

Novel Multi-Frequency Electromagnetic Coupler for Power and Data Transmission

Christopher S. Deloglos*⁽¹⁾, Afroditi V. Filippas⁽¹⁾
(1) Virginia Commonwealth University, Richmond, VA, 23832

A technique to transmit power and data over an electromagnetic coupling system is discussed. This technique provides a streamlined solution for integrating three distinct technologies into a modular system. Using this technique, a single electromagnetic coil is used for physical magnetic coupling, inductive power transmission, and wireless data transmission. This is a valuable solution for autonomous systems operating in EMF-hostile environments. This system was designed for use with unmanned underwater vehicles (UUVs) that periodically require power and data transmission across a temporary physical coupling.

In this discussion we investigate three major components of the coupling system as it pertains to UUVs. First, we investigate the different techniques for combining DC and AC sources without compromising signal integrity. This allows us to transmit power and data without compromising the coupling strength of the electromagnet. The coupling for the electromagnet is accomplished via a DC source while data and power transmission is accomplished via high and low frequency AC sources, respectively. Next we will present techniques for extracting the transmitted power and data from the received signal. For power extraction we investigate techniques for optimizing power rectification circuit design. For data extraction, we will present the use of software defined radio as part of an embedded system for real-time signal processing. Finally, we will present how to best implement these techniques for integration with electromagnets that have a wide variety of AC characteristics. Optimal power transmission and clean data transmission are quintessential to UUVs to ensure quick recharging and valid data transfer. Therefore, we will discuss the different ways to maximize power transfer and minimize system noise in order to provide consistent power and data transmission.