Optimum Beam Form Design of Wireless Power Transfer to Flying Drone

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A wireless power transfer (WPT) is considered as one of hopeful novel radio wave applications to carry a wireless power to users. Especially, the WPT via microwave (MPT ; microwave power transfer) is a far field WPT and is suitable for WPT to a moving target like a flying drone.

We are developing the MPT system to the flying drone and designing an optimum beam form to maximize the MPT efficiency, which consists of a beam efficiency from a transmitting antenna to a receiving antenna and a RF-DC conversion efficiency at a rectenna, rectifying antenna.. There are some beam forming technologies to increase only the beam efficiency with high directive beams. However, beam forming for a high RF-DC conversion efficiency on rectennas (rectifying antennas) hasn't been considered. Since the high directive beams have a large deviation of power density on the rectenna surface, it decreases the RF-DC conversion efficiency. Therefore we proposed a flat-topped beam pattern to increase the conversion efficiency in [1]. This flat-topped beam is capable of not only increasing the efficiency but also maximizing received power on a rectenna array, because maximum dc power is extracted on the whole area of the array. Such a property is suitable for MPT to a flying drone which consumes a large amount of power constantly. In this study, we propose MPT system to a flying drone and its overview and parameters are described in Figure 1. Figure 2 indicates optimized flat-topped beam pattern and Figure 3 indicates comparison of the efficiency by an uniform beam, an focus beam, and proposed flat-top beam. As shown in the Figures 2 and 3, the proposed flat-topped beam can transmit enough power on the receiving area and is robust against transmission range variation.

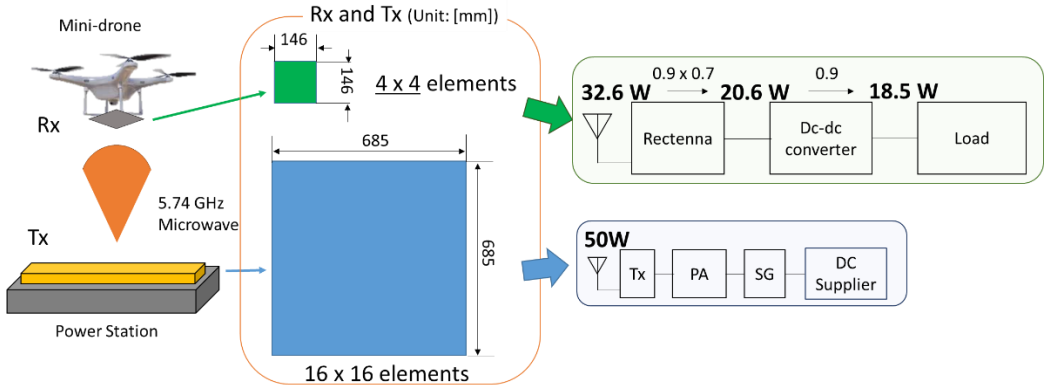

Figure 1. Proposed MPT System Parameters to Flying Drone.

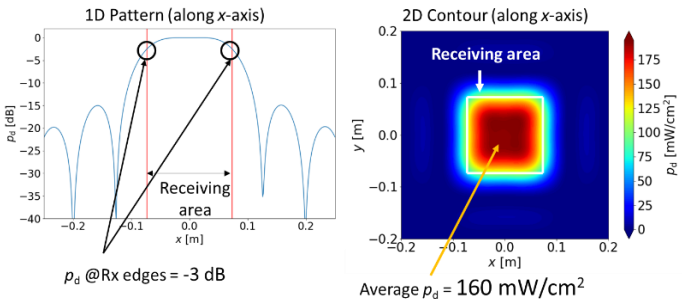

Figure 2. Flat-Top Bema Pattern at z=0.8m, P_{rad}=50W.

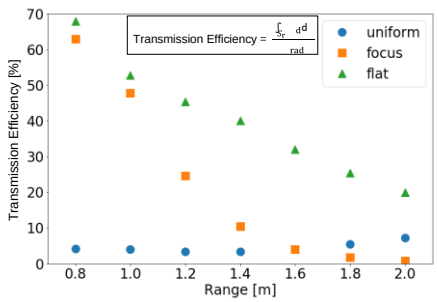

Figure 3. Range Dependence of Efficiency

Reference

[1] N. Takabayashi, N. Shinohara, T. Mitani, M. Furukawa, T. Fujiwara, "Rectification Improvement With Flat-Topped Beams on 2.45-GHz Rectenna Arrays," *IEEE Transactions on Microwave Theory and Techniques*, December 2019, doi: 10.1109/TMTT.2019.2951098.