

## Establishment of Precision System for Underground Facilities Based on 3D Absolute Positioning Technology

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**Abstract :** The study aims to address the limitations of existing underground facility exploration equipment in terms of exploration depth range, relative depth measurement, data processing time, and human-centered ground penetrating radar image interpretation. The study proposed the use of 3D absolute positioning technology to develop a precision underground facility exploration system. The aim of this study is to establish a precise exploration system for underground facilities based on 3D absolute positioning technology, which can accurately survey up to a depth of 5m and measure the 3D absolute location of precise underground facilities. The study developed software and hardware technologies to build the precision exploration system. The software technologies developed include absolute positioning technology, ground surface location synchronization technology of GPR exploration equipment, GPR exploration image AI interpretation technology, and integrated underground space map-based composite data processing technology. The hardware systems developed include a vehicle-type exploration system and a cart-type exploration system. The data was collected using the developed exploration system, which employs 3D absolute positioning technology. The GPR exploration images were analyzed using AI technology, and the three-dimensional location information of the explored precise underground facilities was compared to the integrated underground space map. The study successfully developed a precision underground facility exploration system based on 3D absolute positioning technology. The developed exploration system can accurately survey up to a depth of 5m and measure the 3D absolute location of precise underground facilities. The system comprises software technologies that build a 3D precise DEM, synchronize the GPR sensor's ground surface 3D location coordinates, automatically analyze and detect underground facility information in GPR exploration images and improve accuracy through comparative analysis of the three-dimensional location information, and hardware systems, including a vehicle-type exploration system and a cart-type exploration system. The study's findings and technological advancements are essential for underground safety management in Korea. The proposed precision exploration system significantly contributes to establishing precise location information of underground facility information, which is crucial for underground safety management and improves the accuracy and efficiency of exploration. The study addressed the limitations of existing equipment in exploring underground facilities, proposed 3D absolute positioning technology-based precision exploration system, developed software and hardware systems for the exploration system, and contributed to underground safety management by providing precise location information. The developed precision underground facility exploration system based on 3D absolute positioning technology has the potential to provide accurate and efficient exploration of underground facilities up to a depth of 5m. The system's technological advancements contribute to the establishment of precise location information of underground facility information, which is essential for underground safety management in Korea.

**Keywords :** 3D absolute positioning, AI interpretation of GPR exploration images, complex data processing, integrated underground space maps, precision exploration system for underground facilities

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