3d object localization using superquadric models with a Kinect sensor.

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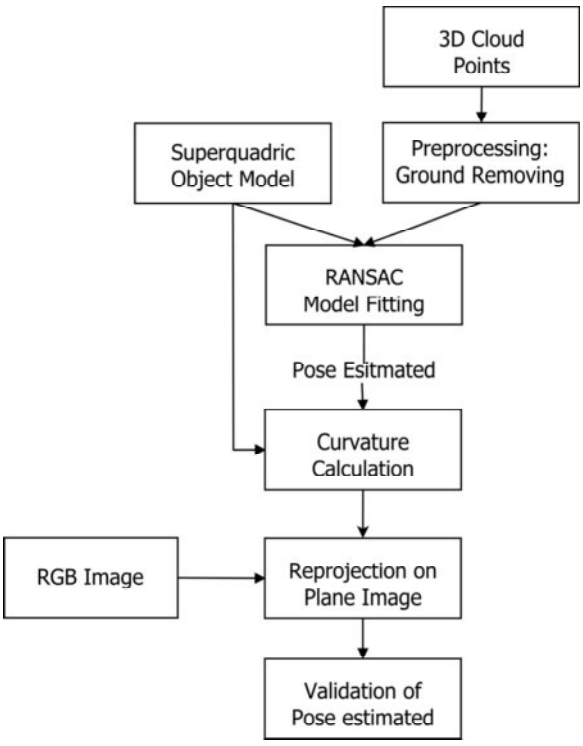
In this abstract is presented a new method for 3D object recognition and pose estimation by using RGB-D sensor, like Microsoft Kinect. The pose is estimated by a robust least square fitting of the 3D points with a SuperQuadric (SQ) model of the searched object. The solution is verified by evaluating the matching score between the projected edges of the object model and the real edges extracted from RGB image. This method can concurrently be used for the refining of the camera and 3D sensor extrinsic parameters.

Details: Object pose estimation starts with a preprocessing phase of cloud of points captured by 3D sensor. In this preprocessing stage, the points relative to the ground are identified with a RANSAC plane-fitting technique and then removed from data set.
The next step consists in fitting a SuperQuadric model of the object of interest with 3D data. SQ models permit to describe complex-geometry object with few parameters and generate simple minimization function to estimate object pose.
SQ modelling allow also to represent geometrical characteristic of the object, as surface normal and curvature, in closed form. Such information are further exploited to identify position of model's edges. To face measurement noise and outliers, object pose estimation problem is approached with RANSAC-based technique.
Pose verification phase consists in reprojecting the SQ-model of the object on RGB image and comparing the position of SQ edges with the ones identified in color image. The comparison exploits a standard pattern matching approach as distance transform techniques.
Using reference objects, the projection of the object identified with the 3D sensor onto the image plane can give a refined estimation of extrinsic parameters between the two sensors while concurrently estimate their extrinsic parameters.



Results: The algorithm has been developed in MATLAB. The RGB-D information were obtained with Microsoft Kinect device and then processed offline. The pose estimation technique described has been tested with simple geometry objects (cube, cylinder, …) giving encouraging results.