



The Integrated inversion interpretation of GPR and Rayleigh wave based on Genetic Algorithm

Tan Qin (1), Yonghui Zhao (1), Shufan Hu (1), Cong An (1), Lorenzo Capineri (2), and Shuangcheng Ge (3)

(1) Tongji University, School of Ocean & Earth Sciences, Shanghai, China (zhaoyh@tongji.edu.cn), (2) University of Florence, Department of Information Engineering, Florence, 50139, Italy(lorenzo.capineri@unifi.it), (3) Zhejiang University of Water Resources and Electronic Power, Hangzhou 310018, China(gesc163@163.com)

Ground Penetrating Radar (GPR) and Rayleigh Wave are general non-destructive testing (NDT) methods used in the near surface exploration. However, loads of project practices and case studies show that the high-frequency signals of electromagnetic wave travels in the medium with high attenuation for long travel times, and many artifacts caused by different interference sources decrease the quality of radargram significantly. Thus the stratum of deep area becomes low S/N ratio in radar profile. Meanwhile the lateral resolution of Rayleigh wave cannot meet the requirement of survey due to the limitation of recording geometry. What mentioned above is a bottleneck of those engineering exploration techniques. In the paper, we tackled this problem by the combination of GPR and Rayleigh wave in inversion. Firstly, we achieved the numerical modelling of electromagnetic wave and surface wave, as well as the calculation of dispersion curve connected with the fundamental surface wave mode. Then we extracted the stacking velocities from radar velocity spectrum produced by the cross-correlation criterion. Through Dix formula, we estimated the velocity ranges and the layer thickness in the case of horizontal layered media. On the other hand, we used Genetic Algorithm (GA) to inverse the shear wave velocities, in which the previous result of GPR was set as a constraint condition. Considering that, the solution of this stochastic inversion method was different every time, we adopted statistical analysis conception to the comparison the joint inversion and individual inversion respectively. The results illustrated that the method we proposed performed much better than either of GPR and Rayleigh wave. Specific for, radargram provided the surface wave inversion with high-resolution information about shallow strata. In return, the former also benefited from the later which possessed greater penetrability and showed more precise layering in deep area. Finally, we conducted a series of field tests for detecting an underground structure. The underground interfaces can be easily distinguished by the integrated method. It has been proved that this method combining the advantages of GPR and Rayleigh wave together will be a decent compensation for the existing geophysical methods.