Numerical Modeling Strategies for Implanted and On-body Antennas and Propagation

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An increasing number of medical electronics applications such as cardiac pacemakers, wireless endoscopy capsules, cochlea implants, etc. include a wireless communication module.

Often, the design of the RF module is done with only little emphasis of the implantation media (tissue) and the propagation channel, i.e. on-body or in-body. With respect to the antenna design the influence of the tissue is typically only taken into account for the impedance matching of the antenna.

On the other hand side on-body applications are often evaluated on a system level, e.g. by calculation of the Bit Error Rate for the desired data rate and a given system and scenario. Such a specific evaluation allows only for limited inside in how the antenna integration affects the overall system performance. Therefore, the derivation of antenna integration design rules of such in- and on-body systems is quite limited.

In principle the entire in-/on-body scenario can be treated by numerical electromagnetic simulation using high resolution body phantoms and realistic antenna integration scenarios. However, such simulations require a large amount of computer resources and finally they also represent only a specific configuration.

The strategy proposed here is based on numerical simulations but focuses on a de-embedding approach for the antenna and the in-/on-body channel. Thereby, equivalent in-/on-body antenna metrics are derived as well as in-/on-body path loss models. These models can later be used for link budged calculations of generalized scenarios.