Design of Broadband Printed Reflectarray Antennas

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In the last years the analysis of the electromagnetic performances of printed reflectarrays has become more and more important due to their promising features, mainly for what concern satellite communications applications, since they naturally fulfill the typical constrains of this kind of antenna, such as high gain, narrow beam with low side lobes, lightweight and smaller volume with respect to other types of antennas with comparable electromagnetic features.

Printed reflectarrays consist in arrays of printed patches, of different shapes, illuminated by a primary feeder, e.g. a horn, that re-radiate the illuminating power back into the space. Since the printed elements have different positions on the reflector plane, the field that propagates from the feed to the patches covers different path lengths, that has to be compensated and this goal may be achieved using different possible techniques, e.g. adding to the patches suitable different-length stub, that can be directly attached to the radiating elements or electromagnetically coupled to them, varying the size of the radiating elements, rotating the elements to different angles, varying the dielectric constant of the material below the radiator itself.

One of the main drawbacks in a larger use of this kind of antennas in other possible appealing practical applications is the poor bandwidth that can be achieved with such structures, usually in terms of 3-6%. This limitation, quite intrinsic to the same idea of an array of printed resonant structures, can be overcome changing the radiating element type, i.e., as in printed arrays, using "large bandwidth" radiators. However, in the case of a reflectarray, the elements have to provide the proper phase shift at the different frequencies, i.e. each element has to guarantee that the introduced phase shift varies with the frequency in such a way to compensate the variation with frequency of the incident field phase, so that the re-radiated field remains almost the same in the whole bandwidth.

With this aim, different kinds of printed elements and different single layer and multilayered structures are under investigation. Once the "optimal" configuration among all the considered will be defined, it will be used to design a whole reflectarray, with expected enhanced bandwidth properties.