Advanced Research and Engineering for Space

# VEHICLE REMOTE CHARGING

## ARES – SWIEE MEETING ROME , SEPT. 26 2014

TOR VERGATA UNIVERSITY

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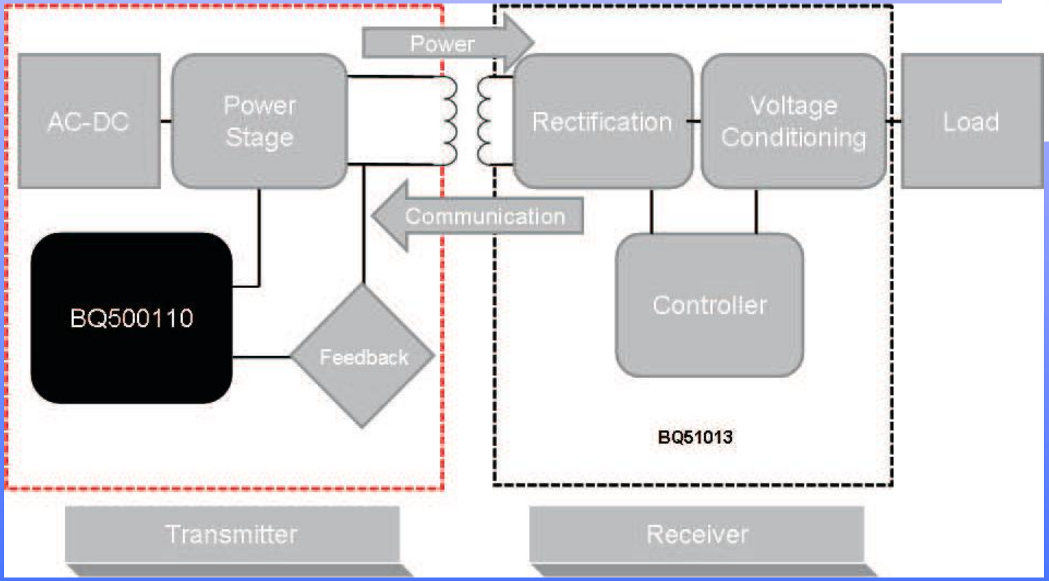
# State of art 1/7

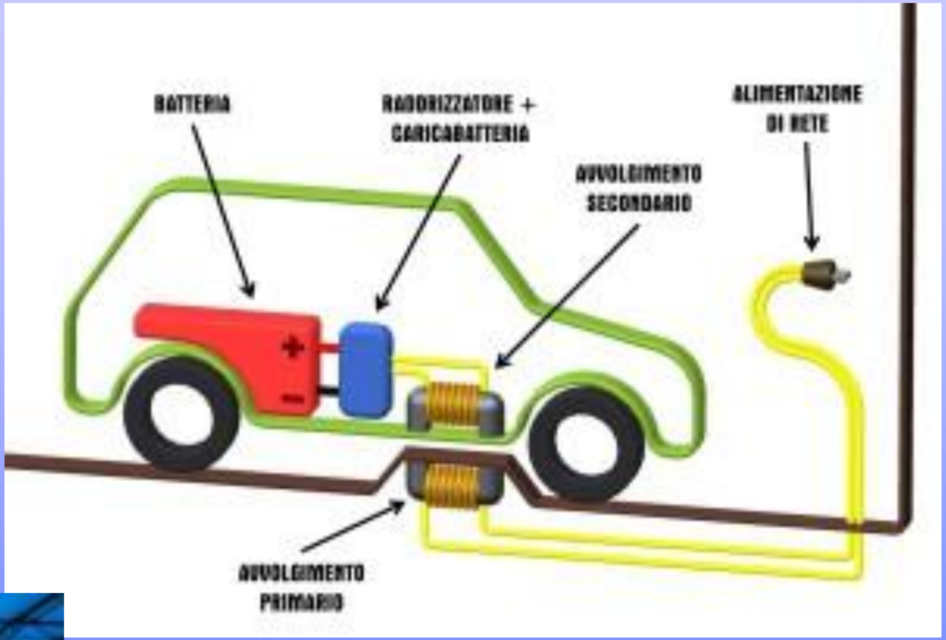
Remote charging for smart phone and home electronic


Many remote charging systems are proposed for commercial applications. They are for small and medium power and are based on the principle of transformer coupling in air (mutual induction) e.g. the Texas Instruments BQ 500 110 / BQ51013 system conforms to the standard WPC 1.0. In this way it is possible to charge mobile phones electric toothbrushes and all those domestic applications of low energy that are operated with batteries of smaller amperage.

