



## GPR Image and Signal Processing for Pavement and Road Monitoring on Android Smartphones and Tablets

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Ground Penetrating Radar (GPR) is a geophysical method that uses radar pulses to image the subsurface. This non-destructive method uses electromagnetic radiation and detects the reflected signals from subsurface structures. It can detect objects, changes in material, and voids and cracks. GPR has many applications in a number of fields. In the field of civil engineering one of the most advanced technologies used for road pavement monitoring is based on the deployment of advanced GPR systems. One of the most relevant causes of road pavement damage is often referable to water intrusion in structural layers. In this context, GPR has been recently proposed as a method to estimate moisture content in a porous medium without preventive calibration. Hence, the development of methods to obtain an estimate of the moisture content is a crucial research field involving economic, social and strategic aspects in road safety for a great number of public and private Agencies. In particular, a recent new approach was proposed to estimate moisture content in a porous medium basing on the theory of Rayleigh scattering, showing a shift of the frequency peak of the GPR spectrum towards lower frequencies as the moisture content increases in the soil.

Addressing some of these issues, this work proposes a mobile application, for smartphones and tablets, for GPR image and signal processing. Our application has been designed for the Android mobile operating system, since it is open source and android mobile platforms are selling the most smartphones in the world (2013). The GPR map can be displayed in black/white or color and the user can zoom and navigate into the image. The map can be loaded in two different ways: from the local memory of the portable device or from a remote server. This latter possibility can be very useful for real-time and mobile monitoring of road and pavement inspection. In addition, the application allows analyzing the GPR data also in the frequency domain. It is possible to visualize the GPR spectrum, and the application returns the (abscissa of the) frequency peak of the GPR spectrum. It is also possible to visualize more GPR spectra on the same figure, in order to understand if a frequency shift (related to moisture content) has been observed. Finally, the GPR spectra can be exported as a JPEG file. This application has a strategic and innovative potentiality for all the Agencies involved in roads and highway management in order to improve the onsite efficiency and effectiveness of the works.

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