Option2
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Comparative analysis of the performance of GPS system for outdoor construction site SLAM and navigation for mobile robot

Young Jae Song[1]*, Se Jun Jang[2]
[1] *Department of Architectural Engineering, Faculty of Architecture Engineering, Kunsan national university, South Korea, E-mail address: ddookbaegi@naver.com*
[2] *Department of Architectural Engineering, Faculty of Architecture Engineering, Kunsan national university, South Korea, E-mail address: jang@kunsan.ac.kr*

Mobile robots are proposed as a solution to address various challenges in construction sites. However, the constant changes, spatial constraints, and diverse working conditions at construction sites increase the complexity and unpredictability, making the application of mobile robots challenging.[1] The use of an accurate positioning system is essential for utilizing mobile robots in the challenging and diverse environments of construction sites, with GPS being one of the key technologies. This study aims to provide guidance on selecting the most suitable GPS system for mobile robots by comparing the accuracy of different GPS technologies. The experimental method of this study was designed to evaluate the accuracy of mobile robot positioning in outdoor construction sites. It compared and analyzed the performance of three different positioning systems integrated into the mobile robot—Odometry, DGPS (Differential GPS), and RTK GPS (Real-Time Kinematic GPS). The experiment was conducted using the Agile-X Scout mobile robot, and the employed GPS system was the SMC2000. The benchmark for comparison was the robot's actual driving route. The results show that odometry, while useful for short-range navigation due to its simplicity and low cost, tends to accumulate errors over time, making it less reliable for long-range operations without additional corrective measures (Figure 1). DGPS faced challenges with signal reflection and obstruction near trees and buildings, a phenomenon known as the multipath effect, which led to increased error values, indicating compromised reliability in certain conditions (Figure 2). RTK GPS demonstrated superior performance by maintaining high accuracy even in the presence of potential signal disruptors (Figure 3). Its resilience to the multipath effect and ability to provide precise location data in real-time make it a robust solution for mobile robot navigation in complex and dynamic environments like construction sites.

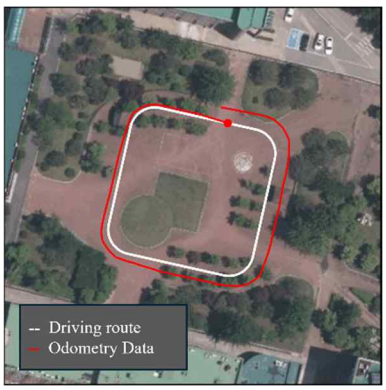

Figure 1. Odometry Data

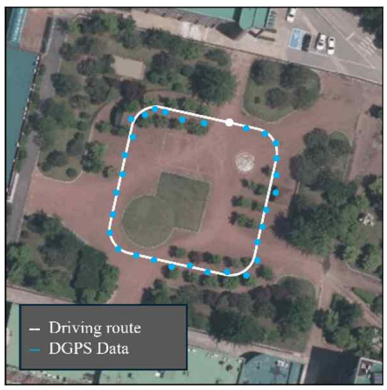

Figure 2. DGPS Data Figure

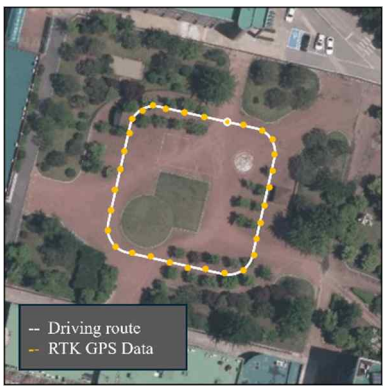

Figure 3. RTK GPS Data

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REFERENCES
[1] Balasuriya, B. L. E. A., et al. "Outdoor robot navigation using Gmapping based SLAM algorithm." 2016 Moratuwa Engineering Research Conference (MERCon). IEEE, 2016.