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The requirement of implementing Fermat's principle of least time in geotechnical DST site characterization

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Downhole Seismic Testing (DST) such as Seismic Cone Penetration Testing (SCPT) is a widely used geotechnical technique for estimating low-strain in-situ interval velocities and absorption values. The in-situ interval velocities form the core (Shear Modulus (G), Poisson's Ratio (μ) and Young's modulus (E)) of mathematical theorems to describe the elasticity/plasticity of soils and they are used to predict the soil response to imposed loads. The horizontally polarized shear wave is also an important parameter for evaluating liquefaction potential due to fact that it is influenced by many of the variables that influence liquefaction. Estimates of low-strain absorption values are very important for predicting and assessing ground amplification during earthquakes. The low-strain absorption estimates also provide for a reference of laboratory tests such as the resonant column test. When processing DST data sets the majority of investigators assume the seismic source waves in DST travel in straight lines (the so-called Straight Ray Assumption (SRA)). The SRA is an inaccurate assumption. Source wave trajectories adhere to Fermat's principle of least time. This means that the raypath travels along the trajectory that minimizes the travel time between points. This paper outlines algorithms which estimate DST interval velocities and absorption values by implementing Fermat's principle of least time. Test bed simulations and case histories are also outlined which demonstrate the importance of implementing Fermat's principle when processing DST data sets.

Biography:

Dr. Erick Baziw received the B.A.Sc. degree in geophysics engineering, the M. A. Sc. degree in geotechnical engineering, and the Ph.D. degree in seismic signal processing from the University of British Columbia. He has been the Managing Director of Baziw Consulting Engineers Ltd. since 1997. Erick is a Registered Professional Engineer in the disciplines of geophysics and software engineering. He is also a senior member of IEEE. Erick's research interests are focused on the design of data acquisition, signal processing and optimal estimation systems for geotechnical and geophysical site characterization. He has published various papers in peer reviewed journals such as IEEE Transactions on Geoscience and Remote Sensing, IEEE Geoscience and Remote Sensing Letters, Pure and Applied Geophysics, Canadian Geotechnical Journal, ASTM International - Geotechnical Testing Journal, Soils and Rocks Journal, and International Journal of Geosciences.


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