Master's Thesis

Coil Array Inductive Power Transfer System for Autonomous Underwater Vehicle

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January 7, 2021

A Master's Thesis
submitted to Graduate School of Information Science,
Nara Institute of Science and Technology
in partial fulfillment of the requirements for the degree of
Doctor of ENGINEERING

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Abstract

For a long time, providing a stable, safe, and efficient power supply for underwater electromechanical equipment has always been a concern in deep-sea exploration. Compared with the complicated docking mechanism, potential safety hazards, and expensive price of traditional wet-mate connectors, wireless power transmission (WPT) technology can transmit energy without any electrical contact between the power supply and the electrical equipment, which provides an effective solution to the aforementioned drawbacks of wired charging. There are many uncontrollable factors in the seawater working environment. Therefore, this topic takes the equivalent circuit and magnetic field distribution as the theoretical basis to study the energy transmission characteristics of underwater WPT and proposes corresponding improvements and solutions to the current problems and deficiencies. Especially for the unstable output voltage of the receiver and excessive magnetic flux density at the internal of AUV.

Keywords:

Autonomous underwater vehicle, inductive power transfer, underwater wireless power transfer, undersea

*Master's Thesis, Graduate School of Science and Technology, Nara Institute of Science and Technology, January 7, 2021.

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1 Introduction

1.1 Background and research purpose

In the foreseeable future, the electrification of ocean systems, renewable ocean power sources and ocean energy networks will be necessary, which could help accelerate the growth and deployment of ocean renewable energy and ways to explore and understand the ocean [1]. To realize electrification in the ocean requires good water resistance, durability and long-distance remoteness. For the waterproofness of the equipment, we can use high-performance waterproof and pressure-resistant materials. The durability of electrical equipment requires low-consumption AUV and high-energy batteries or continuous energy supply for the equipment. Long-distance maneuverability needs to solve the problem of long-distance underwater communication. We can use xx to reach xxkm underwater long-distance distance. Certain attributes of ocean energy, such as its high energy density, make it attractive as a grid-connected energy, or it may make it an isolated and remote ocean energy, thereby providing power solutions for the sustainable development of ocean space, which is attractive. The rapid development of distributed ocean energy applications (such as underwater sensor networks, ocean sensors and monitoring technologies, ocean automatic network buoys, and deep sea and tsunami buoys) is advantageous. In particular, it can power an autonomous underwater vehicle (AUV) whose service life is limited by its battery power.

