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"SPATIO-TEMPORAL CONSISTENCY MAINTANANCE IN INTELLIGENT OBJECT- BASED VIDEO IN PAINTING: A REVIEW"

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ABSTRACT

This work proposes a new approach to maintain Spatio-temporal consistency simultaneously. In this approach it reduces search area by converting video sequences into 2D slices. Here method also helps to advance existing Exemplar-Based in painting method as well as Patch Match algorithm for reducing processing time. Method targets the better priority function for video sequence matching. After collecting completed slices, sequences of virtual contours forms to recover for the mostly similar postures among number of available postures. To overcome over-smoothing problem due to averaging of patches, it tries to give the superior outcome in one fourth time to fill/restore the projected target region. Key-posture selection method and indexing method are used to restrain the complexity of method, posture sequence retrieval. To generate fewer amounts of postures Synthetic posture generation method is used and tries to increase number of postures in database. It also tries hard to maintain spatial consistency as well as the temporal motion continuity of an object simultaneously.

KEYWORDS: Texture Synthesis, Patch Match Inpainting, Exemplar Based Inpainting, Posture Mapping, Object Completion, Posture Sequence Retrieval, Synthetic Posture, Video Inpainting

INTRODUCTION

Object based video in painting is having problem in painting a spatio-temporal holes in a video sequences. Challenges are such as foreground in painting, background in painting and moving objects in painting. The execution time is an additional critical aspect in video in painting algorithms which may take days or even weeks to execute. Video in painting algorithms are basically belongs to "object-based" or "patch-based" categories. Patch based in painting algorithms are usually segmented video in patches and Object-based algorithms usually segment the video into moving foreground and static back-ground. Different algorithms are segmented those images into sequences so as to in paint them. The background is in painted using image in painting methods where, moving objects are copied into the occlusion as smoothly possible. Some methods often comprise restrictive hypotheses on the moving object's motion, such as strict periodicity. Some object-based methods include Patch-based methods that are based on the spontaneous idea of copying and pasting small video "patches" into the occluded area.

This work proposes a simultaneous approach for object-based video in painting scheme that can maintain the spatial consistency as well as temporal motion continuity. This method can also cover the deficiency of less available postures. Initially, the objects which are to be removed have been extracted by object segmentation method. After object extraction, the spoiled objects and background are in painted separately. Mainly this work tries to solve the problem of completing some or complete occluded objects in a video sequence. In this work, object completion method which is

basically operates in three steps: virtual contour construction technique, key-posture based posture sequence matching technique and synthetic of key-posture generation technique. So as to modify the technique to solve spatial as well as temporal continuity problem, virtual contour construction technique and posture sequence matching technique are used. It extracts most similar frame sequences from available object postures. The available postures are collected from the clear part of the input video. If virtual contour construction method unable to search matching sequence in database, it constructs synthetic postures.

PRESENT THEORY AND PRACTICES

Jiaya Jia Tai-Pang Wu Yu-Wing Tai Chi-Keung Tang proposes, "Video Repairing: Inference of Foreground and Background Under Severe Occlusion", [1] new method for video repairing, robustly infer missing static background and moving foreground due to occlusion from video. To recover background pixels image repairing method is used where layer segmentation and homographic blending are used to preserve temporal coherence and avoid flickering. For periodic motion and subclass of camera and object motions, it adopts two-phase approach to repair moving foreground pixels, in sampling phase, motion data are sampled and regularized by 3 Dimensional tensor voting technique to maintain temporal coherence and motion periodicity. In this alignment phase missing moving foreground pixels are inferred by spatio-temporal alignment of sampled motion data at multiple scales.

Ahmed Elgammal and Chan-Su Lee proposes, "Inferring 3D Body Pose from Silhouettes using Activity Manifold Learning", [2] which aims to remove annoying shaky motions from videos. Here video stabilization produces full-frame stabilized videos with well visual quality. Completion method produces window frame videos by logically restoring absent image parts by aligning image data of neighboring frames. Realization in motion in painting is enforced to maintain spatio-temporal consistency to complete static and dynamic image areas. Recent deblurring algorithm improves image quality in stabilized video. Method transfers and interpolates sharper image pixels from neighboring frames, to increase sharpness of frames. Yun-Tao Jia, Shi-Min Hu and Ralph R. Martin proposes, "Video completion using tracking and fragment merging", [3] texture synthesis method for filling hole in three steps we select most promising target pixel at the edge of hole, find source fragment which is most similar to known part of the target's neighborhood, combine supply and fragments to complete target neighborhood, sinking size of hole respectively. To speed up, it tracks moving objects and allows much smaller database when look for source fragments. It completes holes by fragmentation instead of pixel wise replacement. Cut algorithm maintains details by use of graph, when combine supply and fragments. Technique ensures temporal consistency of holes filling over successive frames.

