High Resolution 3D GPR Applied to Archaeology for Characterizing Accurate Subsurface Structure

Mahmoud Gaballah [(1)], Mark Grasmueck [(2)] and Motoyuki Sato [(1)]
[(1)]Center for Northeast Asian Studies, Tohoku University; Division of Geoscience and Remote Sensing; [(2)]RSMAS, University of Miami. (□Oral ■Poster)

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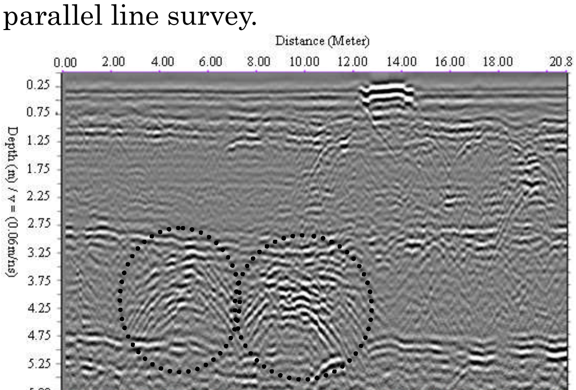
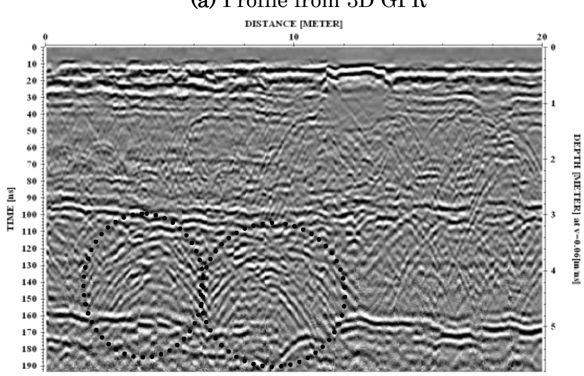
Abstract: Currently Ground Penetrating Radar (GPR) used in archaeological prospection is based on 2D parallel line methodologies characterized by line spacing ranging from 0.25m to 1m (common line separation is 0.5m) with 250MHz or 500MHz antennas and huge amount of interpolation used to fill in the data gaps. Such a 3D GPR surveys produce highly interpolated subsurface maps which do not exploit the full resolution of GPR. High resolution 3D-GPR images of the subsurface can be obtained by a quarter wavelength of grid spacing in all direction. Acquiring such a very huge and dense data using commercial GPR is not practical and data processing takes a very long time. Recently we use a new GPR system which is a combination between commercial GPR with a rotary laser positioning system (RLPS) developed by Miami University. In this paper we will show how the high density 3D-GPR data can improve the image quality and refined the subsurface archaeological structure resolution in Satiobaru burial mounds archaeological site. The GPR vertical cross-sections, horizontal depth slices and the data volume animation extracted from the full resolution 3D GPR reveal a lot of information about the past human activities most likely burial mounds. Figure 2 includes a pair of prominent structures (**T1** and **T2**) that represents anomalies related to archaeological features. Moreover, circular scattered anomalies labeled **R1** and **R2** aligned into well-defined features that give indication that they are associated with subsurface archaeological features. These structures cannot be clearly detected from horizontal time slice created by the conventional 2D GPR parallel line survey.

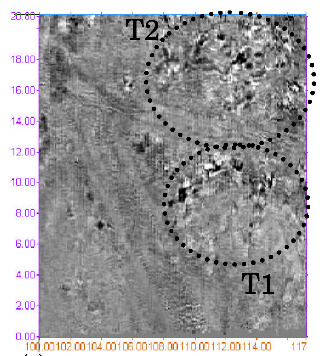


(a) Profile from 3D GPR

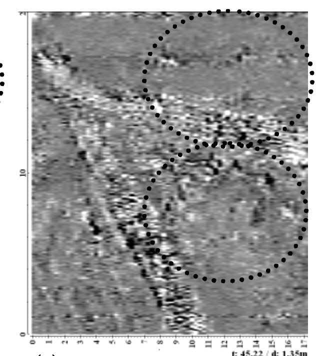


(b) Profile from Conventional GPR

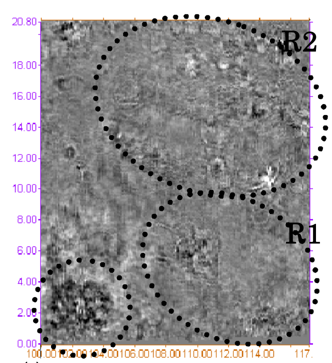
Figure 1: GPR vertical cross-section after data processing (a) From 3D GPR (b) From conventional GPR. Circle indicate the archaeological anomalies locations.



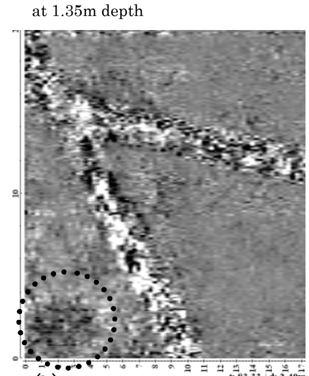
(a) Image from 3D GPR at 1.35m depth



(b) Image from conventional GPR at 1.35m depth



(c) Image from 3D GPR at 2.49m depth



(b) Image from conventional GPR at 2.49m depth

Figure 2. Horizontal time slice (a) and (c) from 3D GPR with 10cm line spacing. (b) and (d) from conventional GPR lines spaced with 25cm, where many subsurface structures are almost invisible.