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Abstract: This paper proposes a new visual tracking framework and demonstrates its merits via mobile robot experiments. An image sequence from the vision system of a mobile robot is not static when a mobile robot is moving, since slipping and vibration occur. These problems cause image blurring. Therefore, in this paper, we address the problem of robust object tracking under blurring and introduce a novel robust visual tracking framework based on the arbitration of the AdaBoost-based detection method and the appearance-based detection method to overcome the blurring problem. The proposed framework consists of three parts: (1) distortion error compensation and feature extraction using the Modified Discrete Gaussian–Hermite Moment (MDGHM) and fuzzy-based distortion error compensation, (2) object detection using arbitration of appearance- and feature-based object detection, and (3) object tracking using a Finite Impulse Response (FIR) filter. To demonstrate the performance of the proposed framework, mobile robot visual tracking experiments are carried out. The results show that the proposed framework is more robust against blurring than the conventional feature- and appearance-based methods.

Keywords: Object Detection, Visual Object Tracking, Modified Discrete Gaussian–Hermite Moment, Finite Impulse Response Tracker, Mobile Robot.

1. Introduction

1.1 Research Motivation

Recently, numerous studies on visual object tracking have been conducted in the area of mobile robot platforms [1–3]. The accurate positioning of objects in camera images allows the mobile robot to avoid collisions with the preceding objects. Mobile robots are increasingly being employed in rough outdoor terrain for applications such as forestry, mining, search and rescue, and hazardous site inspection. These applications often require robots to travel across unprepared, rugged terrain. However, the image sequence from the vision system of a mobile robot is not static in this area. In outdoor settings, a robot's position is strongly influenced by the terrain geometry and physical properties. When navigating over rough terrain, a mobile robot is likely to experience slips, which cause errors in the visual tracking [4]. These problems cause an ego-motion in which the captured image from the onboard camera of the wheeled mobile robot is blurred, and the vision system cannot extract precise features [5]. Therefore, the vision systems of wheeled mobile robots require a novel visual tracking framework that is robust to image blurring.

Many studies have been conducted to overcome the ego-motion and blurring problems in visual tracking. These studies are classified into two categories: vision-based approaches and robot