Fast 3D Maps using Stereo Vision Only

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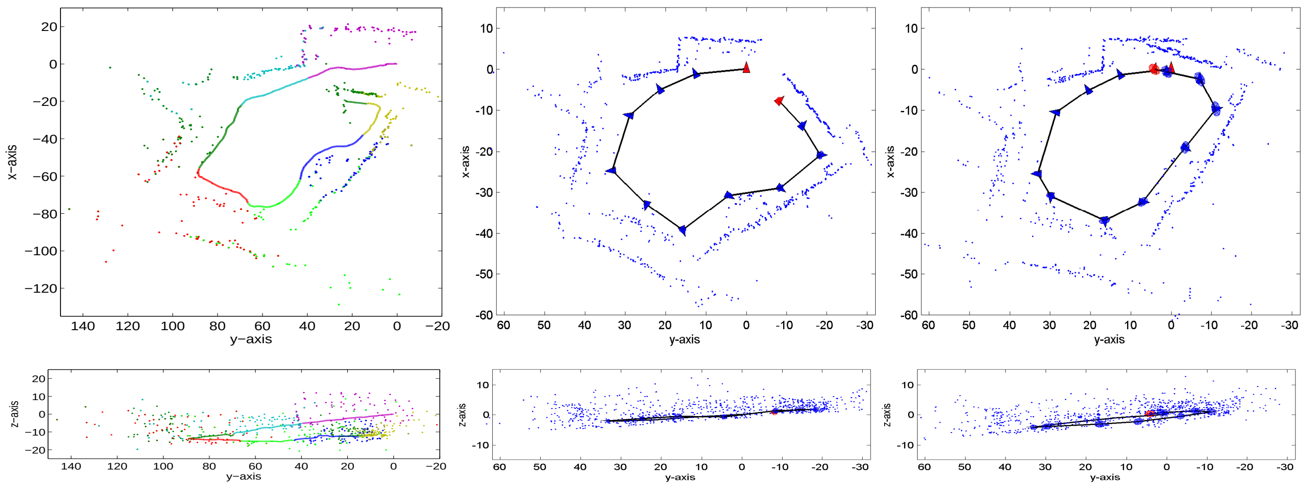

Fig. 1. Comparison of the outdoor maps obtained before the loop closure using three different techniques: monocular SLAM with inverse depth points (left), stereo SLAM with 3D points (middle) and the proposed stereo SLAM with 3D points and inverse depth points (right)

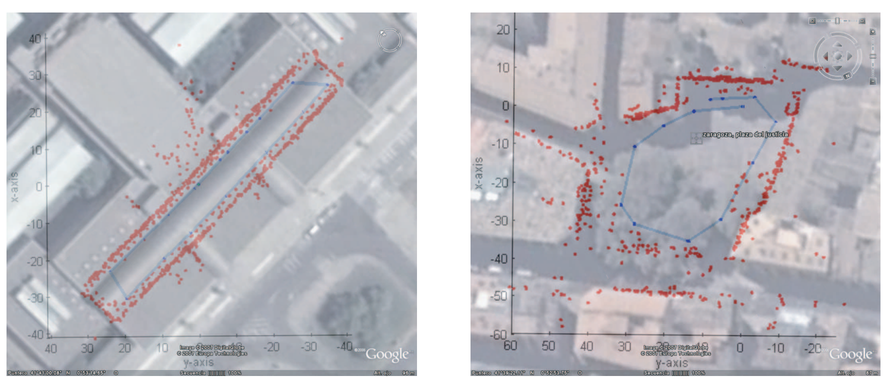

Fig. 2. Stereo visual SLAM recovers the true scale: the building environment (left) and the Public square (right) overlapping Google Earth.

In this talk we will describe a system that can carry out SLAM in large indoor and outdoor environments using a stereo pair moving with 6DOF as the only sensor. Unlike current visual SLAM systems that use either bearing-only monocular information or 3D stereo information, our system accommodates both monocular and stereo (see fig. 1). Textured point features are extracted from the images and stored as 3D points if seen in both images with sufficient disparity, or stored as inverse depth points otherwise. This allows to map both near and far features: the first provide distance and orientation, and the second orientation information. Unlike other vision only SLAM systems, stereo does not suffer from 'scale drift' because of unobservability problems, and thus no other information such as gyroscopes or accelerometers is required in our system. Our SLAM algorithm generates sequences of conditionally independent local maps that can share information related to the camera motion and common features being tracked. The system computes the full map using the novel Conditionally Independent Divide and Conquer algorithm, which allows constant time operation most of the time, with linear time updates to compute the full map. To demonstrate the robustness and scalability of our system, in fig. 2 we show experimental results in indoor and outdoor urban environments of $210m$ and $140m$ loop trajectories, with the stereo camera being carried in hand by a person walking at normal walking speeds of 4-5km/hour.

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