# State of art 2/7

Remote charging for car and bus on dedicated pitch

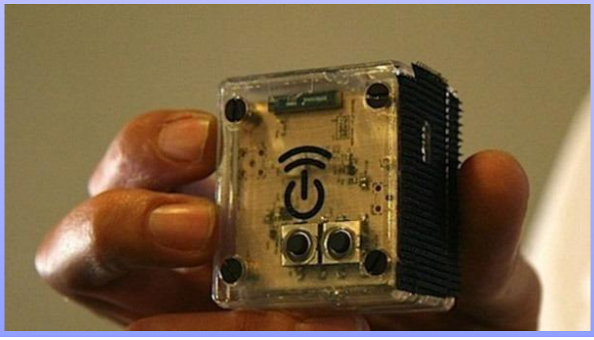




On the same concept it is possible to recharge batteries with higher capacity. Using this technique the vehicle to be charged should be placed with precision on the pitch without the need for cables for connecting to the charging system.

# State of art 3/7

A patented wireless charging system to 9 meters
for flats proposed by Ossia Cota will be produced from 2015

TX 

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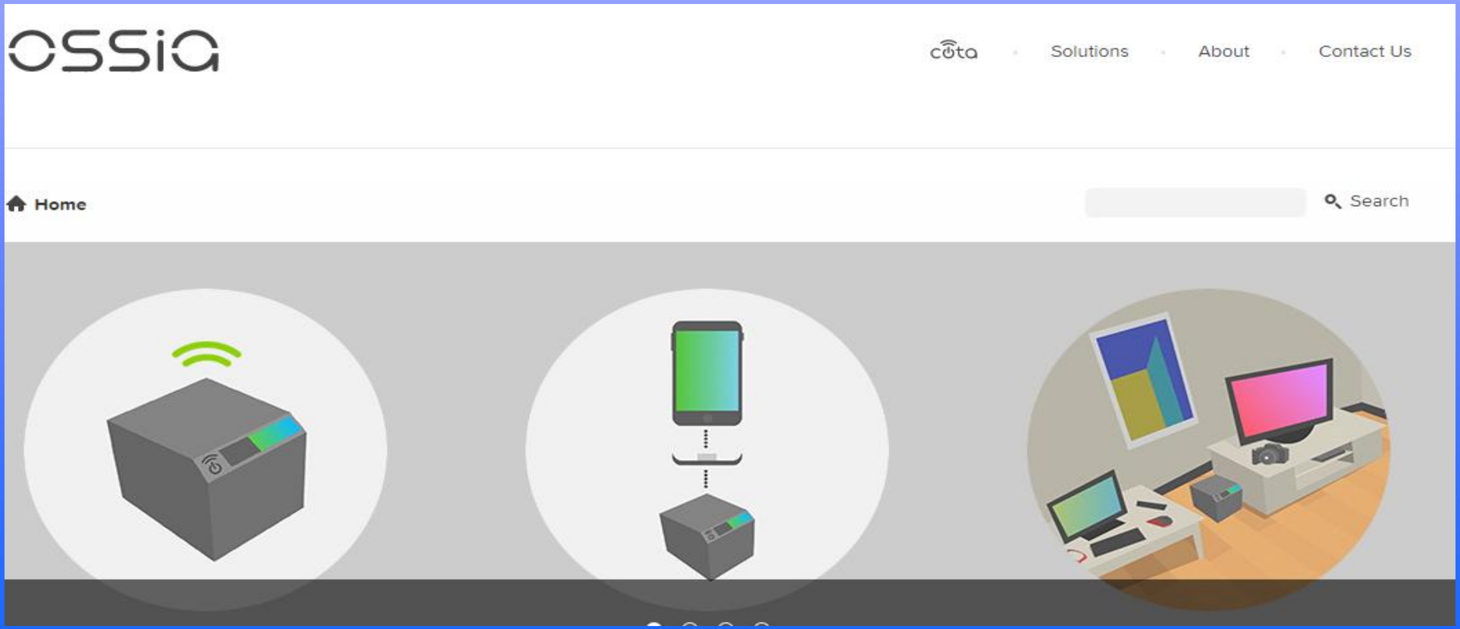

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# Magnetic Metamaterial Superlens for Increased Range Wireless Power Transfer