V. C. Brendan, J.Frey and N. Jojic. Proposes, "Video epitomes", [4] the epitomes, means a patch-based probability models that are learning combine by compiling large number of patches from input images. It describes how epitomes can used to model video data. It also describes significant computational motions that can incorporate into epitome inference learning algorithm. In videos epitomes are estimated as models which are small space-time cubes from input data. Epitome can use for various modeling and renovation tasks which results for video super resolution, video interpolation and object removal. After this computational efficiency is interesting benefit of epitome.

K. A. Patwardhan, G. Sapiro and M. Bertalmios propose, "Video In painting, Occluding and Occluded Objects", [5] technique to fill/heal lost parts of video taken by static/rigid camera. It is implemented in two cases, first is mostly concerned with removal of mobile objects which may occlude stationary background. It uses priority-based spatio-temporal synthesis scheme to in paint static background. And second more complicated cases involve in

filling/healing moving objects which are partially/totally occluded. Mobile objects are in painted by replicating patches from uncontaminated frames and independent copying from background of moving object in remaining frames. It uses as input to optical flow based mask which tells uncontaminated pixel is mobile or static. Yasuyuki Matsushita, Eyal Ofek, Weina Ge, Xiaoou Tang and Heung-Yeung Shum proposes "Full-Frame Video Stabilization with Motion In painting", [6] technique that automatically restores removed areas in images. If video in painting is dealing with problem then, robust tracking algorithm is used. But temporal continuity amongst video frames needs to take into consideration. If video having camera motions like zooming/enlarging and tilting, extends exemplar-based image in painting algorithm by improving patch-match method for video in painting. Algorithm allows variety of camera motion segments with variety of temporal continuity entitle for different correct patches, which are used to in paint holes. Selecting video object based in painting to track and remove holes. Process proposes video in painting algorithm produces "ghost shadows", produce from the image in painting algorithms directly applied on video.

Yuping Shen, Fei Lu, Xiaochun Cao, and Hassan Foroosh proposes, "Video Completion for Perspective Camera Under Constrained Motion", [7] a novel approach to fill missing background and moving foreground of a video occluded by static or moving camera motion. It slices the volume along with the motion manifold of moving object and reduces the search space from 3 Dimensional to 2 Dimensional while preserving spatial and temporal coherence. It improves computational efficiency based on geometric video analysis. This approach is also able to handle real videos under perspective distortion and common camera motions such as panning, tilting and zooming. Results demonstrate that algorithm perform comparably better to 3 Dimensional search based methods and extends state-of-the-art repairing technique for videos with projective effects and illumination changes.

J. Jia, Y. W. Tai, T. P. Wu and C. K. Tang propose, "Video Repairing under Variable Illumination Using Cyclic Motions", [8] a system which is capable to reconstruct large number of pixels that lost due to occlusion. Missing pixels are captured in scene which is having static background or cyclic motions. In main processing video repaired automatically, System employs user to guide video by layer segmentation. Supplied video decomposed into colors and illumination videos. Vital temporal consistency maintained by use of tensor voting in spatio-temporal domain. Lost illumination and colors of background are then synthesized by applying image repairing. Occlude motions are controlled by spatio-temporal alignment by collected samples at multiple scales. Tao Ding, Mario Sznaier and Octavia I. proposes in painting technique "A Rank Minimization Approach to Video In painting", [9] have following proceeding to solve such a crisis, Extracting set of descriptors to reconstruct frame, Estimates the value of these descriptors for occluded frames and uses estimated values to reconstruct the frames. Results shows optimal descriptor estimates that can be efficiently obtained by minimizing rank of matrix directly constructed from available data, which leads to simple approach, computationally attractive algorithm, provides dynamic in painting that optimizes use of spatio/temporal information. Yonatan Wexler, Eli Shechtman and Michal Irani propose, "Space-Time Completion of Video", [10] framework for completing lost information base on local or home structures. A task proposes of completion as universal optimization problem with distinct objective function and derives algorithm to optimize. Lost portions are fill/restore by spatio-temporal patches sampling from available database of video. It operates on space-time completion video of huge space-time holes in video sequences of complex dynamic nature. It improves global spatio-temporal consistency between all patches around hole. After a reliable completion of static parts, dynamic leads simultaneous approach to video sequences that results like realistic. Correction in occluded video frames such as in old movies, modifying a visual story by replacing unnecessary elements, formation of video textures to extend smaller ones are also done by the same.

