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Review on Video Motion Magnification

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***Abstract:** There are subtle motions present in a video sequence which are invisible by human eyes and require certain algorithms to analyse these motions. The fundamental goal of motion analysis is to determine a vector field describing changes in the image over time. In this process, the input video sequence in which motion is to be revealed initially undergoes spatial decomposition followed by the temporal processing of the decomposed frames where the frames are filtered to select desired band of frequencies to be enhanced. These bands of frequencies are experimentally derived and allowed the user to decide the amplification factor by which the motion is to amplify. After the processing and enhancement of the low frequency motions, the spatial pyramid is reconstructed back to get the improved video sequence, where the subtle motions are significantly visible. There are some techniques available for the said objective. The review of such techniques has been done and presented in this article.*

***Keywords:** subtle motion, spatial, temporal, spatial pyramid, decomposition.*

I. INTRODUCTION

Although the human visual tract has moderate spatio-temporal sensitivity, but the signals that fall below this capacity can give useful information. Hence the efficient tools are needed in order to analyse this unapproached signals usually containing significant information.. As these signals corresponds to the hidden motions in the video sequences, the analysis of motion makes us enable for extraction of visual information from the temporal and spatial changes which occurs in an image sequence, and is a fundamental task in computer vision and image processing. Assuming illumination conditions remain constant, image sequence changes because of a relative motion between the scene and the camera; either by the viewing camera moving relative to a static scene, elements of the scene being in motion, or in the general case, both camera and objects moving independently. The problem of motion analysis may be divided into two sub problems; that of feature correspondence and reconstruction. The correspondence problem concerns finding features' pair in two or more perspective views of a scene so that each pair corresponds to the same scene point. Because of this ill-posed and inherent combinatorial complexity nature, feature correspondence is claimed as the hardest and poor-level image analysis tasks. The solubility of the correspondence problems also influenced by factors such as image noise, periodic textures and object occlusion. The reconstruction problem states that, given a number of corresponding elements, and possibly knowledge of the camera's intrinsic parameters, what may be inferred about the 3D motion and structure of the observed world. The extraction of motion information from an image sequence has many important applications. For example, changes in blood circulation causes slight changes in human skin color. This variation is invisible to the naked eye but it can be exploited to extract pulse rate of a person [1]-[3]. Similarly, it is very hard or nearly impossible for human eye to see the motion with low spatial amplitude, hence it should be magnified to reveal interesting mechanical behaviour [4]. The success of these tools induces the development of new techniques to manifest inscrutable signals in videos. In this paper, the approach is presented that in which an annexation of temporal and spatial processing of videos can magnify elusive variations that evince important phase of the world around us.

The concept is to contemplate the time series of color values at any spatial position i.e. pixel and raise the shift in a given temporal frequency band of interest. For example, in human heart rates measurement, the video of human face is taken then one can directly pick, and then amplify, a band of temporal frequencies which includes eventual human heart rates. The amplification exploits the variation of redness as blood flows through the face. The temporal filtering presented in this approach not only amplifies color variation, but also capable of revealing motions with low-amplitude. For example, it is feasible to increase the scrupulous motions around the chest of a breathing baby.

II. LITERATURE REVIEW

In last decade, several methods have been developed to reveal unperceivable in videos. Some methods found out to be very effective and build the base for this area of work. [4] Presented a technique, motion magnification, those analyse and amplify motions that would otherwise be invisible or very difficult to see by naked eye. The input was a sequence of images from a stationary camera. The system automatically segments a reference frame into region of common property, grouped by proximity, similar color, and correlated motions. Analogous to focusing a microscope, the user identifies the segment to modify, and specifies the motion magnification factor. The video sequence was then re-rendered with the motions of the selected layer magnified as desired. The output sequence allows the user to see the form and characteristics of the magnified motions in an intuitive display, as if the physical movements themselves had been magnified, then recorded.

[5] Presented the CAF (Cartoon Animation Filter), a normal filter that takes an licentious input motion signal and harmonize it in such a way that the output motion is more “animated” or “alive”. The filter adds a salved, inverted, and may be time shifted version of the second derivative of the signal back into the prime (original) signal. Almost all the parameters of such filter are automated. Only the desired strength of the filter needs to set by the user. The effectiveness of the animation filter false in its simplicity & generality. The filter had been applied to motions ranging from hand striate trajectories, to simple animations within Power Point presentations, to motion captured Depth of Field (DOF) curves, to video exfoliation results. Experimental results showed that the filtered motion exhibits expectancy, follow-through, hyperbole (exaggeration) and squash-and-stretch effects which are absent in the original input motion data. The approach is made to maintain a balance between simplicity and control that favoured simplicity. The authors have found out that the application of the cartoon animation filter probably is not satisfactory for hand crafted off-line animation systems although it may be useful for previews. The author believe the value of such a simple approach will be in either real time applications such as games, or in less professional settings such as a child focused animation tool, or in 2D presentation systems such as PowerPoint.

The above two methods follow a Lagrangian approach, in accordance to fluid dynamics in which the trajectory of particles is tracked over time. As such, they believe in accurate motion calculation, which is reckoning expensive and hitch to make artefact-free, especially at regions of mazy motions and occlusion boundaries. However, [4] have shown that additional technologies, including motion fragmentation and image in-painting, are required to generate good quality compilation. But this increases the involution of the algorithm further.

