Ricky's Afterthought:

Beamed Wireless Power-Transfer Using a Dynamic Metasurface Aperture

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How often is one frustrated for having forgotten to charge a cell phone, an iPad or other similar devices? What a brilliant idea to be able to devise a system whereby any device within a room could be charged automatically without having to connect cables to the supply?

This is what researchers at Duke University, Intellectual Ventures' Invention Science Fund, and the University of Washington in the USA are working on. Two aspects of this work were discussed independently in our Afterthought articles, first in Issue 75 where I introduced WC Brown's concept of wireless power transmission highlighting the proposed Space Solar Power System, put forward by the Japanese Aerospace Exploration Agency. Then in Issue 82 I focused on a new type of artificial material, called a metamaterial. Well, a focused microwave beam and a metamaterial are at the heart of the scheme discussed here.

"Imagine an electromagnetic wave approaching the large number of tiny cells of the metamaterial, and say you can tune each cell to manipulate the wave in a specific way, you can then dictate exactly what the field looks like when it comes out on the other side.", stated Professor Smith who leads this research initiative at Duke University. According to this study, a flat metamaterial device no bigger than a typical flat-screen television could focus beams of microwave energy, envisaged in the X or K bands (8-12 or 18-26.5 GHz, respectively) down to a spot about the size of a cell phone within a distance of up to 10 m. Although such a scheme is capable of powering more than one device at the same time, one caveat is that each device to be processed must signal its presence in the room and communicate its location and orientation with respect to the transmit aperture. This is within the capability of present day technology.

The proposed Fresnel-zone (near-field) approach of this project takes advantage of widely used LCD technology to enable seamless wireless power delivery to all kinds of smart devices. One other important aspect of this wireless power-transfer scheme is the ability to safely direct focused beams of microwave energy to charge specific devices, while avoiding unwanted exposure to people, pets and other objects.

How near are the researchers in achieving such a goal? They claim that all the principles have been established and confirmed, and such a system can be made. It is simply a question of building such an array of different items and testing it. In their original paper, submitted in the arXiv archive of Cornel University Library in 2016, they state, "We find that approximate design formulas derived from the Gaussian optics approximation provide useful estimates of system performance, including transfer efficiency and coverage volume. The accuracy of these formulas is confirmed using numerical calculations".

For further reading:

D. R. Smith, V. R. Gowda, O. Yurduseven, S. Larouche, G. Lipworth, Y. Urzhumov, M. S. Reynolds, "An analysis of beamed wireless power transfer in the Fresnel zone using a dynamic, metasurface aperture", Submitted to arXiv pre-print repository, 2016, ID:1610.06799.

https://arxiv.org/ftp/arxiv/papers/1610/1610.06799.pdf