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Non-invasive 3D Electrical Tomography for corrosion diagnosis of reinforced concrete materials

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Multi-channel probes-based non-invasive electrical devices bear practical relevance for corrosion diagnosis of reinforced concrete (RC) materials [1, 2]. Injecting current between two electrodes from the surface induces indirect polarization of the rebars, while the resulting potential difference (ΔV), between a set of reception dipoles, is simultaneously recorded. A transfer function permits to compute the apparent resistivities (ρ_{app}) profiles. When ΔV reach steady state, ρ_{app} depends on the concrete resistivities (ρ_c) and on the corrosion current densities (J_{corr}).

The novel Corimager switch device (CSD) developed by IRIS Instruments is an Electrical Resistivity Tomograph (ERT) adapted to contact impedances measurements on cement-based materials thanks to 96 electrodes evenly distributed over the 4 fronts of an iron maiden probe [2]. CSD was successfully applied for 3D ERT measurements on passive RC beams of dimensions 10 x 10 x 40 cm² [2].

In this study, CSD is used on RC beams (10 x 10 x 40 cm²), that were submitted over 10 years to tidal conditions, on the experimental site of La Rochelle. Measurements were performed in laboratory, under controlled temperature and relative humidity. The device provided 3D images of ρ_c and j_{corr} distributions. J_{corr} were compared to those provided by four conventional electrochemical techniques: EIS, LRP, VaOCP and GP. X-ray Tomography was used to comfort the spatialization.

References

[1] B. Oniangue-Ongania, Holzhauser, R. Rodrigues, S. Betelu, S. Gaboreau, R. Cherif, I. Ignatiadis, A. Aït-Mokhtar, J. Gance, Non-invasive corrosion diagnosis of reinforced concrete structures: A sensitivity analysis using a multi-channel resistivity approach, EUROCORR 2023, The Annual Congress of the European Federation of Corrosion, Bruxelles, Belgium, 2023. [2] J. Holzhauser, J. Gance, Y. Fargier, C. Chiaberge, S. Betelu, Inversion of non-invasive resistivity measurements in fourelectrodes configuration for corrosion characterization in reinforced concrete samples, EUROCORR 2023, The Annual Congress of the European Federation of Corrosion, Bruxelles, Belgium, 2023.