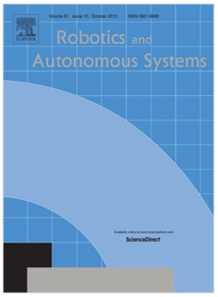
Accepted Manuscript



Comparing holistic and feature-based visual methods for estimating the relative pose of mobile robots

David Fleer, Ralf Möller

PII: S0921-8890(16)30361-X
DOI: http://dx.doi.org/10.1016/j.robot.2016.12.001
Reference: ROBOT 2761

To appear in: *Robotics and Autonomous Systems*

Received date : 30 June 2016
Revised date : 17 October 2016
Accepted date : 2 December 2016

Please cite this article as: D. Fleer, R. Möller, Comparing holistic and feature-based visual methods for estimating the relative pose of mobile robots, *Robotics and Autonomous Systems* (2016), http://dx.doi.org/10.1016/j.robot.2016.12.001

Comparing holistic and feature-based visual methods for estimating the relative pose of mobile robots

David Fleer[a,*], Ralf Möller[a]

[a]*Computer Engineering Group, Faculty of Technology, Bielefeld University, D-33594 Bielefeld, Germany*

Abstract

Feature-based and holistic methods present two fundamentally different approaches to relative-pose estimation from pairs of camera images. Until now, there has been a lack of direct comparisons between these methods in the literature. This makes it difficult to evaluate their relative merits for their many applications in mobile robotics. In this work, we compare a selection of such methods in the context of an autonomous domestic cleaning robot. We find that the holistic Min-Warping method gives good and fast results. Some of the feature-based methods can provide excellent and robust results, but at much slower speeds. Other such methods also achieve high speeds, but at reduced robustness to illumination changes. We also provide novel image databases and supporting data for public use.

Keywords: Visual pose estimation, robot localization, local visual features, holistic visual homing, image databases

1. Introduction

Visual relative-pose estimation — the problem of estimating the relative orientation and movement[1] between two camera postures from the two corresponding camera images — has at least four applications in mobile robotics: First, pose estimation can be used to solve visual homing problems. These include returning to the point at which an image was taken, and traversing a route formed by a series of images [1, 2, 3, 4, 5, 6]. Second, when image sequences are available, successive pose estimates can be integrated to perform visual odometry, for example [7, 8]; overview: [9, 10]. However, this integration requires information about the (relative) movement distance between the individual camera postures. Third, pose estimation can act as a visual odometry component in visual localization and mapping (SLAM) systems [11, 12]. Visual relative-pose estimation can also serve as one component within a more complex SLAM system,

*Corresponding author

Email addresses: dfleer@ti.uni-bielefeld.de (David Fleer), moeller@ti.uni-bielefeld.de (Ralf Möller)

[1]Without depth information, it is impossible to determine movement distances from just two images. However the relative bearing can still be derived.