Ground Penetrating Radar (GPR) in Exploration Geophysics: Principles, Applications and New trends

Hesham M. El-Kaliouby[1]

[1]*Geophysical Sciences Department., National Research Centre, Cairo, Egypt*

Email: hkaliouby@gmail.com

Ground Penetrating Radar (GPR) is a noninvasive geophysical method that is commonly used for imaging near surface features. GPR is quick, easy and quite reasonable to straight, and measured data have highly perpendicular and straight resolutions. GPR could be used for many applications including geotechnical and engineering as it could provide early warning for engineers from civil sector to yield proper securities before arising any situation like catastrophic. GPR could also be used for identifying cavities within sedimentary rock. GPR uses high frequency waves of electromagnetic to plot different lithologies or subsurface objects yielding electrical properties of different nature. Ground Penetrating Radar is commonly dragged along an earth surface using a wheel cart, the transmitter antenna sends pulses of electromagnetic high frequency energy to enter into the earth, a part of the GPR waves are send back to the ground upon encountering an interface with materials contrast in dielectric permittivity. Underground structural features are detected by determining the two-way travel time and amplitude of this reflected energy to the receiver antenna. Limestone with dry nature is a promising source that allow GPR signal to penetrate and gives image of karstic cavities. Due to the electrical permittivity contrast in between the air-gap and the surrounding host rock, this give strong reflections of radar signals. GPR could be measured in different configurations including common- offset, common midpoint and as radar tomography between boreholes. GPR could be used for many other applications including geological and hydrogeological investigations (e.g. mapping of bedrock topography, groundwater levels, glacial structures, and landslide), Environmental Studies (e.g. groundwater pollution, salt water intrusion, hydrocarbon leakage, landmines, unexploded ordnance (UXO), and landfills); engineering and geotechnical investigations (e.g. constructions, foundations, tunnels, utilities, dams, pavements, road beds, railway embankments,

piles, bridge decks, underground storage tanks, and reinforcing bars). GPR is considered as one of the best tools for detection of cavities, tombs, and archaeological targets. GPR could also be used for forensic investigations. The GPR depth of investigation increases with low frequency antenna, high transmitter power and high receiver sensitivity. However, the depth of penetration decreases with high electrically conductive materials like clays and saline water or highly conductive contaminants. In general, GPR is an efficient practice in the documentation and classification of near surface structures. GPR results not only inform us about existing structures, but also warns of potentially hazardous situation like sinkholes and landslides. The presentation will provide background about the principles, applications, restrictions, and appropriateness of the Ground Penetrating Radar process for examining the subsurface and new trends in GPR equipment and field measurements.