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DYNAMIC VISION BASED MOTION RECOVERY

Xinkai Chen
Department of Electronic & Information Systems
Shibaura Institute of Technology
307 Fukasaku, Minuma-ku, Saitama-city, Saitama 337-8570, Japan
chen@sic.shibaura-it.ac.jp

Hiroyuki Kano
Department of Information Sciences
Tokyo Denki University
Hatoyama, Hiki-gun, Saitama 350-0394, Japan
kano@j.dendai.ac.jp

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Abstract. *The recovery of motion for a class of movements in the space by using the perspective observation of one point is considered in this paper. The motion equation can cover a wide class of practical movements in the space. The estimations of the position and motion parameters which are all time-varying are simultaneously developed in the proposed algorithm. The formulated problem can be converted into the observation of a dynamical system with nonlinearities. The proposed observer is based on the second method of Lyapunov. First, the parameters relating to the rotation of the motion are identified, where only one camera is needed. Then the position of the moving object is identified, where the stereo vision is necessary. In the third step, the parameters relating to the straight movement are identified. The assumptions about the perspective system are reasonable, and the convergence conditions are intuitive and have apparently physical interpretations. The proposed method requires minor a prior knowledge about the system and can cope with a much more general class of perspective systems. Furthermore, the algorithm is modified to deal with the occlusion phenomenon.*
Keywords: Machine vision, Motion recovery, Perspective observation, Movement, Nonlinear system, Occlusion

1. Introduction.

Perspective observations arise naturally in the study of machine vision. The observation via a camera consists of the perspective projection of points in the 3-D scene onto the image plane. Thus, points in 3-D space are observed up to a homogeneous line. In general, a perspective system is a linear system whose output is observed up to a homogeneous line.

In the study of machine vision, observing the motion and the structure of a moving object in the space by using the image data with the aid of CCD camera(s) has been studied recently [1,2,10-13,17,18]. The motion treated in this field is composed of a rotation part and a translation part. A very typical method is the application of the extended Kalman filter (EKF). Numerous successful results have been reported, see for example, [2,14,18] where the formulation is based on a discrete expression of the motion, and the observability conditions are derived based on the perspective observations of