K. A. Patwardhan, G. Sapiro and M. Bertalmío propose, “Video In painting under Constrained Camera Motion”, [11] in painting approach for missing parts of video sequence recorded with mobile either stationary camera. Basically in painted region is still or moving in background or foreground. This algorithm is having simple preprocessing stage and two step video in painting. Preprocessing segments each frame in foreground and background. Segmentation done in three steps, first video in painting reconstructs moving objects in foreground those are occluded by in painting and finally fill gap by copying information from moving foreground in other frames by using priority-based scheme. Image mosaicing produces time reliable results to improve performance of algorithm by reducing database. Then remaining hole pixels are filled by extending spatial texture-synthesis techniques to spatio-temporal domain.

Timothy K. Shih, Nick C. Tang, and Jenq-Neng Hwang proposes “Exemplar-Based Video In painting without Ghost Shadow Artifacts by Maintaining Temporal Continuity”, [12]Video in painting specified process to remove portion of video and restoring hole in a visual consistent manner. This method proposes efficient video in painting system to handle static and dynamic portions of the hole. Many presented video in painting algorithms are computationally exhaustive and unable to handle large holes. To in paint static portion system uses background replacement and image in painting techniques to in paint moving objects. It utilizes background subtraction and object segmentation to extract set of object templates and optimal object interpolation is performed using dynamic programming.

Y. M. Liang, S.W. Shih, C.C. Shih, H.Y. Mark Liao and C.C. Lin Proposes, “Learning Atomic Human Actions Using Variable-Length Markov Models”, [13] Human behavior can segment in atomic actions which indicates basic and complete movement of objects. It proposes framework for manage in painting using variable-length Markov models. Method comprises in two modules posture labeling module and VLMM atomic learning action and module recognition. Posture-template selection algorithm base on modified shape-context matching technique is developed first. Then selected posture templates form codebook converts input posture sequences in discrete symbol sequences for succeeding processing. VLMM technique learns training symbol sequences of atomic actions. Finally VLMMs are getting converted into hidden Markov models for input atomic actions recognition. It combines advantages of excellent learning function of VLMM and fault-tolerant recognition having an ability of HMM.

C. H. Ling, C. W. Lin, C. W. Su, H. Y. M. Liao and Y. S. Chen propose, “Video Object In painting Using Posture Mapping”, [14] approach for object-based video in painting. To complete occluded object, it sample 3 dimensional volume of video in to directional spatio-temporal slices, then performs patch-based image in painting to repair partially degraded object trajectory in 2D slices. In painted slices are combined to obtain virtual contour sequence of damaged objects. To extract most similar sequence from presented pure postures of object Virtual contours and posture sequence retrieval technique are used. Key-posture selection and indexing are used for reducing, complexity of posture sequence retrieval. To enriches collection of key-postures to reduce effect of insufficient key postures, Synthetic posture creation scheme.

Amanna Ghanbari and Mohsen Soryani proposes “Contour-Based Video In painting”, [15] technique that extracts occluded images and video frames from video. In this algorithm video in painting is done when an object is totally got damaged. Here background and the moving objects are separated and a large mosaic image is constructed. A patch-based in painting method in combine with a contour-based method and large patches heals the holes. Objects’ settling is done on their right places in each frame and then in painted foreground is acquired. Stationary backgrounds’ Missing regions are filled separately.

Chih-Hung Ling, Yu-Ming Liang, Chia-Wen Lin, Yong-Sheng Chen and Hong-Yuan Mark Liao proposes, "Human Object In painting Using Manifold Learning Based Posture Sequence Estimation", [16] technique which divides overall process in 3 steps:- human posture synthesis, graphical model construction and posture sequence estimation. To improve the number of postures selections in the database which are used to build a graphical model that can calculate approximate motion tendency of an object Human posture synthesis is used.

