Probabilistic Active Recognition of Multiple Objects using Hough-based Geometric Matching Features

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Abstract

Bayesian methods have proved effective in many active sensing scenarios, including object recognition from a mobile platform, tracking and medical diagnostics. Despite its importance though, models for active object recognition have concentrated on simple scenarios in which a single object is present, and there is no clutter or occlusion. In this paper, we investigate models for active object recognition in circumstances which are both more complex and realistic, in which multiple objects must be recognized simultaneously, and occlusion and clutter (through distracter objects) is common. We propose a representation for object viewpoints using Hough transform based geometric matching features, which are robust in such circumstances. We show how these features can be incorporated into Bayesian object models which can be used for single and multi-object active recognition tasks. Further, we investigate an efficient active viewpoint selection algorithm based on vocabulary-tree clustering and Term Frequency Inverse Document Frequency (TFIDF) uniqueness metric. We test our fully Bayesian approach on challenging data containing multiple objects, and show it to give excellent results compared to approaches which do not incorporate geometric matching. Further, we show our viewpoint selection algorithm to be both faster and more accurate than alternatives in both Bayesian and discriminative contexts, including methods based on mutual information in the former case.