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A visual global positioning system for unmanned aerial vehicles used in photogrammetric applications.

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Summary: The combination of photogrammetric aerial and terrestrial recording methods can provide new opportunities for photogrammetric applications. A UAV (Unmanned Aerial Vehicle), in our case a helicopter system, can cover both the aerial and quasi-terrestrial image acquisition methods. A UAV can be equipped with an on-board high resolution camera and a priori knowledge of the operating area where to perform photogrammetric tasks. In this general scenario our paper proposes vision-based techniques for localizing a UAV. Only natural landmarks provided by a feature tracking algorithm will be considered, without the help of visual beacons or landmarks with known positions. The novel idea is to perform global localization, position tracking and localization failure recovery (kidnapping) based only on visual matching between current view and available georeferenced satellite images. The matching is based on SIFT features and the system estimates the position of the UAV and its altitude on the base of the reference image. The vision system replaces the GPS signal combining position information from visual odometry and georeferenced imagery. Georeferenced satellite or aerial images must be available on-board beforehand or downloaded during the flight. The growing availability of high resolution satellite images (e.g., provided by Google Earth or other local information sources) makes this topic very interesting and timely. Experiments with both synthetic (i.e., taken from satellites or datasets and pre elaborated) and real world images have been performed to test the accuracy and the robustness of our method. Results show sufficient performance if compared with common GPS systems and give a good performance also in the altitude estimation, even if in this last case there are only preliminary results.

Keywords: visual global positioning system; unmanned aerial vehicles; photogrammetric applications; natural landmark visual matching

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