It introduces couple of constraints to imprison motion continuity properties, first will limits maximum search distance if trajectory in graphical model is uneven and second search direction to maintain tendency of object's motion.

It performs in forward and backward predictions both to get local optimal solutions. Then to compute a best solution, it applies Markov random field model to take potential trajectory with maximum total probability as results. Posture sequence estimation helps to identify set of match postures from posture database to restore occluded postures and make reconstructed motion sequence look continuous.

C. H. Ling, C. W. Lin, C. W. Su, Y. S. Chen and H. Y. M. Liao propose, "Virtual Contour Guided Video Object In painting Using Posture Mapping and Retrieval", [17] approach for object completion in video. To complete occluded object, it samples 3 Dimensional video into directional spatio-temporal slices and performs patch-based image in painting. It completes partially damaged object trajectories in 2 Dimensional slices and then completed slices are collectively obtaining sequence of virtual contours damaged object. Posture sequence retrieval method applies on virtual contours to extract most similar sequence of object postures in existing pure postures. Key-posture selection and indexing method are used to shrink complexity of posture sequence retrieval. Synthetic posture generation enriches collection of existing postures which reduces effect of insufficient postures.

Alasdair Newson, Matthieu Fradet, Patrick Pérez, Andrés Almansa and Yann Gousseau proposes, "Towards fast, generic video in painting", [18] Achieving worldwide consistent video in painting results in sensible time. It builds on influential work on an automatic video in painting algorithm elastic convincing results in greatly reduced computational times by Wexler et al. It extends the Patch-Match algorithm in spatio-temporal case, to accelerate search for approximately nearest neighbors in patch space.

It provides simple and fast solution for over-smoothing problem found from averaging of patches. It also shows results similar to a supervised state-of-the-art method may be obtained on high resolution videos excepting any manual intervention. Our result indicates globally consistent patch-based algorithms, that are feasible and gives attractive solution to difficult problem of video in painting.

B. A. Ahire and N. A. Deshpande, propose, "Video in painting of object using modified Patch based technique", [19] a method for Efficient moving object removal by using improved exampler-based in painting method. 3 Dimensional (3D) volume of video converted into 2 Dimensional (2D) slices for maintenance of spatio-temporal consistencies.

Object detection and tracking carried out by using background extraction technique. Improved exampler-based image in painting algorithm gives improved results at the last. When it combines in painted slices sequence of virtual contour, retrieve most similar postures among frame of available postures. Key-posture selection and indexing are jointly used to minimize complexity of posture sequence retrieval. To increase the number of available postures synthetic postures creation method is used.

