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On the combined use of radar systems for multi-scale imaging of transport infrastructures

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Ground Penetrating Radar (GPR) systems are worth to be considered as in situ non invasive diagnostic tools capable of assessing stability and integrity of transport infrastructures. As a matter of fact, by exploiting the interactions among probing electromagnetic waves and hidden objects, they provide images of the inner status of the spatial region under test from which infer risk factors, such as deformations and oxidization of the reinforcement bars as well as water infiltrations, crack and air gaps.
With respect to the assessment of concrete infrastructures integrity, the reconstruction capabilities of GPR systems have been widely investigated [1,2]. However, the demand for diagnostic tools capable of providing detailed and real time information motivates the design and the performance evaluation of novel technologies and data processing methodologies aimed not only to effectively detect hidden anomalies but also to estimate their geometrical features.
In this framework, this communication aims at investigating the advantages offered by the joint use of two GPR systems both of them equipped with a specific tomographic imaging approach.
The first considered system is a time domain GPR equipped with a 1.5GHz shielded antenna, which is suitable for quick and good resolution surveys of the shallower layers of the structure. As second system, the holographic radar Rascan-4/4000 [3,4] is taken into account, due to its capability of providing holograms of hidden targets from the amplitude of the interference signal arising between the backscattered field and a reference signal. The imaging capabilities of both the GPR tools are enhanced by means of model based data processing approaches, which afford the imaging as a linear inverse scattering problem. Mathematical details on the inversion strategies will be provided at the conference.
The combined use of the above GPR systems allows to perform multi-resolution surveys of the region under test, whose aim is, first of all, to detect hidden anomalies and then to provide a high resolution image of their geometrical features. Therefore, reliable and efficient diagnostic surveys devoted to state the healthy state of a structure can be scheduled.
Numerical examples and on field validations assessing the achievable reconstruction capabilities will be provided at the conference.

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