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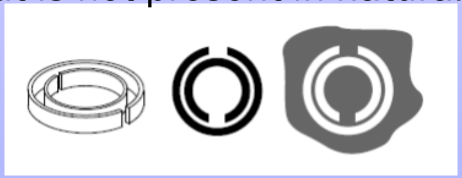
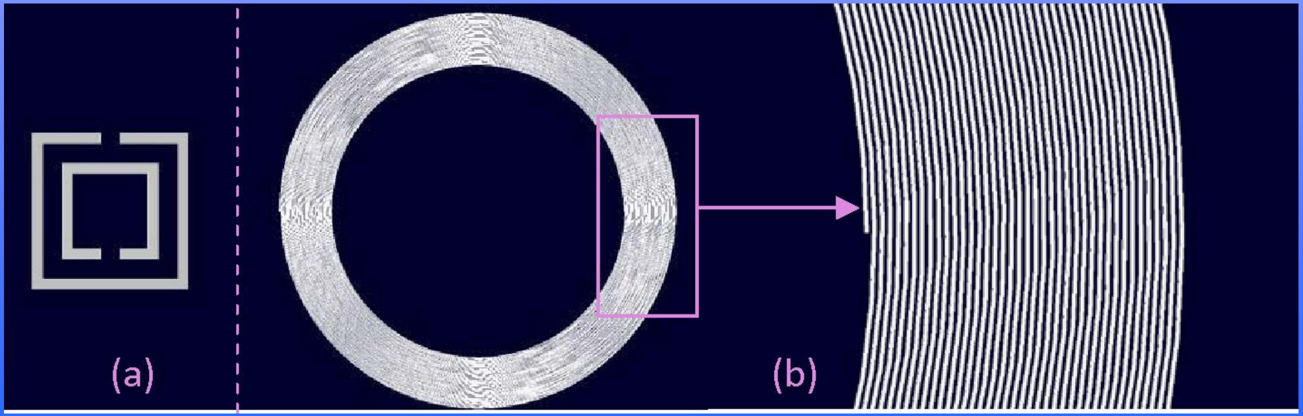
The ability to wirelessly power electrical devices is becoming of greater urgency as a component of energy conservation and sustainability efforts. Due to health and safety concerns, most wireless power transfer (WPT) schemes utilize very low frequency, quasi-static, magnetic fields; power transfer occurs via magneto-inductive (MI) coupling between conducting loops serving as transmitter and receiver. At the "long range" regime – referring to distances larger than the diameter of the largest loop – WPT efficiency in free space falls off as $(1/d)^6$; power loss quickly approaches 100% and limits practical implementations of WPT to relatively tight distances between power source and device. A "superlens", however, can concentrate the magnetic near fields of a source. Here, we demonstrate the impact of a magnetic metamaterial (MM) superlens on long-range near-field WPT, quantitatively confirming in simulation and measurement at 13–16 MHz the conditions under which the superlens can enhance power transfer efficiency compared to the lens-less free-space system.

# State of art


SPLIT-RING RESONATORs (SRRs) negative refraction, a feature that is not present in natural materials



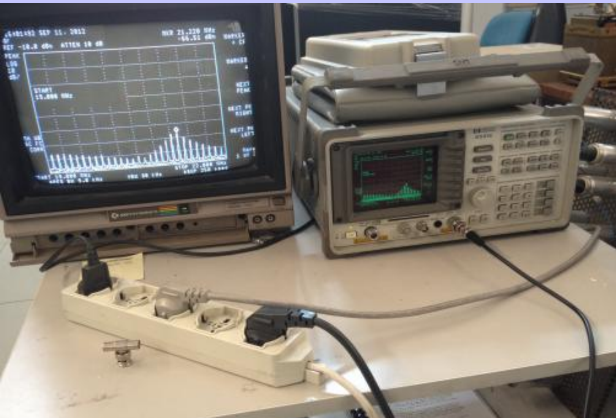
Metamaterials (so called because of their engineered electromagnetic properties) hold great promise for new applications in the megahertz to terahertz bands, as well as optical frequencies. Conventional metamaterials are limited in their ability to demonstrate these phenomena because of their ohmic and dielectric losses and dissipation. However, some new type of metamaterials exceed these problems and have the added benefit of being much smaller, more tunable, and more nonlinear than their ordinary counterparts. Among the metamaterial designs that feature both negative permittivity and permeability (and thus a negative index of refraction), split-ring resonators (SRRs) placed in a wire array medium have drawn a great deal of attention. These devices generally employ normal metal films on a dielectric substrate, and operate in the gigahertz frequency spectrum and higher.

