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Resonant Bessel-Beam Launchers for Wireless Power Transfer at Millimeter Waves

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Bessel beams are a kind of *diffraction-free* beams, i.e., beams whose transverse profile remains constant at a significant distance from the source [1]. A device capable of generating Bessel beams is commonly known as *Bessel beam launcher*. The maximum distance at which a Bessel beam maintain its shape invariant is theoretically infinite, but is practically limited to a distance which depends on the size of the launcher and its working point.

Bessel-beam launchers can be realized in various ways. In optics, they are usually generated through axicon lenses [2], whereas at microwave/millimeter-wave frequencies waveguide-like devices are usually preferred [3]. The latter are further distinguished between *wideband* and *resonant* launchers.

Resonant Bessel-beam launchers are attractive for the generation of millimeter-wave wireless links in the radiative near-field region wireless power transfer applications as they combine a compact size (just a few wavelengths) to a remarkable focusing character and cover distance [3]. They basically consist of a circular metallic cavity fed from the bottom by a simple coaxial feed and whose top metallic sheet is patterned to allow for radiation [4].

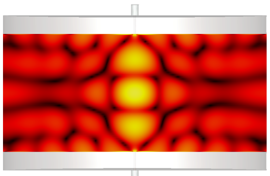

Figure 1. A pictorial representation of a wireless link by means of resonant Bessel-beam launchers.

In this work, we show the generation of a wireless power transfer link (see Fig.1) through the coupling of two identical resonant Bessel-beam launchers suitably designed to work at 30 GHz and featuring a very compact size, namely a cavity height of 0.5 cm and a diameter of only 2 cm. The electromagnetic-field distribution is evaluated through time-domain CST full-wave simulations, demonstrating that a wireless link can effectively be established between the two launchers up to a distance of 4 cm, thus located within the Fresnel region. The link budget obtained with CST full-wave simulations is cross-validated with an in-house numerical algorithm [5]. The estimated received power at 30 GHz is then converted to DC with a simple half-wave rectifier, obtaining a satisfactory RF-to-DC efficiency conversion. Further details on the numerical methods employed, the results achieved, and the effect of misalignment and tilting with respect to the line-of-sight will be given at the conference.

References

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