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Radio frequency tomography for the investigation of cracks in reinforced concrete structures

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We are interested in investigating the presence of cracks inside reinforced concrete structures using Radio Frequency Tomography (RFT).
RFT applies electromagnetic waves to probe the environment and is based on the use of multiple transmitting and receiving antennas.

RFT is a multistatic system where the volume under investigation is illuminated and observed from different directions, which results into an increase in resolution.

In an application of RFT there are two main phases: the forward problem and the inverse reconstruction. The forward problem consists in the determination of the electromagnetic field scattered by the volume under investigation, which is illuminated by the transmitters. The scattered field depends on the spatial distribution of the dielectric permittivity in the volume under investigation. This distribution determines the contrast function. The inverse problem consists of the reconstruction of the contrast function from the scattered electromagnetic field.

One of the challenges in RFT is the determination of the best approach to solve the inverse problem.

In order to focus solely on the behavior of the inverse approach, we consider simplified geometries for the volume under investigation, such as a cylindrical concrete pillar with a metallic steel bar that is coaxial to the cylinder. In this way, it is possible to analytically evaluate the scattered electromagnetic field in an exact way. We then investigate the behavior of the reconstruction approach from the point of view of (1) geometry of the illumination and observation antennas; (2) frequency used to illuminate the volume under interest; (3) fusion of the results obtained at various frequencies.