Table 1: Spatio-Temporal Consistency Maintenance Review in Painting Approach

Sr. No.	Year	Authors	Title	Previous Spatio-Temporal Consistencies Estimation Analysis
1	2004	J. Jia, T.P. Wu, Y.W. Tai and C.K. Tang.	Video Repairing: Inference of Foreground and Background Under Severe Occlusion	In sampling motion data are sampled and regularized by 3D tensor voting to maintain temporal coherence and motion periodicity.
2	2004	Ahmed Elgammal and C.S. Lee.	Inferring 3D Body Pose from Silhouettes using Activity Manifold Learning	Silhouette recovers intrinsic body and detects spatial or temporal outliers. To recover view-based represented activity manifolds and learns mapping functions between such central representations and visual and 3D body pose space both.
3	2005	Y.T. Jia, S.M. Hu and R. R. Martin.	Video completion using tracking and fragment merging	Fine details are maintained by use of graph cut algorithm when merging source and target fragments.
4	2005	V. C. Brendan, J. Frey and N. Jojic.	Video epitomes	In videos small space-time cubes from the input data epitomes are estimated to model. Epitome used for modeling and reconstruction tasks.
5	2005	K. A. Patwardhan, G. Sapiro and M. Bertalmios.	Video In painting Of Occluding And Occluded Objects	Priority scheme in paints occluded moving Objects, fill remaining area with static background using method input optical-flow based mask, which tells if an undamaged pixel is moving or is stationary.
6	2006	Y. Matsushita, E. Ofek, W. Ge, X. Tang and H.Y. Shum.	Full-Frame Video Stabilization with Motion In painting	Motion in painting enforces spatio-temporal consistency of completion in static and dynamic image database.
7	2006	Y. Shen, Fei Lu, X. Cao and H. Foroosh	Video Completion for Perspective Camera Under Constrained Motion	Extends the current state-of-the-art repairing techniques to preserve the spatial and temporal coherence.
8	2006	J. Jia, Y.W. Tai, T.P. Wu and C.K. Tang	Video Repairing under Variable Illumination Using Cyclic Motions	Necessary temporal consistency is maintained by tensor voting in spatio-temporal domain.
9	2007	Tao Ding, Mario Sznaier and Octavia I. Camps	A Rank Minimization Approach to Video In painting	Rank minimization of matrix can directly constructed from available data, leading to simple, computationally attractive, dynamic in painting algorithm to optimize spatio-temporal information.
10	2007	Y. Wexler, E. Shechtman, and M. Irani	Space-Time Completion of Video	Space-time completion of large holes in video sequences used to fill Missing portions sampled spatio-temporal patches by existing parts video and modifies global spatio-temporal consistency between patches around hole.
11	2007	K.A.Patwardhan, G. Sapiro and M. Bertalmío	Video In painting Under Constrained Camera Motion	Spatial texture synthesis technique maintains spatio-temporal consistencies.
12	2009	T. K. Shih, N. C. Tang, and J.N. Hwang.	Exemplar-Based Video In painting Without Ghost Shadow Artifacts by Maintaining Temporal Continuity	Modified exemplar-based image in painting algorithm along with improved patch-match strategy maintains Spatio-Temporal Consistencies in video in painting.
13	2009	Y.M.Liang, S. W. Shih, A.C. C. Shih, H.Y. M. Liao and C.C.Lin.	Learning Atomic Human Actions Using Variable-Length Markov Models	VLMM technique applied to learn training symbol in sequences of atomic actions. Constructed VLMMs transforms in hidden Markov models for recognizing input atomic actions.
14	2009	C.H. Ling, C.W. Lin, C.W. Su, H.Y. Mark Liao and Y.S. Chen.	Video Object In painting Using Posture Mapping	To complete occluded object, it samples 3-D volume of video into 2-D directional spatio-temporal slices, then it performs patch-based image inpainting to repair the partially damaged object.
15	2011	A. Ghanbari and M. Soryani.	Contour-Based Video In painting	A new mechanism virtual contour is used for patch searching and patch adjustment to preserve the spatial as well as temporal continuity of video.
16	2011	C.H. Ling,Yu-M. Liang,C.W. Lin, Y.S.Chen and H.Y.M. Liao.	Human Object Inpainting Using Manifold Learning Based Posture Sequence Estimation	Markov random field model take potential trajectory with maximum probability as final result which maintain Spatio-Temporal Consistency.
17	2011	C.H. Ling, C.W. Lin, C.W. Su, Y,S. Chen and H.Y.M. Liao	Virtual Contour Guided Video Object In painting Using Posture Mapping and Retrieval	Tensor voting technique is used to maintain consistency in both the spatio-temporal domain.
18	2013	A. Newson, M.Fradet, P.P.A. Almansa, Y. Gousseau	Towards fast, generic video In painting.	We extend the Patch-Match algorithm to the spatio-temporal case in order to accelerate search for approximate nearest neighbors in patch space.
19	2013	B.A.Ahire and N.A. Deshpande	Video in painting of objects using modified Patch based technique	An efficient moving object removal using modified exampler based inpainting algorithm is proposed for 3D volume of video is converted into 2D slices for maintaining spatio-temporal consistencies.

CONCLUSIONS

This review shows spatio-temporal consistency maintained in various image in painting and video in painting algorithms works till now. All methods have its own advantages and disadvantages on the basis of consistency performance. This work shows how past proposed methods removes objects with good quality in terms of the object's spatio-temporal consistency, it avoids over-smoothing artifacts and compensates for insufficient available postures. Most of the video in painting algorithms are unable to maintain spatial and temporal consistencies but this review work gives detail idea to solve the problem of spatio-temporal consistency approach simultaneously. Spatio-temporal consistency maintaining In painting technique selection is basically depends on requirements.

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