# Analysis and Numerical Solution of Electromagnetic Scattering from Multiple Cavities

Aihua W. Wood
Department of Mathematics and Statistics
Air Force Institute of Technology
WPAFB, OH 45433, USA

Here concerned are scattering problems that explore the effect an inhomogeneous medium has on an incident field. In particular, if the total field is viewed as the sum of an incident field and a scattered field, the direct scattering problem is to determine the scattered field from the incident field and the differential equation governing the wave motion; the inverse scattering problem is to determine the nature of the inhomogeneity, such as location, geometry, or material property, from what is known of the scattered field. These problems have played a fundamental role in a range of scientific areas such as radar and sonar, nondestructive testing, geophysical exploration, medical imaging, near-field optical microscopy, and nano-optics.

In this talk, we consider the phenomenon of the electromagnetic wave scattering by multiple open cavities, which are embedded in an infinite two-dimensional ground plane. Above the ground plane and the open apertures of the cavities, the space is assumed to be filled with a homogeneous medium with a constant permittivity; while the interiors of the cavities may be filled with some inhomogeneous media with a variable permittivity. By introducing a new transparent boundary condition on the cavity apertures, the multiple cavity scattering problems is reduced to a boundary value problem imposed in the separated interior domains of the cavities. We present mathematical modeling techniques and computational methods that address, in addition, several scientific challenges in applied and computational mathematics. They include multi-scale modeling and computation of acoustic and electromagnetic wave propagation in heterogeneous media, large scale computational direct and inverse scattering problems, numerical solution of Maxwells equations and well-posedness of associated mathematical models, and numerical solution of ill-posed inverse scattering problems.