

ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

**MUR DM 117/Wavison - Study, development,
implementation and testing of microwave systems
integrated with machine learning approaches**

Funded By	MINISTERO DELL'UNIVERSITA' E DELLA RICERCA [P.iva/CF:97429780584] Politecnico di TORINO [P.iva/CF:00518460019] WAVISION SRL [P.iva/CF:12732280016]
Supervisor	VIPIANA FRANCESCA - francesca.vipiana@polito.it
Contact	VIPIANA FRANCESCA - francesca.vipiana@polito.it
Context of the research activity	Study, development, implementation and testing of microwave systems integrated with machine learning approaches for the creation of innovative production processes with high efficiency and sustainability Progetto finanziato nell'ambito del PNRR – DM 117/2023 - CUP E14D23002000004
Objectives	<p>Foreign object contamination is a major cause of customer complaints against food/beverage manufacturers, resulting in recall costs and loss of brand loyalty. Cases of contaminated food/beverage continue to reach the market and incidents remain significant, particularly with plastic and glass shards. Nowadays different technologies, such as X-ray systems, metal detectors and near infrared techniques, are used for inline monitoring of food/beverage products. However, X-ray systems are not able to detect low density contaminants (such as common plastic), metal detectors can only detect metal objects and infrared systems cannot penetrate inside the product, checking only the outer packing. Therefore, there is a clear need for new technologies to be applied to the monitoring of packaged food/beverage products online.</p> <p>The research activities will be focused on the study, development, construction and testing of systems for the detection and monitoring, during industrial production, of biological risks (such as bacterial pathogens, fungi and parasites) and chemical/physical (such as microplastics, accidental fragments of e.g. plastic and glass) in the food, pharmaceutical and cosmetic</p>

production sector. The systems will be based on microwave imaging and sensing technology integrated with machine learning approaches to control the quality, safety and authenticity of products.

The application of the developed detection and monitoring system, able to identify only the contaminated products (if any), will allow to minimize production waste which today, in the case of contaminated production lines, can include the entire lot. Furthermore, by avoiding the distribution of contaminated lots, it will be possible to minimize product recalls by the company, with clear savings in terms of costs and carbon footprint. In the food sector, the proposed activity is part of the European "Farm to Fork" strategy which has the primary objective of reducing food waste and losses. Furthermore, the microwave sensing and monitoring systems will be low power, limiting energy consumption (mW compared to kW required by X-ray based systems). The reduction of waste and energy consumption will lead to an improvement in the efficiency and sustainability of the production process.

Skills and competencies for the development of the activity

- Expertise in electromagnetic (EM) modelling, simulation and optimization
- Development of numerical algorithms for computational electromagnetic
- Capabilities in programming with C/C++ and/or Matlab and/or Fortran
- Knowledge of 3D EM softwares such as CST Studio Suite