



H.F.R.I.
Hellenic Foundation for
Research & Innovation

Description of the funded research project
2nd Call for H.F.R.I. Research Projects
to Support Post-Doctoral Researchers



Title of the research project: Innovative Textile Structures for Mechanical Electromagnetic Reconfigurability of Wearable Antennas

Principal Investigator: Aris Tsoilis

Reader-friendly title: M-REWEAR

Scientific Area: Engineering Sciences & Technology

Institution and Country:

Host Institution: NCSR "Demokritos", Institute of Informatics and Telecommunications

Collaborating Institution(s):

**Project webpage
(if applicable):**

Budget: 195.740€

Duration: 36 months

Research Project Synopsis

In recent years, there has been growth in the use of wireless wearable systems, which is associated with the need for antennas that can change their characteristics (reconfigurable antennas). The wearable antennas on one hand, present some limitations in implementing reconfigurability techniques applied in conventional antennas, on the other hand they have some special features that can be used to develop new techniques for reconfigurability that are adapted to them. The M-REWEAR research project will study, develop and evaluate innovative structures for the reconfiguration of wearable textile antennas (WTA), focusing on devices for wearable applications at 1-8GHz frequency bands.

The main objectives of this research, concern the testing of several mechanical reconfiguration antenna structures in the development of reconfigurable WTA. The feasibility to achieve reconfigurability by exploiting different textile materials, embroidery techniques, clothing and sewing accessories such as Zipper, Velcro strips, Snap-on buttons etc., will be investigated.

The research methodology includes the following phases:

- Specification and design of the novel structures for mechanical electromagnetic reconfiguration of WTA;
- Verification of the desired operation of the proposed structures through simulations and implementation of prototypes;
- Assessment of the performance of the proposed structures through measurements and development of demonstration experiments.

Project originality

M-REWEAR project will investigate the design, implementation and evaluation of innovative structures appropriate for mechanical electromagnetic reconfiguration of the operation mode (on-/off-body) of WTA at 1-8GHz frequency bands (1.575-GPS, 1.9GHz-GSM, 2.4GHz/5GHz-ISM). Use of sewing and embroidery accessories (Zip, Velcro, embroidery patterns with conductive yarns etc.) for the reconfiguration of WTA (Polarization reconfiguration, Radiation pattern reconfiguration, Frequency bandwidth reconfiguration, Textile Transmission line to WTA operating mode reconfiguration).

The main challenges, which define the originality of the project are:

- The realistic electromagnetic modelling of the novel structures which will use mechanical reconfiguration components (e.g. Velcro, zip, embroidery patterns with conductive yarns etc.);
- Integration techniques of the mechanical components onto the wearable textile antenna (by using embroidery or other techniques);
- Effectiveness in wearable antenna operation mode (on-/off-body);
- User-friendly and simplified in terms of electronics complexity and energy saving.

Main goals and innovations of the project will be: a) to overcome electrically reconfiguration complexity and electrical energy consumption by using the mechanically reconfiguration technique by creating user-friendly and wearable compatible textile structures and b) to use the embroidery procedure to embed the mechanical reconfiguration parts (e.g. zip, Velcro etc.) into antenna structure.

Expected results & Research Project Impact

The expected M-REWEAR project results are:

- The realistic electromagnetic modelling of the novel structures which will use mechanical reconfiguration components (e.g. Velcro, zip, embroidery patterns etc.). It is extremely important to accurately design and estimate the performance of the antennas with these components integrated on them.
- Definition of integration techniques of the mechanical components onto the wearable textile antenna (by using embroidery or other techniques). This is very important in terms of achieving the closest as possible prototypes to the designed structures.
- Optimization of the efficiency of the proposed antennas in wearable operating mode (on-/off-body). Though the antennas to be designed will not look like the conventional ones they still have to operate as they are in terms of RF performance.
- Design of user-friendly wearable structures, simple and with low complexity in terms of electronics and energy saving.

The M-REWEAR project impact:

The research on reconfigurable technologies for wearable antenna systems focuses on the design and implementation of new technology wearable antennas for integration into smart wearable systems. It is emphasized that the wearable systems are an important part of e-Health and IoT systems with numerous applications in sports, health monitoring and fitness, wellness, information and entertainment, workers safety and industry to assist processes of labor automation. Internationally, despite the great technological progress, the use of wearable systems is not yet as widespread as expected, however a strong growth is foreseen with further technological development and the user acceptance of wearable systems. These application areas have significant socio-economic impact. The M-REWEAR project is mostly research and therefore the direct beneficiaries of its implementation will be the participants in this research. The research results will be available through communications in international conferences and high-impact journals, creating in this way a direct benefit to the wider research community.

The importance of this funding

My involvement in the project will increase my knowledge and further academic recognition. Leading the project's research group, I will have the chance to enrich my experience in the academic research and education as well as to qualify for further academic positions. Moreover, the cooperation with the project's MSc students will improve my capabilities of supervising young researchers running through for a higher educational title.

Some general expectations engulfing personal aspirations are the following. The possibility of patent applications for selected innovations of the project, constitutes a challenging aspect. The research topics to be discussed during the project lifetime are at the cutting edge of information and communication technology worldwide. So the scientific and technological excellence achieved would allow further exploitation of the results and claiming National or European funding to support the coordination of new research activities.



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