, to receive feedback from other research groups working on similar topics, and to disseminate the results.

Over the many common aspects in the research groups at both institutions, there are many complementary issues that are going to be explored during the two years period that Ladislau Matekovits will spend in Australia, and will contribute to the diversification of his expertise and skill.

This real example of researchers' mobility gives the opportunity to extend the cooperation between the two Universities, in directions like double degrees or Ph.D.s. Agreements in this sense have been signed, or are under preparation, by Politecnico di Torino with other Australian universities. Beyond the technical aspects, the exchange of students between two universities allows them a better understanding of the culture of the host country and development of personal contacts, useful for future transcontinental collaborations.

Ladislau Matekovits was born in Arad (Romania), on November 19, 1967. He received the degree in Electronic Engineering from Institutul Politehnic din Bucureşti, Bucureşti, Romania and the Ph.D. (Dottorato di Ricerca) in Electronic Engineering from Politecnico di Torino, Turin, Italy in 1992 and 1995 respectively. Since 1995 he has been with the Electronics Department of the Politecnico di Torino, first with a post-doctoral fellowship, then as a Research Assistant. He joined the same Department as Assistant Professor in 2001. His main research activities concern numerical analysis of printed antennas and in particular development of new, numerically efficient full-wave techniques to analyze large arrays, metamaterials and optimization techniques. In late 2005 Ladislau Matekovits was Visiting Scientist at the Antennas and Scattering Department of the FGAN-FHR, Wachtberg, Germany.

Dr. Matekovits is recipient of many awards in international conferences, and is member of various conferences program committees. He was Assistant Chairman and Publication Chairman of the European Microwave Week 2002 (Milan, Italy). He serves as a reviewer for the various journals in the field of antennas.

Ladislau Matekovits speaks Hungarian, Romanian and Italian fluently and has good knowledge of English. He holds both Italian and Romanian citizenships.

Ladislau Matekovits
Dipartimento di Elettronica, Politecnico di Torino
C.so Duca degli Abruzzi, 24, 10129 Torino - Italy
phone: +39-011-564-4119 (office), fax: +39-011-564-4217
e-mail: ladislau.matekovits@polito.it
skype: ladislau_matekovits

Edoardo Calia
Istituto Superiore Mario Boella
Via Pier Carlo Boggio 61
10138 Torino, ITALY
email: calia@ismb.it
tel: +39 011 2276201
fax: +39 011 2276299

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