ABSTRACTS (MASTER THESIS)

Study on an Auto Tracking Microwave Power Transmission System for a Mars Observation Airplane

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In order to attain the weight saving of a Mars observation airplane, we are planning to supply energy by microwave. This paper presents auto tracking, which is composed of direction detection and beam direction control. First, we estimated the system requirements of the transmission system. Second, we described phase control of a magnetron, and an image processing method. With them, we conducted ground flight experiments, and succeeded in flying an airplane by an auto tracking microwave power transmission system. However, the direction detection error of the image processing method and its calculation time is larger than the requirements. In order to meet requirements, we adopted the method using pilot signal. By acquiring phase difference of receiving antennas, we calculate the direction of the airplane. For weight saving, we utilize second harmonics radiated from the rectennas mounted on the airplane as pilot signal. Third, we measured the power of the second harmonics radiated from the rectifying circuit we used in ground experiments, and found that the generated second harmonics power was weaker than the input microwave power by 20 dB. Forth, we described phase difference detection circuits, especially an amplifier circuit and a quadrature detection circuit. We used automatic gain control in order to input the constant amplitude into the quadrature detection circuit. We also used a feedback loop in the 90 ◦ phase shifter circuit to improve the accuracy of phase shift. Finally, we conducted direction detection experiments utilizing the second harmonics radiated from 15 rectennas mounted on a ground experiment airplane, and made out that the rectennas composed a phased array. If pilot signal is radiated from a phased array, its phase differs as the direction changes and causes phase difference error on the direction detection antennas. When this phased array directs its main lobe to the direction detection antennas, this phenomenon causes less effect. Therefore, if we can control the phase of the second harmonics from rectennas, we can adopt this method in Mars observation.

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