

## Development of a Wall Climbing Robotic Ground Penetrating Radar System for Inspection of Vertical Concrete Structures

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**Abstract :** This paper describes the design process of a 200 MHz Ground Penetrating Radar (GPR) and a battery powered concrete vertical concrete surface climbing mobile robot. The key design feature is a miniaturized 200 MHz dipole antenna using additional radiating arms and procedure records a reduction of 40% in length compared to a conventional antenna. The antenna set is mounted in front of the robot using a servo mechanism for folding and unfolding purposes. The robot's adhesion mechanism to climb the reinforced concrete wall is based on neodymium permanent magnets arranged in a unique combination to concentrate and maximize the magnetic flux to provide sufficient adhesion force for GPR installation. The experiments demonstrated the robot's capability of climbing reinforced concrete wall carrying the attached prototype GPR system and perform floor-to-wall transition and vice versa. The developed GPR's performance is validated by its capability of detecting and localizing an aluminium sheet and a reinforcement bar (rebar) of 12 mm diameter buried under a test rig built of wood to mimic the concrete structure environment. The present robotic GPR system proves the concept of feasibility of undertaking inspection procedure on large concrete structures in hazardous environments that may not be accessible to human inspectors.

**Keywords :** climbing robot, dipole antenna, ground penetrating radar (GPR), mobile robots, robotic GPR

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