ABSTRACTS (MASTER THESIS)

Study on efficiency improvement of microwave power transfer system for stratospheric platform

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A stratospheric platform (SPF) is attracting attention as a new communication platform for communication area expansion and disaster communication. In SPF, unmanned airplanes stay at the stratosphere and are used as communication relay stations. Therefore, a light and stable power supply is needed for long-term operation. Microwave power transfer (MPT) is proposed as a solution (Fig.1). We investigate the feasibility of MPT on SPF by numerical simulations. The MPT system on SPF is restricted by the shape of receiving array antenna, the size of the transmitting array antenna, the flight altitude and the coverage of communication service. In the present research, the MPT system with 2kW DC output under those requirements is proposed, allowing the uninterrupted operation of SPF. We calculate electric field intensity at the receiver by taking superposition of transmitted electric field from each antenna element. The maximum beam efficiency in free space is 23.4% with the operation frequency, the size of the receiving antenna, the size of transmitting antenna are 24GHz, 2m×80m and 40m×2.5m, respectively(Fig.2). The atmospheric attenuation of receiving power is negligible, whereas the efficiency is significantly decreased due to the rain attenuation. The total beam efficiency over the flight route is investigated. The SPF is positioned in the3km radius from the transmitting antenna at an altitude of 20km. We find that the beam efficiency for D-shaped route is 12.0%, which is the highest between the potential four route; a circle, the figure-8 and the oval route. By using the rectifier model in the previous research, the net efficiency including RF-DC conversion is 6.7% (Fig.3). With the 30kW power from the transmitting antenna, 2kW DC output is realized.

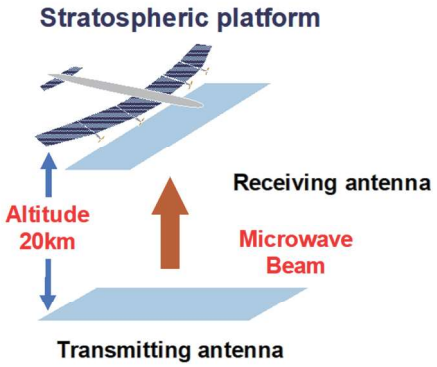

Fig.1. Microwave power transfer system for SPF

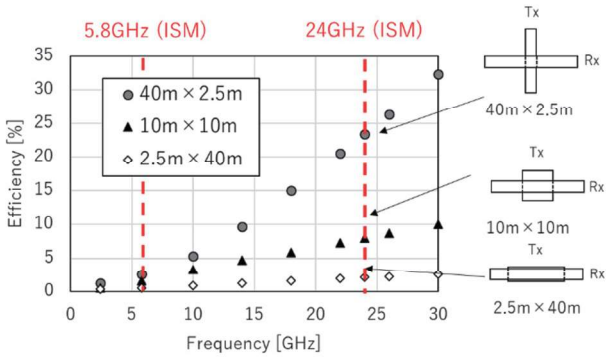

Fig.2. Calculated beam efficiency

(a)

(b)

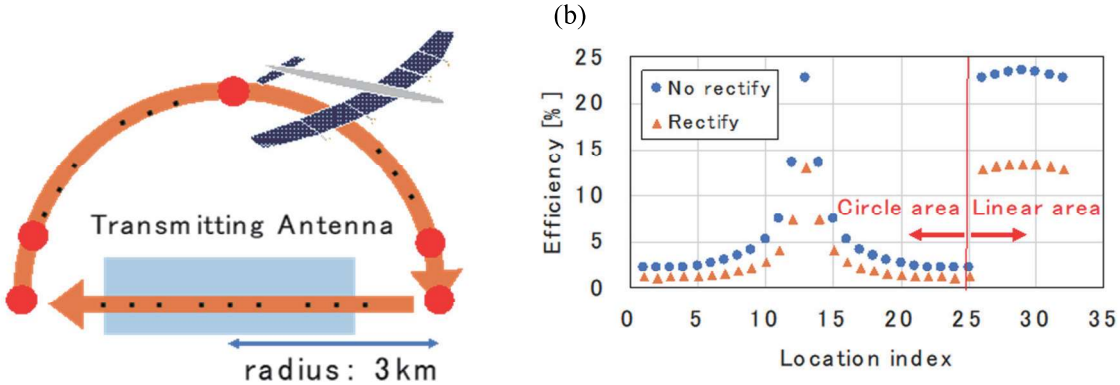

Fig.3. (a) Proposed antenna and flight root for maximum efficiency (b) Estimated efficiency by flight root