# 面向林地建图的激光惯导融合 SLAM 算法

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**摘要：**激光惯导融合的同步定位与建图算法可以构建高精度的三维点云地图，为森林关键林木参数信息的获取提供可靠数据。为了解决现有基于平滑和建图的激光惯导里程计（Lidar Inertial Odometry via Smoothing and Mapping，LIO-SAM）难以提取树干特征和滤除地面点的问题，本文提出了基于平滑和建图的林业激光惯导里程计（Forestry Lidar Inertial Odometry via Smoothing and Mapping，F-LIO-SAM）。该方法包含两个创新点，一是根据圆弧半径特征树干提取，二是利用惯导姿态信息滤除地面点。最后对比研究了改进前后两种算法的特征提取方法和去地面点方法的实际效果，并分析了不同林木密度对建图和定位精度的影响。实验结果显示，F-LIO-SAM 提取到的树干特征点数量相比 LIO-SAM 提升明显，最终的单木定位精度平均绝对误差和均方根误差相比 LIO-SAM 更少。研究表明，本文提出的 F-LIO-SAM 是一种适合用于林下环境单木定位的同步定位与建图算法，为森林调查中的林木参数获取提供了技术支撑。

**关键词：**激光惯导融合；同步定位与建图；LIO-SAM；特征提取；地面滤除

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# Lidar Inertial Navigation Fusion SLAM Algorithm for Forest Land Mapping

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**Abstract:** The SLAM algorithm of lidar inertial navigation fusion can build a high-precision three-dimensional point cloud map and provide reliable data to acquire critical forest tree parameter information. The existing LIO-SAM is challenging to extract trunk features and filter ground points. We proposed F-LIO-SAM based on LIO-SAM to solve the problem. The algorithm proposed in this paper includes two innovations: a trunk feature extraction method using arc radius and a ground point filtering method using inertial navigation attitude information. The effects of the feature extraction method and the ground point removal method of the two algorithms are compared, and the effects of different tree densities on the mapping and positioning accuracy are analyzed. The experimental results show that the number of trunk feature points extracted by F-LIO-SAM is 50% higher than LIO-SAM. The average absolute error of the final single tree positioning accuracy is 25% lower than that of LIO-SAM, and the root means the square error is 24%. The research shows that the F-LIO-SAM proposed in this paper is a SLAM algorithm suitable for single tree location in an understory environment, which provides technical support for the acquisition of forest parameters in forest investigation.

**Key words:** Lidar and IMU fusion , Simultaneous Localization and Mapping, LIO-SAM, Feature extraction, Ground filtering