

PROCEEDINGS OF
2017 3rd International Conference on
Mechatronics and Robotics Engineering
ICMRE 2017



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2017 3rd International Conference on Mechatronics and Robotics Engineering

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Preface

2017 3rd International Conference on Mechatronics and Robotics Engineering (ICMRE 2017) was held in Paris, France during February 8-12, 2017. The purpose of ICMRE is to bring together researchers and people from industry working in the fields of mechatronics and robotics engineering. It seeks to offer a broad spectrum of current research in this area of mechatronics and robotics engineering

The volume consists of 31 selected papers (from originally 76 papers) which are presented orally at the conference or via poster session. The topics of papers include design and control of robot system, mechanical design and control engineering, performance analysis of composites: methods and experiments as well as signal analysis and application.

The papers are accepted after being peer-reviewed by the conference Technical Program Committee and international reviewers based on the topic of each paper. All the authors of accepted papers have done excellent presentations on this conference via oral presentation or poster presentation. On the basis of the conference achievement, we collect and compile these research papers into the conference proceedings, in which the content represents the latest international academic progress of mechatronics engineering and robotics fields. We hope that the presented papers will be interesting for readers and be a good base for inspiration for future development.

The chairpersons, keynote speakers, plenary speaker played important role in conducting the proceedings of the session in a timely and efficient manner and on behalf of the conference committee, we express sincere appreciation for their involvement. The reviewers of the manuscripts, those by tradition would remain anonymous, have also been very helpful in efficiently reviewing the manuscripts, providing valuable comments well within the time allotted to them. We express our sincere and grateful thanks to all reviewers.

We truly believe the participants will find the discussion fruitful, and will enjoy the opportunity for setting up future collaborations. It is our sincere hope that ICMRE will one day become the leading conference in this specific academic area.

ICMRE 2017 organizing committees
March 8th, 2017

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A Comparative Analysis on Image Translation and Rotation Algorithms towards Implementations in Micro Aerial Vehicles

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ABSTRACT

A comprehensive analysis on estimation of critical ego-motion parameters such as image translation and rotation using feature and intensity information method is presented. In feature approach, scale invariant feature transform is adopted, and in intensity method both frequency domain and compressive sampling (CS) techniques are considered. Comparative evaluation is performed with respect to their accuracy, time complexity and feasibility for deployments in aerial vehicles. A simplified version of frequency and CS methods has been proposed and experiments are conducted in standard image database and real time images. Results suggested that frequency domain approach performs faster in estimating motion parameters accurately. An indoor testing is also conducted on integrating the micro camera on a micro aerial vehicle to demonstrate the practicality and concept validation.

CCS Concepts

• Information systems~Information systems
applications • Information systems~Mobile information
processing systems

Keywords

Compressive Sampling, Ego motion, Features, Frequency Domain, MAVs

1. INTRODUCTION

Ego motion technique involves estimating three dimensional (3D) motion parameters of MAVs with an aid of micro camera mounted on it to facilitate autonomous control and navigation [1] [2] [3]. The stringent pay load of MAV limits the on-board sensors that increase the burden of real time navigation of the

vehicle. Traditionally MEMS based IMUs and sensors are employed to estimate the vehicle state during flight. They increase the payload which in turn affects endurance of the MAV. Navigation of MAV necessitate rapid and computationally effective estimation algorithms for real time implementation. Hence, estimating vehicle motion parameters through ego-motion technique to facilitate autonomous capability is a challenging task. In general, the majority of the procedure involves processing successive frames and identifying its optical flow based on the feature or intensity information. In feature approach, various key point detectors and classifier algorithms are developed. Many other methods have been proposed based on intensity pattern [4] correlation [5] and frequency spectrum in intensity approach. Recently, few methodologies [6] [7] are also proposed using compressive sampling techniques which involve application of randomized sampling protocols. In order to obtain the optical flow pattern, the main parameters required for estimation are translation, rotation and angular velocity of the vehicle. Among them, this paper mainly addresses various approaches for the estimation of image translation and rotation.

A comparative analysis on the performance of various approaches in computing the image translation and rotation for the real time of control MAV has been presented. These methods are evaluated based on the accuracy, time computation and memory requirement. In feature based approach, the well-established Scale invariant feature transform (SIFT) [8] is considered for analysis. Fourier and cosine transform approaches are utilized under frequency transform. On compressed domain approach, random circulant matrices are used as measurement matrix and computation are performed in the reduced dimension.

SIFT basically comprises of key point detection, descriptor establishment and image feature matching. Though it is used extensively for its superior accuracy and robustness to illumination, rotation and view point changes, it's having few limitations. Especially in ego motion applications, it may not give good accuracy when computing two pictures of same object from different key point [9]. It is not effective in handling high resolution images as observed in Table 1 [10]. Many of the real videos especially captured in the homogeneous environments often lack sufficient features that resulted in poor ego motion estimation and in some other scenario, the inadequate features leads to prolonged time for identification of key points. In order to overcome these difficulties, frequency and compressed domain approaches are also used. One of the main advantages of these

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