



Near-Field Coupling in Wireless Systems

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The analysis of the near-field coupling between closely spaced antennas has attracted a lot of attention since decades ago. Most of the research work is about array antennas, where the interest is on the techniques for reducing the coupling level between adjacent radiating elements, or for developing advanced array synthesis methods that are able to account for the coupling phenomena. Near-field coupling is also of interest in the design of multi-antenna platforms, such for example antennas operating on a satellite or a car, at different frequencies and for different applications. Further areas where near-field coupling has attracted attention are electromagnetic compatibility problems, design of near-field scanning probes, optimization of near-field to far-field (NF-FF) antenna measurement systems, development of effective and accurate numerical techniques, as well as approximate analytical models, for the coupling analysis.

The authors' goal is to present an overview of problems involving near-field coupling analysis, when considering some recent applications in the context of wireless data and power transfer. Among them, it is worth mentioning those wireless systems where RX and TX antennas *are not* in the far-field region of each other. Although, such situations are in a limited number with respect to the conventional far-field radio links, they represent an interesting research area as the performance of many devices and systems can be improved significantly when the near-field coupling phenomena are correctly accounted for.

Among above cited systems, it is worth mentioning the following ones:

- near-field wireless power transfer [1];
- near-field RFID applications (printer encoders, Near-Field UHF RFID systems [2]);
- radio links between either wearable antennas or wearable antennas and body-embedded antennas;
- near-field focusing at microwave and mm-wave frequency bands [3, 4];
- near-field communication (NFC) systems;
- Chip-to-Chip (C2C) or board-to-board wireless links.

The analysis will focus on the applications, key-performance indicators, analysis techniques, equivalent circuit models.

1. A. Buffi, A. Michel, P. Nepa and G. Manara, "Numerical Analysis of Wireless Power Transfer in Near-Field UHF RFID," *Wireless Power Transfer*, Cambridge University Press, Special Issue on "Wirelessly powering the future", 2017, pp. 1-12, doi:10.1017/wpt.2017.16.
2. A. Michel, P. Nepa, X. Qing, Z. N. Chen, "Considering High-Performance Near-Field Reader Antennas: Comparisons of Proposed Antenna Layouts for Ultrahigh-Frequency Near-Field Radio-Frequency Identification," *IEEE Antennas and Propagation Magazine*, **60**, n.1, pp. 14-26, 2018, doi: 10.1109/MAP.2017.2774141
3. A. Buffi, P. Nepa, "Near-Field Focused Microwave Antennas: Near-field shaping and implementation," *IEEE Antennas and Propagation Magazine*, **59** (3), pp. 42-53, June 2017, doi: 10.1109/MAP.2017.2686118.
4. P. Nepa, A. Buffi, A. Michel, G. Manara "Technologies for Near-Field Focused Microwave Antennas," *International Journal of Antennas and Propagation (IJAP)*, Vol. 2017, 17 pages, 2017, doi: 10.1155/2017/7694281.