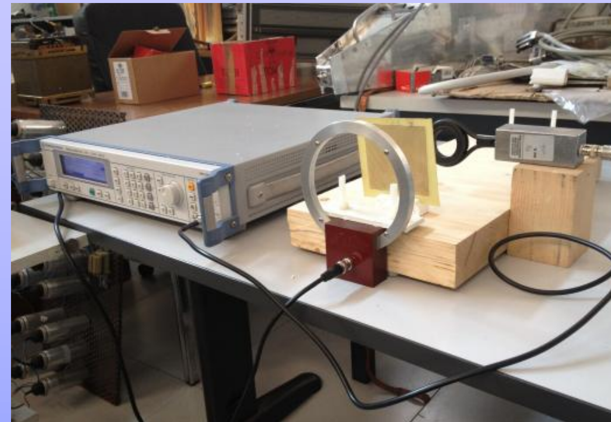


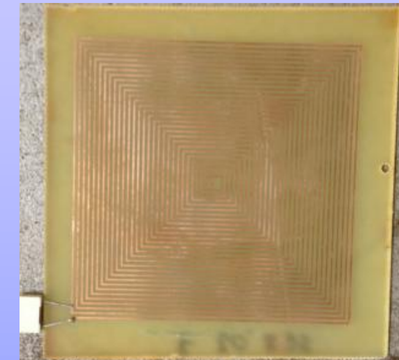

*(a) Split ring resonator for high-frequency metamaterials (outer ring diameter is 2.26mm). (b) Spiral resonator for radio frequency metamaterials (outer diameter is 6mm and has 40 turns).*

