Consideration of Transmitting Space Solar Power to UAVs by Microwave Transmission

Alexander Holland
Wilson Lysford
Jens Pearson
Jeremy Straub
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Alexander Holland¹, Wilson Lysford¹, Jens Pearson¹, Jeremy Straub¹
¹Department of Mechanical Engineering, University of North Dakota
²Department of Computer Science, University of North Dakota

Introduction
The purpose of this poster is to explore the possibility of the transmission of power from a space-based solar power satellite to UAVs via microwave radiation. The type of system that will collect and transmit the solar power will be discussed and the economics of the solution will be considered. The frequency of transmission, area, and the free space loss will be considered to determine the effectiveness of the system. The UAV power-consumer craft will also be discussed.

Methodology
In order to obtain the power and the antenna size to transmit power for a reasonable distance, we consider two things: a necessity: compact design for the launch into space, and a large surface area for the solar array and the antenna system.

To obtain the design constraints, there were a lot of methods to consider, but the use of Origami-style solar panels was selected. These panels ensure that the design constraints are met by increasing the original array by 3 times the surface area. In addition, this also allows for the usage of a phased array system on the opposing side for wireless power transmission.

The UAV design also has to consider some design constraints. Such constraints are the impact to aerodynamics, size of antenna, and longevity of flight. The work done demonstrates that updates to existing UAV designs can be modified to extend the flight with little to no impact on flight.

Data/Calculations
Calculations and data found were for the following:
- Frequency 220 GHz
- Satellite with panels designed for NASA SLS Heavy rocket
- U.S. Air Force’s MQ-1B Predator drone
- 30% solar panel efficiency
- Assumed optimal conditions of transmission
- High gains on both antennas

With these conditions, the graphs show why 220 GHz high frequency was chosen, the variances in distances and slight variances in frequencies.

Then using the Friis Power Transmission equation, the work done showed that there could be a transmission of about 80 kilo watts to an aircraft with an optimally sized antenna and extremely high gain. This would allow the aircraft to fly indefinite. But would require complete remodeling of the aircraft.

References