

Autonomous Exploration, Navigation and Mapping Payload Integrated on a Quadruped Robot

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Abstract : The world is rapidly moving towards advancing and utilizing artificial intelligence and autonomous robotics. The ground-breaking Boston Dynamics quadruped robot, SPOT, was designed for industrial and commercial tasks requiring limited autonomous navigation. Out of the box, SPOT has route memorization and playback - it can repeat a path that it has been manually piloted through, but it cannot autonomously navigate an area that has not been previously explored. The presented SPOT payload package is built on ROS framework to support autonomous navigation and mapping of an unexplored environment. The package is fully integrated with SPOT to take advantage of motor controls and collision avoidance that comes natively with the robot. The payload runs all computations onboard, takes advantage of visual odometry SLAM and uses an Intel RealSense depth camera and Velodyne LiDAR sensor to generate 2D and 3D maps while in autonomous navigation mode. These maps are fused into the navigation stack to generate a costmap to enable the robot to safely navigate the environment without causing damage to the surroundings or the robot. The operator defines the operational zone and start location and then sends the explore command to have SPOT explore, generate 2D and 3D maps of the environment and return to the start location to await the operator's next command. The benefit of the presented package is that it is much lighter weight and less expensive than previous approaches and, importantly, operates in GPS-denied scenarios, which is ideal for indoor mapping. There are numerous applications that are hazardous to humans for SPOT enhanced with the autonomy payload, including disaster response, nuclear inspection, mine inspection, and so on. Other less extreme uses cases include autonomous 3D and 2D scanning of facilities for inspection, engineering and construction purposes.

Keywords : autonomous, SLAM, quadruped, mapping, exploring, ROS, robotics, navigation

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