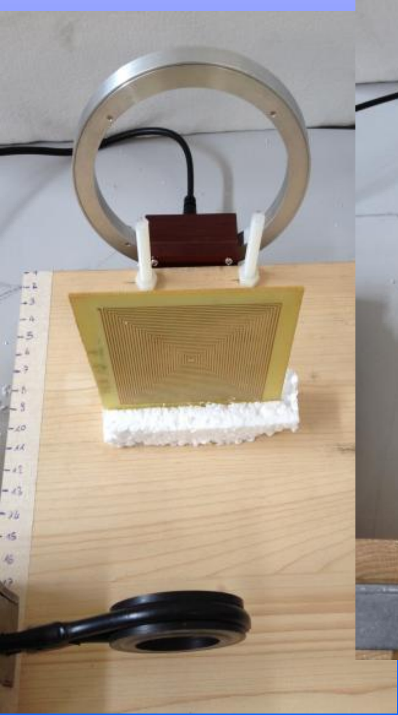
# State of art

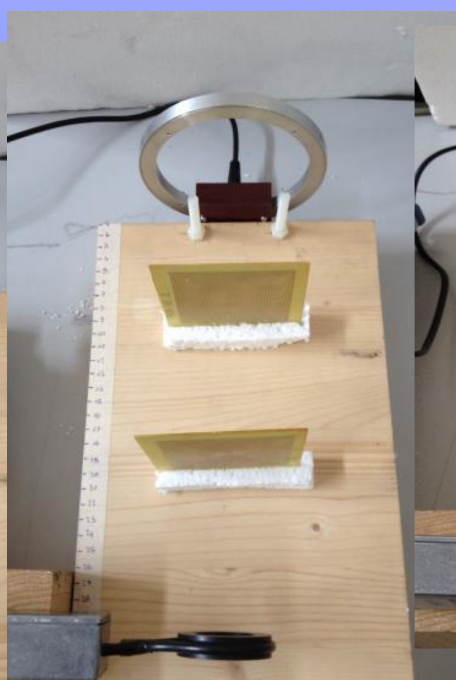


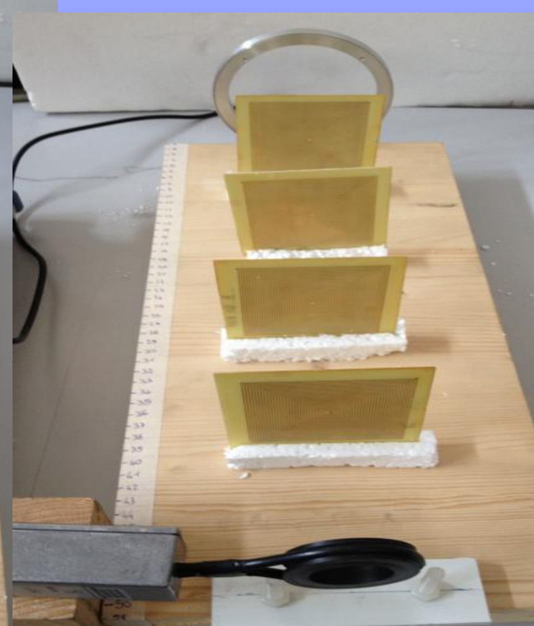


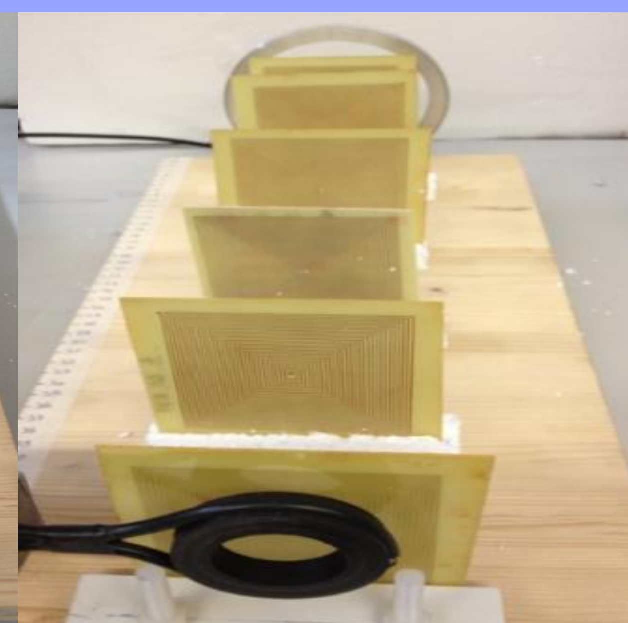








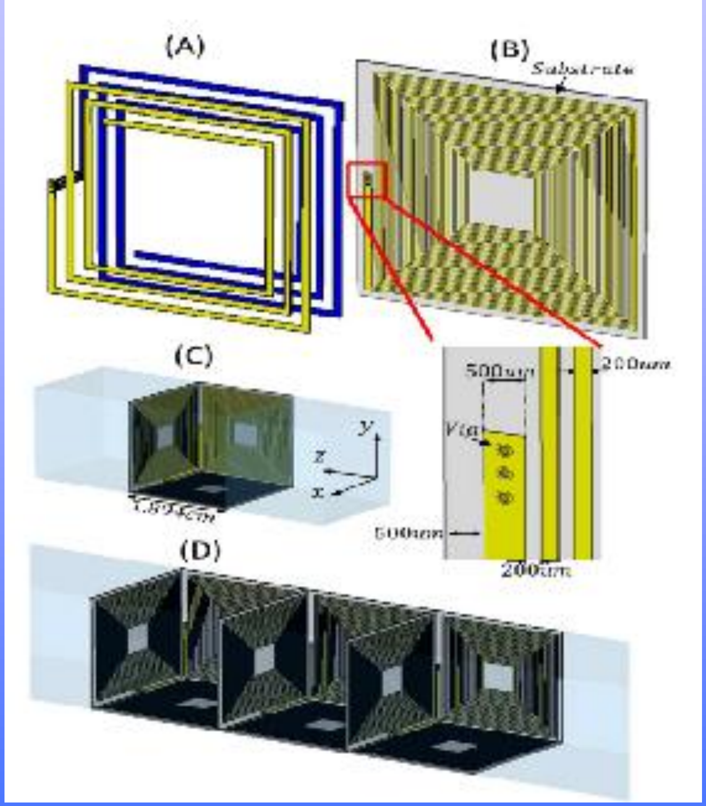




# State of art 

**Duke University and Toyota research**

13–16 MHz the conditions under which the superlens can enhance power transfer efficiency compared to the lens-less free-space system.



# THE ARES WITRICITY POLICY

The phased array antenna system allows to manage all the RF energy available to a charging device of the target using the same RSSI (Received signal strength indication) like to get feedback on the intensity and amount of energy received. In practice, the various component elements of the transmitting antenna (array) are fed with phase angles variables to obtain the perfect tuning with the receiving antenna which is omnidirectional instead. Once hooked the target you establish a dialogue with the transmitter to maximize every moment on the tuning phased array antenna. A transmitter system of this kind, to have good directional characteristics and reduced dimensions, must work in high frequency; for this ARES has extensive experience, for the construction of W-band RF transmitters.

**To increase the transmission efficiency, the fusion of the phased array antenna technique and metamaterials/magnetic lens, is today possible is the unexplored way of remote power transmission.**