Previously, temporal processing has been used to smooth motions [6] and to chuck out invisible signals [2]. [2] Presented a novel methodology for extracting the pulse rate from video recordings of the human face and demonstrated an execution using a simple webcam with extensive daylight providing illumination. They introduced a real low-cost method for non-contact heart rate measurement that is automated and motion-staying. Moreover, they have shown how the approach is gaugeable for simultaneous assessment of multiple people in front of a camera easily. This technology appeared to be promising for extending and improving access to medical care, there is an availability of the low cost and widespread webcams.

[6] Introduced a system with controlled temporal sampling behaviour. It transforms a high frames per second input stream into a conventional speed output video in real- time. Making use of these filters, we present a novel computational imaging system which performs real-time temporal pre-filtering to dampen temporal aliasing. Their system allows for temporally

overlapping filters, which are a prerequisite for successful anti-aliasing. They have made the provision to arbitrarily choose the shape and extent of the temporal filter, hence different filtering operations can be performed, such as optimally pre-filtering for a given output kernel or artistically emphasizing or modulating motion blur. Furthermore, they have demonstrate specialized filter banks for analysing the signal in the Fourier domain, in order to understand and enhance video content based on its temporal behaviour, e.g. emphasizing or de-emphasizing motion. After the experimentation, the authors found out some of the limitations of their systems such as cost involved in Performing temporal pre-filtering by starting from a super- sampled sequence, As each sub-frame is exposed for a very short period <2ms, the number of recorded photons is limited. The signal to noise ratio is weaker compared to a single exposure for the entire frame but they have managed to reduce it after certain modifications.

One group of researcher, [1] had extracted the cardio-vascular pulse variation using mass light and a simple consumer level digital camera in movie mode. Respiration and Heart rates could be quantified up to various harmonics. Even though the green channel featuring the strongest plethysmographic signal, analogous to absorption peak by (oxy-) haemoglobin, the red and blue channels also contained plethysmographic data or information. Their results show that ambient light photo-plethysmography can be useful for medical purposes such as remote sensing of vital signs (e.g., heart and respiration rates) for triage or sports purposes and characterization of vascular skin lesions (e.g., port wine stains). This research became one of the backbone for using the motion analysis in video sequence for the measurement of various medical parameters related to human body.

III. THE PROPOSED APPROACH

The approach proposed in this paper for the motion magnification is emboldened by the Eulerian perspective, where properties of fluid, such as pressure and velocity, evolve over time. In this case, the variation of pixel values over time is amplified and studied, in a spatially-multiscale manner. In Eulerian approach to motion magnification, motion is not explicitly estimated, but rather exaggerated by amplifying temporal color changes at fixed positions. The approach relied on the same differential approximations that form the groundwork of optical flow algorithms [7][8].

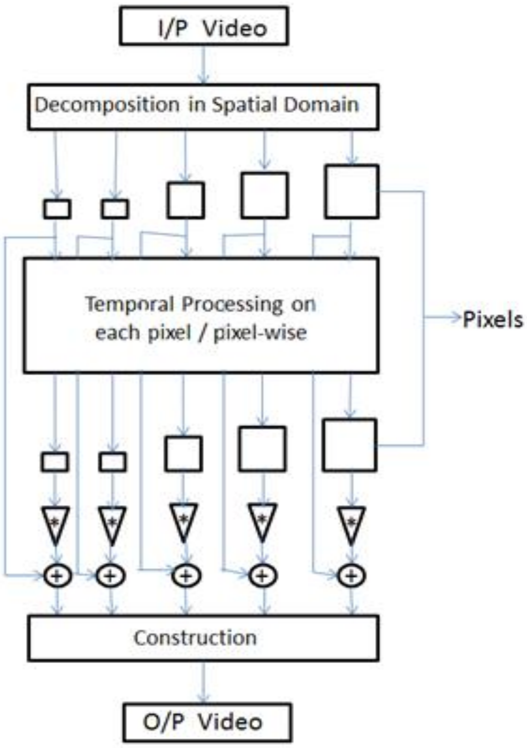

Figure 1: Oversight of the video magnification framework

The approach combines temporal and spatial processing to intone subtle temporal changes in a video. The process is illustrated in Figure 1. The video sequence is first decomposed into multiple spatial frequency bands. These bands might be magnified differently because either they might contain spatial frequencies for which the linear approximation used in our motion magnification does not hold or they might exhibit different signal-to-noise ratios. In the latter case, the amplification is reduced for these bands to suppress artefacts. When the goal of spatial processing is simply to enhance temporal signal-to-noise ratio by pooling multiple pixels, then the video frames are spatially low-pass filtered and down sampled for computational efficiency. In the general case, a full Laplacian pyramid is computed [9].

Then temporal processing is performed on each spatial band. The time series is considered corresponding to the value of a pixel in a frequency band and a bandpass filter is applied to extract the frequency bands of interest. The temporal processing is identical for all spatial levels, and for all pixels within each level. After that the extracted bandpassed signal is multiplied by a magnification factor that can be specified by the user, and may be assuage automatically depending on certain parameters. Then the magnified signal is added to the original and collapses the spatial pyramid to obtain the final output.

IV. CONCLUSION

In this paper, the certain methods for exploiting the hidden information embedded in the minute invisible motions in a video sequence are reviewed briefly, some of which used feature tracking or optical flow computation. Moreover, a straightforward method that takes a input video and exaggerates subtle color changes and unseen motions is presented. To amplify motion, the method merely magnifies temporal color changes using spatio-temporal processing. This Eulerian based method, which temporally processes pixels in a fixed spatial region, is able to successfully reveal informative signals and amplify small motions in real-world videos.

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