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Active Contour-Based Visual Tracking by Integrating Colors, Shapes, and Motions Using Level Sets

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Abstract: Using a camera,the visual object tracking is one of the most important process in searching the spot of moving object over the time. In the case of the object moves fast relative to the frame rate,the visual object tracking is difficult task. The active contour evolution algorithm which is used for the tracking of object in a given frame of an image sequence. Active contour based visual object tracking using the level sets is proposed which does not consider the camera either stationary or moving. We present a framework for active contour-based visual object tracking using the level sets. The main components of our framework consist of the contour-based tracking initialization, colour-based contour evolution, the adaptive shape-based contour evolution for the non-periodic motions, the dynamic shape-based contour evolution for the periodic motions and handling of the abrupt motions. For the contour-based tracking initialization, we use an optical flow-based algorithm for the automatically initializing contours at the first frame. In the color-based contour evolution, we use Markov random field theory to measure correlations between values of the neighboring pixels for the posterior probability estimation.In the adaptive shape-based contour evolution, we combined the global shape information and the local color information to hierarchically develop gradually the contour, and a flexible shape updating model is made. In the dynamic shape based contour evolution, a shape mode transition matrix is gain to characterize the temporal correlations of the object shapes. In the handling of abrupt motions, particle swarm optimization (PSO) is used to capture the global motion which is applied to the contour in the current frame to produce an initial contour in the next frame.

Keywords*: Abrupt motion, active contour-based tracking, adaptive shape-based model for contour evolution, dynamic shape-based model for contour evolution.*

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I. INTRODUCTION

Visual object tracking is a lively research topic in the computer application. In the general method of visual object tracking, objects are represent using predefined common shape models such as rectangles or ellipses but active contour-based tracking [16] which provides more detailed information about object shape. But in general, active contour-based tracking is more difficult than general tracking of the same object in the same real-world condition. Due to the active contour-based tracking aims to pick up finer details of the object i.e. the boundary of the object and the extract object from the background disturbances. In videos taken by the stationary camera, regions of object motion can often be extracted using background subtraction and the object contours can be produced by tracing the edges of the object motion regions. However in videos taken by the moving camera, the background subtraction cannot be used to extract regions of object motion, producing the contour-based tracking more complicated than in the videos taken by stationary cameras. Active contour-based object tracking, not think about whether the camera is stationary or moving, has concerned much more attention in recent years.

II. LITERATURE SURVEY

In general, there are two ways to describe object contours:

1) Explicit representations which are characterized by parameterized curves such as snakes [1].
2) Implicit representations which used to represent a contour using a signed distance map such as level set[2].

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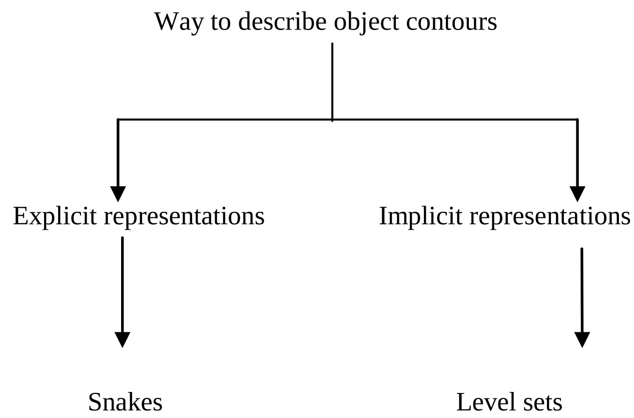
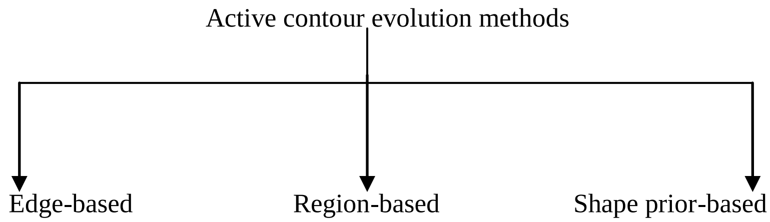


The implicit representation is more popular than the explicit representation because it provide a stable numerical solution and it is able of handling topological changes. Active contour evolution methods are divided into three categories:

