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Cooperative Localization in GPS-denied Areas for Bridge Inspection Using Multiple UAVs

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ABSTRACT

Bridge inspection using unmanned aerial vehicles (UAVs) provides an efficient and cost-effective alternative to traditional inspection methods. However, accurately localizing UAVs in GPS-denied environments remains a critical challenge. To address this issue, this study proposes a cooperative localization approach that utilizes multiple UAVs equipped with ultra-wideband (UWB) sensors to estimate relative distances and improve the localization accuracy of a single UAV operating in a GPS-denied area. The proposed method integrates UWB-based ranging data with onboard inertial measurement unit (IMU) information through a sensor fusion framework to enhance localization performance. The effectiveness of the proposed approach is validated through simulations and pilot tests conducted in outdoor environments. Experimental results demonstrate that cooperative localization using UWB sensors significantly improves positioning accuracy compared to standalone UAV localization methods, ensuring reliable navigation and inspection in challenging GPS-denied environments. This study contributes to advancing UAV-based bridge inspection by enabling precise localization and enhancing operational efficiency in GPS-challenged scenarios.

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