Frontier-Based Exploration Adapted for Searching With Drones

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Two similar but different tasks for autonomous robots are exploring an area and searching within an area for a moving target. A common algorithm for exploring an area is frontier-based exploration, which generates a map of the area and directs the robot toward the frontiers between explored and unexplored territory. However, this method is ineffective at searching for a moving target because it avoids revisiting previously explored areas. Two adaptations of frontier-based exploration were created, optimized to search for a moving target. In the first adaptation, cells of the map used to identify frontiers gradually revert from being considered explored to unexplored, causing the robot to return to areas it has already visited after some time. This is necessary to find a target that has moved into a previously explored area. The second adaptation stores an additional map of the probability that the target is in each possible location and updates this map based on the predicted motion of the target. The robot moves toward the frontiers between high and low probability areas. These algorithms were implemented in Python and tested in Gazebo simulations of autonomous unmanned aerial vehicles searching for a moving target in randomly generated worlds. The results of these tests showed that the two new algorithms were able to find the target more quickly on average than standard frontier-based exploration. These new algorithms are easier to implement than many existing algorithms for moving-target search because they do not require neural network training or multiple searchers.