1) Edge-based
2) Region-based
3) Shape prior-based



COMPARISION OF DIFFERENT EVOLUTION METHOD FOR ACTIVE CONTOUR-BASED VISUAL TRACKING

References	Active contour evolution methods	Advantages	Disadvantages
1) Snakes: Active contour models[1] 2) Geodesic active contours [3] 3) Geodesic active contours and level sets for the detection and tracking of moving objects [4]	Edge-Based Methods	1) Their simplicity, intuitiveness, and effectiveness for determining contours with salient gradient.	1) They only consider local information near to contour, and thus the initial contour must be near to the object. 2) Contour sections lying in the homogeneous regions of an image cannot be optimized. 3) They are of course sensitive to image noise.
1) Region competition: Unifying snakes, region growing and bayes/MDL for multiband image	Region-Based Methods	1) Combined regions' statistical information with the prior knowledge of object color and texture, can increase the	1) The pixel values are treated as if they were independent for the posterior probability estimation.This independence assumption makes the

segmentation [5] 2) Object contour tracking using level sets [6]		robustness and accuracy of contour evolution.	obtained contour sensitive to disturbances caused by similarities of color or texture between the object and the background.
1) Dynamical statistical shape priors for level set based sequence segmentation[8] 2) Active shape models-their training and application [10] 3) Online, incremental learning of a robust active shape model [11]	Shape prior-Based Methods	1) The disturbed, occluded, or blurred edges can be recovered.	1) Does not simultaneously handle the multiple new shape samples, and fails to compute the sample eigenbasis with sample mean updating. 2) The model assumes that the underlying motion is closely approximated by a periodic motion, however human motion is rarely exactly periodic.

COMPARISION OF DIFFERENT ALGORITHM FOR ACTIVE CONTOUR-BASED VISUAL TRACKING

References	Which component discussed	Which Technique Used	Advantages	Disadvantages
1) Region competition: Unifying snakes, region growing and bayes/MDL for multiband image segmentation[5] 2) A review of statistical approaches to level set segmentation: Integrating color, texture, motion and shape [16]	Color-based contour evolution	Region competition algorithm with Bayes statistics	the hypothesis of independence of pixel values for posterior probability and likelihood estimation is too strong, especially when there are local associations between pixels,	misidentify pixels around object boundary sections where the contrast between the object and the background is low
1) On incremental and robust subspace learning [13] 2) Matching distance functions: A shape-to-area variational approach for global-to-local registration [14].	Adaptive shape-based contour evolution for non-periodic motions	Principal component Analysis	combines both the global shape information and the local color information to obtain a contour closer to the true contour.	Less flexible shape model updating algorithm
1) Dynamical statistical shape	Dynamic shape-based	novel graph-based clustering	used to cluster the samples in order	Does not make large changes in shapes of

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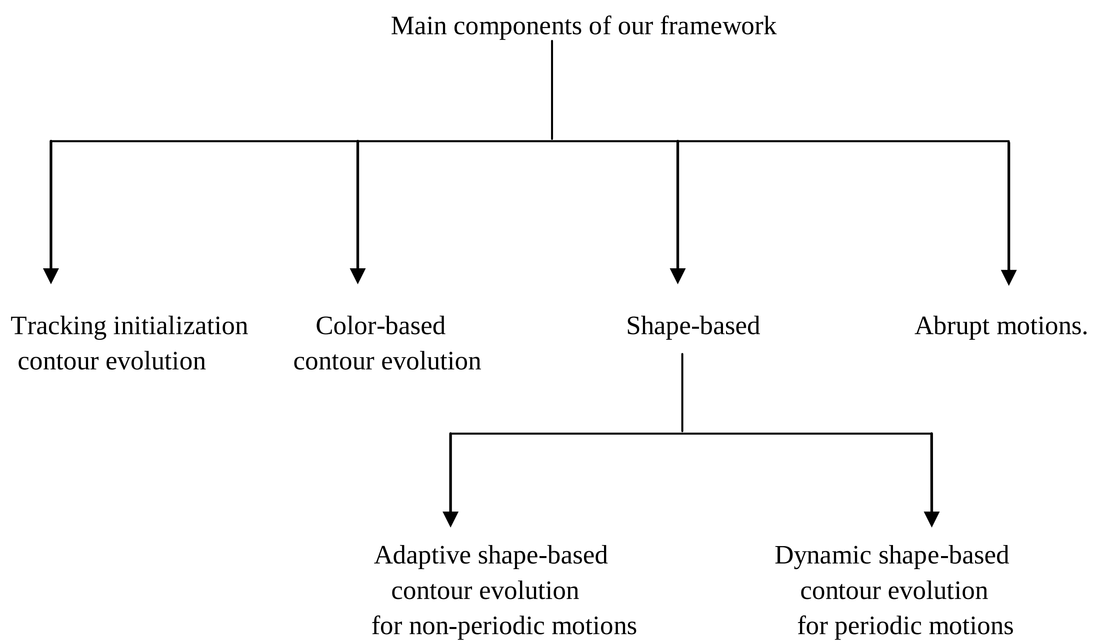
priors for level set based tracking [8]	contour evolution for periodic motions	algorithm	to construct the typical shape modes.	non-rigid object contours
1) Particle swarm optimization [15]	Abrupt motion	particle swarm methodology	extremely wimple algorithm that seems to be effective for optimizing a wide range of functions	

