
SEMINAR

Design of Phased Arrays for Medical Applications

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Many medical applications of microwaves exploit phased arrays. For instance, properly driven arrays are used in hyperthermia to induce the required increase of temperature in the region to be treated, while preserving the surrounding tissues. In diagnostics, microwave imaging techniques rely on the capability of handling a large number of array elements and recording all the channels in a fast and reliable way.

Although it is commonplace to design this class of systems using the usual microwave engineer toolbox, this task actually poses peculiar and novel challenges. In particular, the region of interest is three-dimensional, close or even in contact with the array elements. Moreover, the scenario is highly heterogeneous, lossy and changes from patient to patient. Neglecting these aspects, unavoidably leads to sub-optimal systems, in terms of number of elements and/or achievable performances, with detrimental consequences on the effectiveness of the treatment or the accuracy of the diagnosis, as well as on the complexity and the cost of the system. Hence, a more sound approach would require facing the abovementioned challenges, reconsidering the fundamentals of phased array design in order to devise proper criteria and tools.

In this talk, we introduce a general framework and the required mathematical tools for designing the layout (i.e., number and locations of the elements) of an array for medical applications. Notably, the approach does not depend on the actual scenario (i.e., the specific characteristics of the patient) and relies on a properly revisited version of the classic parameters used to design radiating systems.

The framework is meant to tackle the two basic design problems relevant to biomedical applications, namely the design of an array for therapeutic purposes and of an array for diagnostic/imaging goals, but it can be naturally extended to the theranostic case of dual-devices, capable of both detecting the illness and treating it.

- **About the Speaker**

Ovidio Mario Bucci (F'93) was born in Civitavecchia, Italy, in 1943. He received the Diploma degree in electronic engineering from the University of Naples, Naples, Italy, in 1966. From 1967 to 1975, he was an Assistant Professor with the Istituto Universitario Navale, Naples, and then became a Full Professor of Electromagnetic Fields at the University of Naples. He was the Head of the Department of Electronics Engineering and the Vice Rector with the University of Naples, the Director of the Istituto per il Rilevamento Elettromagnetico dell'Ambiente, Naples, an Institute of the Italian CNR, the President of the National Group of Electromagnetism, and the Director of the Interuniversity Research Center on Microwaves and Antennas. He has authored or co-authored more than 400 scientific papers, mostly in international journals or international conference proceedings, on many topics in theoretical and applied electromagnetism, such as scattering from loaded surfaces, reflector and array antennas, degrees of freedom of electromagnetic fields, near-field far-field measurement techniques, inverse problems and noninvasive diagnostics, diagnostic and clinical applications of nanoparticles, and electromagnetic fields.