Nondestructive evaluation of embedded structures in concrete: Modeling and imaging

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Steel reinforcements and metallic tendon ducts are typical structures embedded in concrete to be detected and located with microwaves, i.e. Ground Probing Radar (GPR) systems. Since propagation and scattering of electromagnetic waves by such complex geometries is rather intricate, numerical modeling techniques can help considerably to understand received signals physically. We utilize the Finite Integration Technique as realized as a commercially available code (Microwave Studio by CST) to model microwave propagation through steel reinforcements either in reflection or transmission. These results are compared with experimental data in order to understand measured arrival times.

Regarding microwave imaging we rely on the FT-SAFT algorithm (Fourier Transform Synthetic Aperture Focusing Technique) as a frequency diversity diffraction tomographic solution of linearized inverse scattering; the essence of this technique is SAR via the spatial Fourier space of the scatterer. We apply FT-SAFT in either a monostatic or a bistatic mode to experimental data obtained from a GPR system as well as to laboratory data upscaled in frequency: The possible extension of FT-SAFT to polarimetric data can the be evaluated in detail. Previously, this new polarimetric linear inverse scattering algorithm has been successfully applied to synthetic data, and now it will have to demonstrate its superiority over the corresponding scalar version against experimental data.