Tutorial of Motion Estimation Based on Horn-Schunk Optical Flow Algorithm in MATLAB®

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Abstract

The Horn-Schunk algorithm (HS) is one of the classical algorithms in optical flow due to its reasonable performance and simplicity of the algorithm. This article presents in detail the process of the HS algorithm and its step by step coding in MATLAB®. The HS algorithm is a technique used to identify the image velocity or motion vector based on Spatial Temporal Gradient Technique which computes the image velocity from spatiotemporal derivatives of image intensity. Firstly, the original estimated intensity for gradient constraint on the image sequence is obtained by using the gradient constraint with a global smoothness. Then, iterative equations are solved to minimize the sum of the errors for the rate of change of image gradient intensity and obtain the image velocity.

Keywords: Spatial Temporal Gradient Technique, gradient intensity, motion vector, image velocity.

Introduction

Optical flow is a technique used for many particular fields, such as motion estimation to predict the motion vector of a moving object, video compression and reconstruction for reducing temporal redundancy present in frame sequences and allowing a better compression of video material, and image segmentation for tracking a moving object. In conventional predictive methods for motion estimation, the difference between the current frame and the predicted frame, based on a previous frame (motion vector, or MV), is coded and transmitted; then it is used to reconstruct a higher resolution still image or video sequence from a sequence of low resolution images in achieving super-resolution (Kesrarat and Patanavijit 2011). This article concentrates on a classical optical flow algorithm, namely the Horn-Schunck algorithm (HS) proposed by Horn and Schunck (1981). The HS algorithms are the most popular differential algorithms which have been applied for many applications and have been referenced for many

performance evaluation models. Barron, Fleet and Beauchemin (BFB) adjusted the kernel model for performance evaluation over HS algorithms, but its focus is on the density of velocity (Barron *et al*. 1994). This article explains the motion estimation algorithm based on the Horn-Schunk optical flow algorithm (HS), which applies the kernel of BFB, and also represents the algorithm step by step in MATLAB®.

Horn-Schunk Algorithm (HS)

This algorithm is based on a differential technique computed by using a gradient constraint (brightness constancy) with a global smoothness to obtain an estimated velocity field (Horn and Schunk 1981). There are two main processes for the implementation of the HS algorithm. The first one is an estimation of partial derivatives, and the second one is a minimization of the sum of the errors by an iterative process to present the final motion vector.