1.2 Wireless power transfer technologies

Far field power transfer

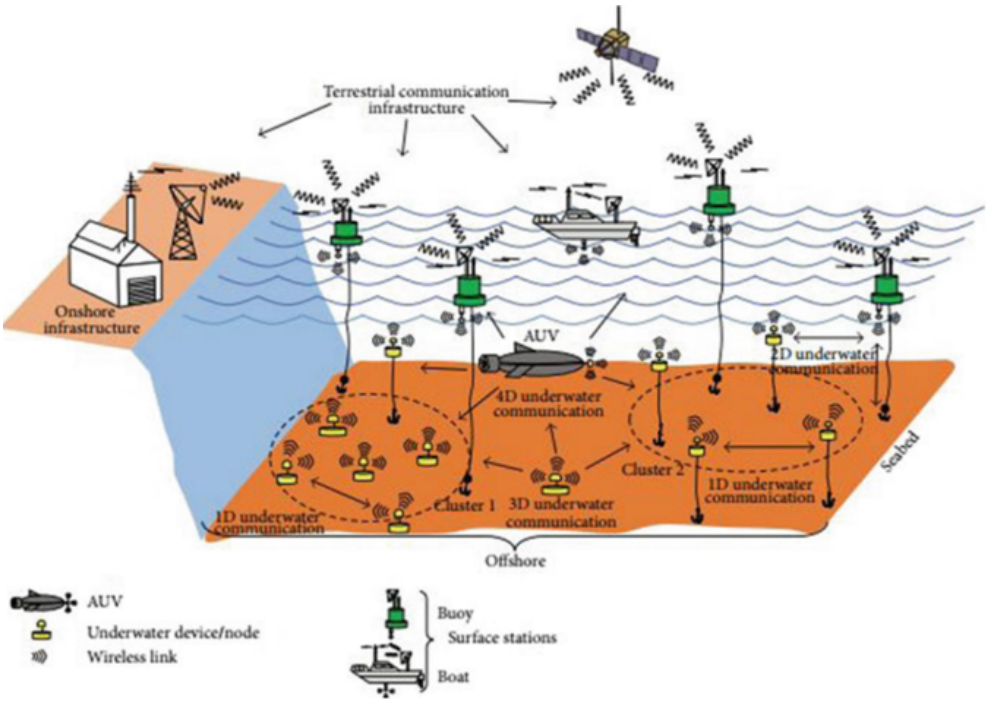
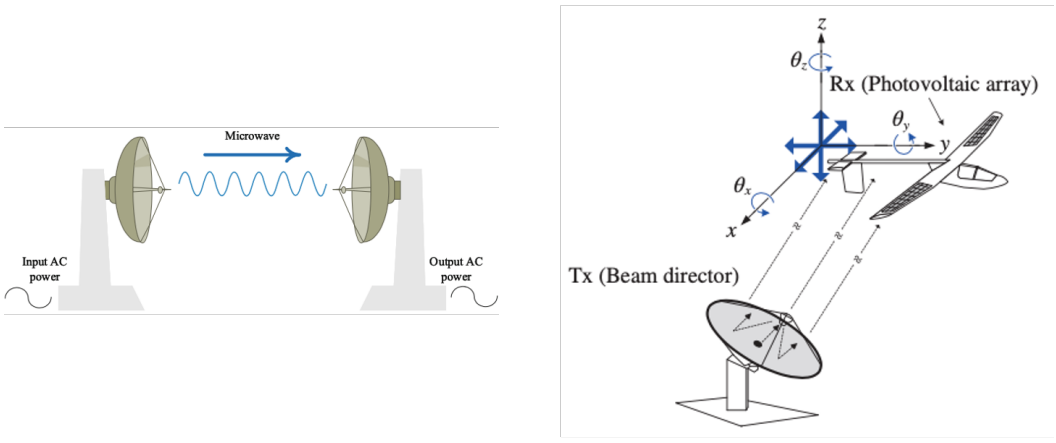


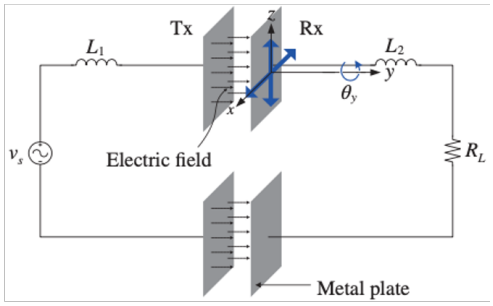
Figure 1.1: Underwater sensor networks architecture [2].



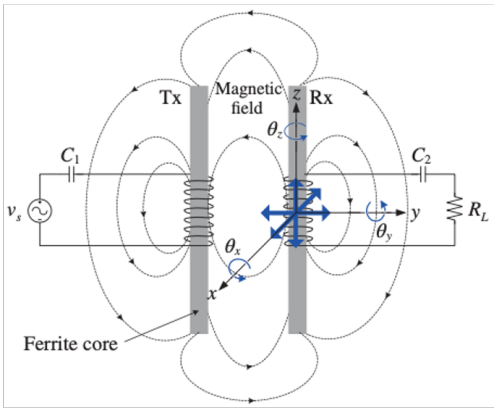
(a) Microwave power transfer [1].

(b) Laser power transfer [3].

Figure 1.2: Far-field wireless power transfer.



(a) Capacitive power transfer [3].



(b) Inductive power transfer [3].

Figure 1.3: Near-field wireless power transfer.

1.3 Underwater wireless power transfer

1.4 The main research content of this thesis

1.5 Roadmap

2 The theoretical analysis of magnetically coupled resonance WPT

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3 Proposed method

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4 Conclusion

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Acknowledgements

Thank you, and thank you.

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Publication List

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