Geophysical Research Abstracts
Vol. 20, EGU2018-3158, 2018
EGU General Assembly 2018

Non-linear Optimization of GPR Data to Predict Thin Overlay Thickness and Density

Imad Al-Qadi, Siqi Wang, and Shan Zhao

University of Illinois, Urbana-Champaign, Illinois Center for Transportation, Civil and Environmental Engineering, United States (siqiw2@illinois.edu)

Ground penetrating radar (GPR) is widely used for continuous monitoring of pavement layer thickness and density during asphalt concrete (AC) pavement compaction. However, overlapping of reflected pulses from surface and bottom of thin AC overlay, as well as the surface moisture used during compaction, pose a challenge to the utilization of GPR for a successful application for this purpose. In this study, non-linear optimization was used to predict the layer thickness of thin AC overlay with presence of surface moisture. The pavement structure was simplified as a linear time-invariant (LTI) system. Finite difference time domain (FDTD) models were built to generate GPR reflected signals. The thin AC overlay thickness in the model ranges from 19 mm (0.75 in) to 50 mm (2 in) at an interval of 6 mm (0.25 in). The surface sprayed water was simplified as a 2 mm thin layer. A cost function was generated and local minimum was found using gradient descent method to solve the scaling and shifting factors of the LTI pavement system. The simulation results are sensitive to the initial conditions when gradient descent was conducted. The results show that the non-linear optimization method is effective for thin AC layer thickness estimation when surface sprayed water was applied. The thickness results show that the maximum, minimum and average prediction error are 8mm, 0.25mm and 5mm, respectively.