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Power flow-conformal reflectors for subwavelength field concentration

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1 Extended Abstract

The simplest approach to design reflectors for wave-front manipulation is simply writing down the desired distribution of the reflected field over the reflector surface and find the ratio of the tangential components of the total fields at the reflector surface. If we realize an impedance boundary with the input impedance equal to this ratio, the reflected field will be exactly as desired. For example, we can require that a cylindrical wave emitted by a line source converges to an arbitrary point. Figure 1(left) illustrates this principle. Here, the shape of the impedance-boundary reflector is chosen to be a circular cylinder. Of course, we need to position a lossy line at the focal point, to absorb the incident power. However, the required surface impedance Z_{s2} is complex-valued, requiring active elements for actual realization.

Figure 1. Left: Cylindrical active-lossy impedance boundary focuses a cylindrical wave to a point. Right: A power flow-conformal lossless reflector for the same function.

In studying anomalous reflectors, it was found that is possible to find such a shape of the reflecting boundary that the required surface impedance becomes purely reactive [1, 2, 3]. In this case, realization is possible using simple phase-shifting elements.

In this talk, we will present our recent results on the use of this principle to realise subwavelength focusing. An example of a properly curved surface for focusing cylindrical waves is shown in Figure 1, right. In the talk, we will explain the surface design and present also the case of an open surface and compare it with a parabolic reflector. Details of the theory can be found in recent paper [4].

References

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