Imperial College London

SIGNAL OPTIMIZATION FOR WIRELESS INFORMATION AND POWER TRANSMISSION

Author: **Yang Zhao (yang.zhao18@imperial.ac.uk)**
Supervisor: **Dr Bruno Clerckx and Dr Morteza Varasteh**

MOTIVATION

Energy-constrained wireless devices are conventionally powered by batteries. However, the development of large-scale networks as Internet-of-Things (IoT) is strictly restricted by its limited working time and frequent recharging or replacement. Although Wireless Power Transfer (WPT) via inductive coupling has enjoyed some success in real-world applications, it is impractical for most devices on the move since the operation range is very short. As a promising alternative, the Radio-Frequency (RF) wave is typically with lower power level (µW to W) but larger coverage (up to hundreds of m) (**Ng2019**). Interestingly, it indeed carries both information and energy simultaneously, with the potential to power billions of mobile nodes wirelessly while keeping them connected. The recent revolution in harvester model and the significant power drop of electronics bring more possibility to the research on Wireless Information and Power Transfer (WIPT) via RF signals.

RECTENNA MODEL

A rectenna receives electromagnetic power with antenna and convert it to electric power with rectifier.

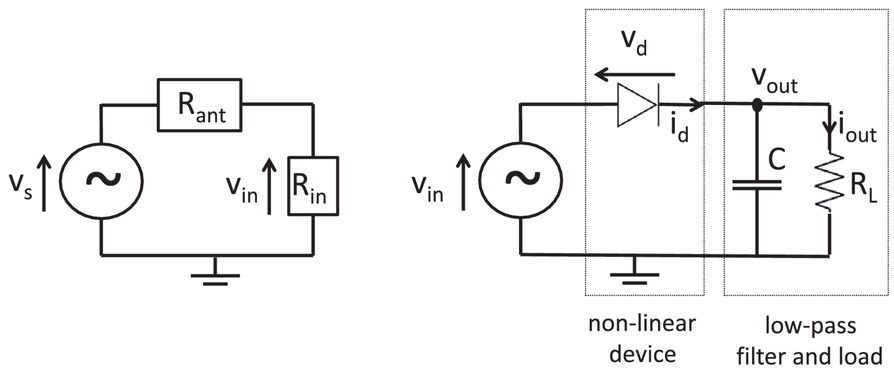

Figure: Rectenna equivalent circuit (left) and a single diode rectifier (right) **Clerckx2018a**

- Diodes account for nonlinearity
- Approximate diode characteristics equation by Taylor series
- Truncate the result to n_o-th order
  - **diode linear model ($n_o = 2$)** is the conventional perspective that assumes the total output power is the sum of the sub-band power. It omits the rectifier nonlinearity and is typically suitable for a very low input power (below -30 dBm).
  - **diode nonlinear model ($n_o > 2$)** considers the contributions of higher order terms to the harvested power. It captures the diode nonlinear behavior with the product terms that consist of contributions from different frequencies. The model is accurate for the power regime between -30 and 0 dBm.

FIGURE 2

Golden ratio

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TABLE 2

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FIGURE 3

Golden ratio

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