Object tracking using a combined appearance and geometric model

Pierre Gabriel °, Justus Piater * and Jacques Verly +

° *University of Liège, Department of Electrical Engineering and Computer Science, Sart-Tilman, Building B28, B-4000 Liège, Belgium*
✆*: +32/4/3662618,* 🖷*: +32/4/3662910,* 🖃*: p.gabriel@ulg.ac.be*
* *same address, but* ✆*: +32/4/3662279 &* 🖃*: Justus.Piater@ulg.ac.be*
+ *same address, but* ✆*: +32/4/3664994 &* 🖃*: Jacques.Verly@ulg.ac.be*

There has been considerable research activity in the area of objects tracking in video sequences over the last 20 years. However, most current tracking systems do not deal well with complex situations, where objects can have different sizes, be of similar appearances or occlude each other. In fact, most of them are based on either a region extraction with a background subtraction or a contour extraction using particle filtering.

The main goal of this work is to track objects from image to image in a video sequence. More precisely, we want to track each interest point associated to an object. In fact, to do this, we apply the color Harris detector [2] to the region of interest (ROI) of each object and we search for a correspondence between the interest points in the current frame and those in the previous frame based on both an appearance model and a geometric model.

The appearance model consists of characterizing each detected interest point with a vector containing some local attributes. After a study of different configurations of characterizations, we chosen the color local jet [3] up to order 1 and added the *cornerness* (i.e. the value given by the color Harris detector) to the vector.

The geometric model consists of two geometric parameters: the distance from the center of the object to each interest point, and the angle measured counterclockwise with regard to the horizontal and around the center of the object. Note that the center of the object is defined as being the center of the bounding rectangle defined by the interest points.

In the global system an interest point *i* in the current frame will match an interest point *j* in the previous frame if it has a both similar appearance and geometry as *j*. Therefore, we define a criterion $d(i,j)$ that combines the Mahalanobis distance between the characteristic vectors and the Euclidean distance between the geometric features [1]. The matching process consists of finding the couples (i,j) that minimize $d(i,j)$.

In the present work, we consider a single camera with color images and we focus on a particular application, i.e. the tracking of football players. We will also show the performances of our system in the presence of occlusion.

References

[1] P.F. Gabriel "*Object tracking using interest points*", DEA thesis, University of Liège, Department of Electrical Engineering and Computer Science, 2004.
[2] V. Gouet and N. Boujemaa "*About optimal use of color points of interest for content-based image retrieval*", Internal Report, INRIA Rocquencourt, 2002.
[3] J.J. Koenderink and A.J. Van Doorn "*Representation of local geometry in the visual system*", Biological Cybernectics, 1987.