Comparison of Microwave Transmission and Reflection Imaging Methods

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Microwave imaging techniques are driven by their applications as to their reliance upon transmission or reflection data. In the medical field, both transmission and reflection methods are effective and also achievable, while in certain other areas such as through-the-wall imaging, land mine detection, or geophysical exploration, the reflection method appears to be the only option due to the self-evident practical limitations.

We have developed an imaging technique based on the Field Mapping Algorithm (**FMA**), which is applicable to both transmission and reflection data. **FMA** is a direct inversion method requiring neither optimization nor iterative procedures. Conventional microwave tomography is based on optimization strategies which require large modeling libraries for the generation of effective start-up configuration seeds that lead to successful forward solutions for internal electric parameters, such as conductivity and dielectric permittivity. Knowledge regarding the spatial distribution of these latter two parameters should be regarded as synonymous with internal image formation. Unfortunately, the associated computations are then of necessity intensive as to both execution time and CPU demands.

By contrast, the **FMA** determines the full vector field everywhere, in regions interior and exterior to the target of interest, biological or otherwise. It is based on a single-slice, near-field data capture, and provides complete disclosure of all three components of both electric and magnetic fields throughout the target region. The **FMA** is a direct, closed-form solution which is numerically straightforward and CPU-efficient. From the internal field distributions to which it provides an easy access one can infer the corresponding distributions of the desired electrical attributes.

An assessment comparison of the **FMA** imaging technique in its use of either transmission or reflection data is carried out from both theoretical and measurement viewpoints. Ten measurement examples are given, five cases for transmission data, and five for its reflection counterpart. The imaged objects are of both a metallic and dielectric kind, in addition to vegetation and biological tissue. A trade-off is drawn and presented.