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Wireless power transfer via $\mathcal{PT}$-symmetric resonant system including 2-D waveguide

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1. Objective

This project is aimed at:

Development of a large-area contactless power transmission method using a two-dimensional waveguide sheet and high-quality-factor (high-Q) resonators [1]. 2-D waveguide sheets enable large-area wireless power transfer (WPT) without coil arrays. Higher power efficiency is achieved by higher Q of the resonators; however, it is not robust to the displacement of receiver/transmitter resonators. Resonator displacement on the waveguide causes fluctuation in resonant frequency and decreases in efficiency, which are common problems in most WPT systems using high-Q resonators. The recently proposed parity-time symmetric ($\mathcal{PT}$-symmetric) WPT system [2] is one of the promising approaches to solving that problem. This project aims to develop a practical large-area 2-D WPT system by introducing $\mathcal{PT}$-symmetry physics into microwave engineering.

2. Project Outline

To that end, the project will consist of the following phases:

(a) skill in mathematical analysis of $\mathcal{PT}$-symmetric 2-D WPT systems;
(b) skill in constructing an experimental system for investigation of the characteristics of the $\mathcal{PT}$-symmetric 2-D WPT system; and
(c) skill in implementing a large-area $\mathcal{PT}$-symmetric 2-D WPT system to demonstrate robust power transfer characteristics.

3. Expected Performance

In this project, the successful candidate would be expected to:

(a) work independently;
(b) think logically;
(c) enjoy tough challenges.

4. Required Skills and Knowledge

The successful candidate for this project will have the following knowledge and skills:

(a) knowledge of the fundamentals of electromagnetics; and
(b) knowledge of the fundamentals of electronic circuits and skill in soldering/handcrafting circuits under testing.

References

[1] NODA, Akihito; SHINODA, Hiroyuki. Selective Wireless Power Transmission Through High-Q Flat Waveguide-Ring Resonator on 2-D Waveguide Sheet. *IEEE Transactions on Microwave Theory and Techniques*, 2011, 59.8: 2158-2167.
[2] ASSAWAWORRARIT, Sid; YU, Xiaofang; FAN, Shanhui. Robust wireless power transfer using a nonlinear parity–time-symmetric circuit. *Nature*, 2017, 546.7658: 387-390.

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