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Development of innovative electrodes for the application of ERT methods to the benefit of immovable Cultural Heritage Conservation

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In the field of science in conservation, it is well known that most of the damages are induced by moisture changes. Indeed, water content distribution in masonry is a determining factor in the frame of the weathering and alteration processes. The evaluation and monitoring of water content in immovable cultural heritage with Non Destructive Technics (NDT) remain a scientific challenge. Electrical Resistivity Tomography (ERT) is a NDT that enables to image the in-depth spatial and/or temporal variations of the electrical resistivity related to the water saturation. Thus, this study investigates adaptation of ERT to Cultural Heritage issues.

The application of the ERT method is based on the injection and reception of an electrical signal through the surface of the auscultated object. Due to the preciosity of the masonry, adapted electrodes are developed. Sensor development takes into account of electrode/material surface interfacial quality to prevent any damage to the structure and optimum electrical coupling.

The aim of this study concerns the development of a new type of electrodes specially adapted to the ERT monitoring on heritage buildings. Thus, the coupling interface (electrode/material) and the electrical properties of the electrodes are tested in the laboratory as well as in the field conditions.

In the laboratory conditions two tests are performed: first, the electrical properties of the electrodes like the capacity of the electrodes to be polarized, the internal resistance, the relation between surface of electrode and the injected to received signal ratio magnitudes and others are tested. Second, the performance of electrodes is tested on a limestone block from a Gallo-Roman temple. The contact resistance of the electrodes as well as the response of the material to the injected electrical signal at different degrees of saturation are tested.

The practical implementation of the new electrodes in the field conditions is the last step. The electrodes are used in real conditions by applying the ERT method on the Gallo-Roman Temple of the archaeological site of Genainville (France). This allows to validate the design of the electrodes in a complete acquisition system for in situ long term monitoring of water distribution in masonry submitted to water table rising periods.