High-Power Field-Focusing Circuit Topology for Dynamic Wireless Power Transfer Systems

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Energy, Environment, & AerospaceElectrical & Computer Engineering

Abstract

USU Researchers have developed a self-regulating system that utilizes field-focusing techniques to maximize efficient dynamic wireless power transfer, primarily for electric vehicles. The technology has been tested in laboratory conditions and data acquisition shows that the maximum output power of this technology is higher than conventional technology by 102%.

Problem

Current dynamic wireless power transfer systems often have very low efficiency. In automotive settings, the transmission and receiver coils oscillate in and out of alignment, leaving a large unused stray electromagnetic field unreceived.

Solution

This technology utilizes field-focusing techniques to create a system that maximizes power transfer in aligned states and decreases field production in misaligned states. This increases efficiency of power transfer.

Value Proposition

This power transfer system requires fewer inverter and receiver sensors and offers a less complex topology than previous systems. The simplified system saves costs in manufacturing, implementation, upkeep, and wasted energy.

Benefit

A primary concern with dynamic wireless power transfer systems is the efficiency of their power transfer. Because the transmission and receiver coils move in and out of alignment as the vehicle drives over the charging surface, there is a large stray field of electric energy that is not received by the receiver coil in the car. This stray field creates inefficiency, as induced magnetic fields are energy intensive.

This technology uses field-focusing techniques to create a self-regulating system that maximizes power transfer in the aligned states and quickly drops power transfer to near zero in the misaligned states. By so doing, this technology increases the efficiency of power transfer while decreasing the stray field of electric energy.

This technology requires fewer inverter and receiver position sensors and offers a less complex system topology than previous dynamic wireless power transfer systems, lowering costs related to manufacturing, implementation, and upkeep of the system because there are fewer required parts. Furthermore, the increased energy efficiency of the system saves electricity due to less stray field energy lost to the environment.

Additionally, the technology can be utilized for designated bus routes to increase the energy efficiency of public transit. Furthermore, this technology can be expanded to entire roadways, allowing electric vehicles to be charged as they are operated daily and thereby providing a convenience for electric vehicle owners.

Market Application

Directly affected markets include electric vehicles, electric vehicle production, public infrastructure production, and wireless charger manufacturing.

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Publications

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Intellectual Property

U.S. Patent No. 11,862,993 issued January 2, 2024, entitled “High-Power Reflexive Field Containment Circuit Topology for Dynamic Wireless Power Transfer Systems”