Investigation of Novel and Unconventional Microwave Antenna Designs Using in silico Modeling

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The goal of this research project was to use antenna simulation software to model the gain and radiation patterns of a variety of novel, unconventional, and previously untested microwave antenna designs to identify antennas that could be utilized to wirelessly transmit solar power from space. Novel shapes that included Hilbert curve fractals, Klein bottles, hemispheres and pentagonal pyramids with projected Hilbert curves, unduloids, and tesseracts were identified using the Wolfram Mathematica Shape Library. Autodesk Inventor was used to draft antenna structures based on Mathematica graphical file dimensions. Autodesk files were then exported into WIPL-D Pro CAD antenna simulation software (a virtual anechoic chamber) to assess directional performance and gain. The results indicated that a modified tesseract antenna had the greatest directional performance of all novel antennas tested (+15.35 dBi). The tesseract antenna configuration appears promising for efficient, directional power transmission for space solar energy applications. In silico modelling proved to be a powerful and cost effective tool for screening and optimizing many unusual and potentially useful new antenna designs.

Awards Won:

Second Award of $2,000

National Aeronautics and Space Administration: Second Award of $750