ABSTRACTS (MASTER THESIS)

Development of microwave power transfer system with high efficiency for drone application

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Drones, multicopter-typed unmanned aerial vehicles, gathering a lot of attention from various kinds of industries. In such a circumstance, we proposed to give those drones a function of wireless power transfer (WPT). Among WPT methods, microwave power transfer (MPT) has an advantage for long-range power transmission, that is suitable for flying drones. Therefore, for drone applications (Fig.1), we aim to enhance the overall efficiency of MPT system by array antenna beamformings and circuit technologies.

First of all, we tackle beamformings to synthesize at-topped beams mainly at 2.45 GHz. Then we design and practically produce a 32-element array for power transmission and a 37-element array for power absorption. Then we conduct simulations and experiments for the flat-topped beam's transmission between a 32-element transmitting and a 37-element receiving antenna by employing synthesized beams. These results indicate how much power is intercepted on the receiving plane. Subsequently, using the obtained illuminance distributions on the rectenna plane, we investigate the rectification efficiency of these flat-topped beams from viewpoints of simulations and experiments. Conventionally, rectifications of rectenna array have energy loss caused from multiple rectifiers' connection. Flat-topped beams have been expected to reduce such a connection loss, but that have never confirmed. Therefore, we compare the efficiencies for rectifications in detail between conventional beams and our designed flat-topped beams. Then we show the flat-topped beams have almost zero connection loss for the rectification by the rectenna array. Finally, we conduct overall experiments of MPT at 2.45 GHz, where the overall efficiency of MPT are measured and the advantage of flat-topped beam are confirmed (Fig.2 and Fig.3).

In this thesis, we mainly evaluate the MPT efficiencies of flat-topped beams at 2.45 GHz. These results show the flat-topped beams have a potential to achieve MPT with extremely high efficiency where the overall efficiency exceeds 60% .

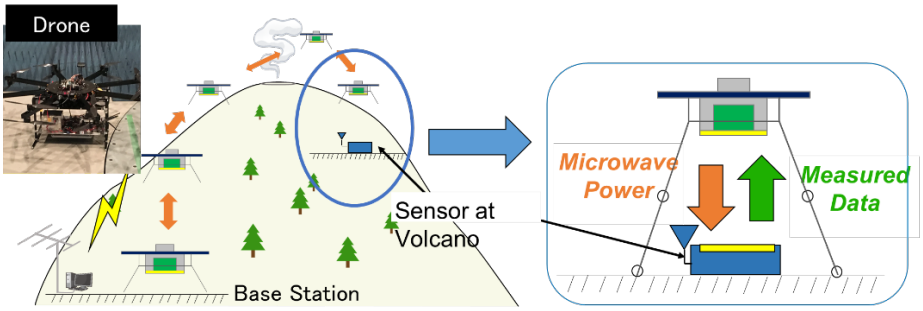

Fig. 1 Proposed MPT-aided sensor system with drone

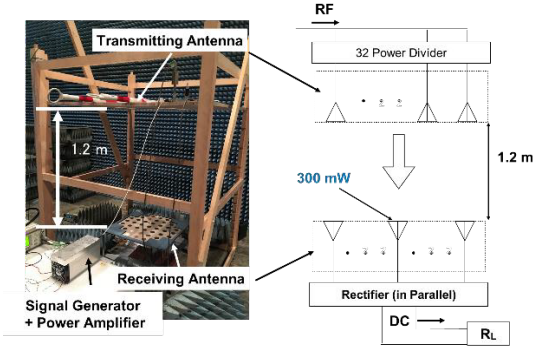

Fig.2 Experimental setup

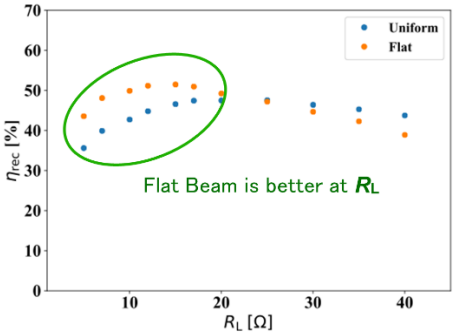

Fig.3 Total efficiency by flat beam and conventional beam