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DISCRETE LENSES FOR MULTIBEAM APPLICATIONS.

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Introduction: The capability of having many different beams illuminating the earth surface from a geostationary satellite has been an issue of interest during the last few years.

The need of increasing the services provided by satellites urges the designers to propose different alternatives. The classical and conventional solution of using direct radiating arrays (DRA) is strongly limited by the maximum number of beams, since each one needs its own beam-forming network and the final number of phase-shifters and/or amplifiers increases exponentially with the number of beams. Other possibility would be to introduce some kind of lens or reflector system in order to focus certain number of beams, but there are strong limitations in the number of distortion-free beams and the maximum angular resolution that can be achieved.

Some proposals have been made recently [1-3], all of them based on discrete lenses, using different approaches. In [1,2], the discrete lens is defined by a regular triangular grid of receiver/transceiver pairs whilst the proposal of the reference [3] the disposition of the receivers and the transmitters could be different in both sides of the lens following a sparse disposition.

The use of a discrete lens, offers the advantages of a DRA combined with the simplicity of an optical BFN. The amplification should be introduced inside the lens whilst the distribution of the different signals to the radiating aperture is performed by an optical beam forming network.

A spherical discrete lens antenna based on the back-to-back combination of two choked-horn antenna arrays interconnected through smooth waveguides sections implementing the spherical phasing law, has been designed, simulated and fabricated.

The spherical phasing law of the lens converts the incoming spherical phase front, from a small feeder placed at the focal plane, into a plane phase front. Depending on the feeder position at the focal plane (the perpendicular plane to the len's axis containing the focal point) the beam is pointed in different directions. The minimum angular distance between two beams is directly related to the minimum distance between two adjacent positions of low directive and, therefore, small feeders.

The selected implementation offers several advantages compared to a curved lens, such as the simplification of the fabrication, the constant length of the phasing waveguides and the dispersion of the back-scattered power, reducing significantly the coupling between feeders.

A trade-off between the number of elements and the appearance of grating lobes is clearly defined. With the inclusion of sparse distribution, the grating lobes apparently disappear but the radiated power is not recovered, or redirected, to the desired radiation direction. In the final paper alternative solutions will be proposed, as well as the first measurements of the fabricated discrete lens.

REFERENCES

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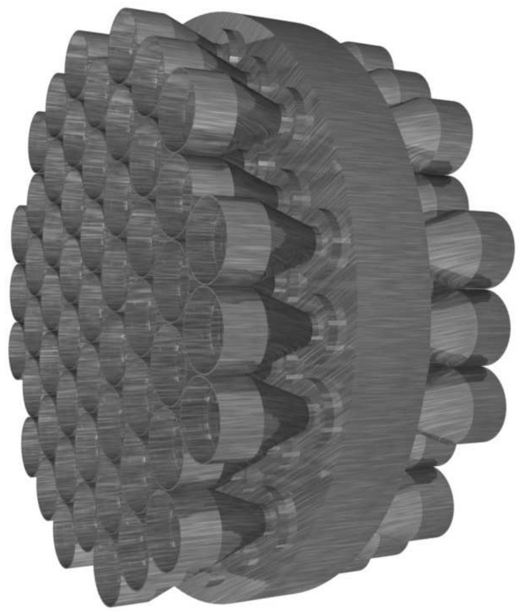

Fig.1: Example of a discrete lens.