III. PROPOSED WORK

In this paper, we scientifically study the aforesaid most important limitations in tracking of contour and represent a framework for tracking object contours, not consider whether the camera is either stationary or moving. The framework implements the region-based contour evolution method which are represented using level sets evolution model. On the first frame, the method describe in [19] which is used to give back for the camera motion and after that the optical flow at each pixel is estimated. By using the estimated optical flows, one or more motion regions are identified. The boundaries of these motion regions which are used as the initial contours. After that these initial contours are evolved by using color information. Derived from the result of color-based contour evolution, the shape prior is introduced to contract with noise or partial occlusion etc. to achive more perfect contours. We assume shape priors for non-periodic motions to adaptive shape models and non-periodic motions to dynamic shape models. After that the contour evolution is completely cover in the current frame, there is a make sure for abrupt motion which are estimated by using the method which are provide in [18]. If there is no abrupt motion in current frame, the result of evolution in the current frame which is used as the initial contour of the object in the next frame. In current frame ,there is abrupt motion, then the affine motion parameters are estimated by using a stochastic algorithm and apply to the contour in the current frame to achive the initial contour of object for the next frame. The most important components in our framework consist of:1)contour-based tracking initialization,2)color-based contour evolution,3)adaptive shape-based evolution,4)dynamic shape-based evolution and 5)handling abrupt motion The contributions of most important components in our framework which are given below:



1) TRACKING INITALIZATION:
We offer an automatic and quick tracking initialization algorithm which based on optical flow detection. In this algorithm, regions of object motion are extracted in the first frame and then the closed initial contours close to the boundaries of object regions are built.
2) COLOR-BASED CONTOUR EVOLUTION:
We suggest a color-based contour evolution algorithm. In this algorithm, correlations between neighboring pixels values are constructing by using Markov random field (MRF) theory and integrated into the estimation of the posterior probability of segmentation. So, this can be ensures that our color-based evolution algorithm is not sensitive to the background disturbances and so it can be achieves rigid and soft contours.
3) ADAPTIVE SHAPE BASED CONTOUR EVOLUTION
We offer an adaptive shape-based contour evolution algorithm. In this algorithm, the results achieved by using the color feature alone and the shape priors are successfully combined, adapting to various contour locations, to achieve the final contour. A new incremental principal component analysis (PCO) technique is applied to renew the shape model, by making the shape model flexible.
4) DYNAMIC SHAPE BASED CONTOUR EVOLUTION*:*
We suggest a Markov model-based dynamical shape model. In this shape model ,the dominant set clustering which is used to achive the usual shape modes of a periodic motion. The transitions matrix between these shape modes is after that construct. In the tracking process, the contour evolved using the color information only and the transition matrix of shape mode are merged to calculate the current shape mode and after that the contour is additional evolved below the constraint of the predicted shape mode.

5) ABRUPT MOTION:
We suggest an algorithm used for handling abrupt motion in the process of contour tracking by incorporating particle swarm optimization (PSO) into the level set evolution. Even though the algorithm in [33] combine the particle filter with the level set evolution, this cannot handle abrupt and random motions. In our algorithm, principal component analysis(PSO) which is used to calculate approximately the global motion of the object. The original contour is achieved by applying the estimated global motion to the contour of the object in the previous frame.

IV. CONCLUSION

In this paper, we have obtainable an effective framework for object contours tracking. We have the following termination: 1) Our color-based contour evolution algorithm which apply the MRF theory to the model the correlations between the pixel values for estimation of posterior probability is more robust to the background disturbance than the region-based evolution method which does not assume the correlations between the neighboring pixels values for estimation of posterior probability. 2) Our adaptive shape-based contour evolution algorithm which are powerfully fuses the information of global shape and the information of local color and uses a flexible shape model updating algorithm which is vigorous to partial occlusions, weak dissimilarity at the boundaries and blurring motion etc. 3) Our dynamical shape prior model successfully characterizes the temporal correlations between contour shapes in the periodic motion and hence it obtains more perfect contours than the existing autoregressive contour model. 4) Our PSO-based algorithm handling abrupt motion can covenant effectively with contour tracking for the videos by abrupt motions and it do better than the particle filter-based algorithm.

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