# GPOF Extraction of Complex Leaky Wave Wavenumbers for Metasurfaces with Axially Symmetric Modulation

A. Benini, G. Minatti, F. Caminita, E. Martini and S. Maci
University of Siena, Department of Information Engineering and Mathematics,
Via Roma 56, 53100 Siena, Italy.

Modulated metasurface antennas are a class of leaky wave (LW) antennas operating on an interaction between a cylindrical surface-wave (SW) and a spatially modulated equivalent impedance. This latter is usually realized by printing a dense texture of small reactive loads on the surface of a grounded dielectric slab. The cylindrical SW can be launched by a small vertical dipole placed at the center of the structure. Beam shape, polarization and all the radiative characteristics of these antennas are fully controlled by the modulated impedance pattern and the SW spectrum.

The design of the modulated impedance pattern is often faced referring to the results of the analysis of a local canonical problem (A.A. Oliner and A. Hessel, "Guided waves on sinusoidally-modulated reactance surfaces", Antennas and Propagation, IRE Transactions on, vol.7, no.5, pp.201-208). The latter is the 2D problem of a sinusoidally modulated reactance excited by a planar SW wavefront, and allows rigorously determining the complex wavenumber of the supported leaky wave for given modulation parameters. In metasurfaces with an axially symmetric modulation, a common approximation is that the local interaction between an elemental angular wavefront of the cylindrical SW and the corresponding elemental angular sector of the impedance pattern happens as in the local canonical problem.

In this work, we have analyzed the current distribution on an axially symmetric impedance pattern excited by a cylindrical TM SW wavefront. The analysis has been done by means of an efficient MoM code based on jump impedance boundary conditions. Afterwards, we have extracted the complex LW wavenumbers by means of an expansion of the MoM currents as a sum of complex exponentials using a generalized pencil of function (GPOF) method. This estimate of the complex LW-wavenumbers of the cylindrical problem is then compared with the one obtained from the 1D canonical problem. The comparison provides a quantitative description of the error committed in using the local 1D canonical problem as approximation for the design of cylindrical modulated metasurface antenna.