**BEST: International Journal of Management, Information Technology and Engineering (BEST: IJMITE)**
**ISSN 2348-0513**
**Vol. 2, Issue 4, Apr 2014, 15-24**


# VIDEO SHOT BOUNDARY DETECTION BASED ON NODAL ANALYSIS OF GRAPH THEORITIC APPROACH

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## ABSTRACT

Extraction of video shots is a promising step in the process of shot boundary detection. Most of the existing methods measure discontinuities between the two consecutive video frames based on its low level features. In this paper we present an innovative method that take the advantage of previously define method to measure discontinuity between the frames. The conceptual knowledge of nodal analysis is combined with the existing technique: histogram difference method and statistical deviation of pixel intensities using contrast change parameters to detect the edit effect occurring in different videos. These effects include both abrupt transition and gradual transition. Proposed method is tested on different videos and the result shows its accuracy and efficiency in detecting shot boundaries.

**KEYWORDS:** Distance Learning, Video Data Requires, Machine Algorithms

## INTRODUCTION

Video processing, an analysis of the content of the video to obtain an understanding of the scene that it describes. It is an essential component of a number of technologies, including video surveillance, robotics, and multimedia. From a basic science perspective, methods in video analysis are motivated by the need to develop machine algorithms that can mimic the capabilities of human (and other animal) visual systems. It is an area of research that has seen huge growth in the recent past. Researchers in video analysis have varied backgrounds, including signal/image processing, computer science, systems theory, statistics, and applied mathematics. Detection is also an analysis task in this area as it can help identify the interesting objects in the scene, e.g., people, which can then lead to an understanding of the scene or an analysis of the actions of the objects. Analysis of the image intensities and their variations, often result in building statistical models that can serve as a signature for that object. Recent developments in video compression technology, the widespread use of digital cameras, high capacity digital systems, coupled with the significant increase in computer performance and the growth of Internet and broadband communication, have increased the usage and availability of digital video. Applications such as multimedia information systems, distance learning, video-on-demand produce and use huge amount of video data. This situation created a need for tools that can effectively categorize, search and retrieve the relevant video material.

Multimedia usage necessitates the development of efficient and effective methodologies for manipulating databases storing this information. Moreover, in its first stage, content-based access to video data requires segmenting of each video stream into its building blocks. The video stream consists of a number of shots, each one a sequence of frames pictured using a single camera. A shot is defined as a part of the video that results from one continuous recording by a single camera. A scene is composed of a number of shots, while a television broadcast consists of a collection of scenes.

Switching from one frame to another indicates the transition from a shot to the next one. Therefore, the detection of these transitions, known as scene change or shot boundary detection, is the first step in any video-analysis system.

There are mainly four different types of common shot boundaries within shots:

- **A Cut:** It is a hard boundary or clear cut which appears by a complete shot over a span of two serial frames.
- **A Fade:** Two different kinds of fades are used: The fade-in and the fade-out. The fade-out emerges when the image fades to a black screen or a dot. The fade-in appears when the image is displayed from a black image. Both effects last a few frames.
- **A Dissolve:** It is a synchronous occurrence of a fade-in and a fade-out. The two effects are layered for a fixed period of time e.g. 0.5 seconds (12 frames).
- **A Wipe:** This is a virtual line going across the screen clearing the old scene and displaying a new scene. It also occurs over more frames.

A number of algorithms for video shot detection have been proposed in the recent time. A comparative study of two shot boundary detection approach: dual tree complex wavelet transform and block matching algorithm id done to investigate the detection of edits [1]. An approach based on segment selection and singular value decomposition (SVD) to speed up the SBD. In it, the positions of the shot boundaries and lengths of gradual transitions are predicted using adaptive thresholds and most non-boundary frames are discarded at the same time [2]. A novel approach for processing encoded video sequences prior to complete decoding proposed an algorithm which first extracts structure features from each video frame by using dual-tree complex wavelet transform.

Then, spatial domain structure similarity is computed between adjacent frames. The declaration of shot boundaries are decided based on carefully chosen thresholds. [3]. This approach combines two methods namely: Block based Histogram difference and Block based Euclidean distance difference for SBD. [4]. A new approach for key frame extraction based on the block based Histogram difference and edge matching rate. Firstly, the Histogram difference of every frame is calculated, and then the edges of the candidate key frames are extracted by Prewitt operator. [5]. A fuzzy colour histogram-based shot-boundary detection algorithm specialized for content based copy detection applications. [6]. This a new approach to detect shot boundary based on motion estimation for uncompressed video This algorithm proposes the concept of frame comparison and the adaptive threshold. [7]. A Model-Based Shot Boundary Detection Technique Using Frame Transition Parameters by formulated frame estimation scheme using the previous and the next frames. [8]. An algorithm that is efficient for action movies/videos. Conventional shot boundary detection (SBD) algorithms have limitations in handling video data that contain fast illumination changes or rapid motions of objects and background based on the combination of two motion features: the modified displaced frame difference (DFD) and the block wise motion similarity. [9]. A Novel approach for Shot Detection based on Graph Theory.

At first the feature of colour is extracted, the dissimilarity of video frames is defined. Then the video frames are divided into several different groups through performing graph-theoretical algorithm. [10]. An innovative shot boundary detection method for news video based on video object segmentation and tracking. It combines three main techniques: the partitioned histogram comparison method, the video object segmentation and tracking based on wavelet analysis. [11]. The approach presents mapping of space of inter-frame distances onto a new space of decision better suited to achieving a sequence-independent thresholding. This mapping aims to consider frame ordering information within the thresholding process; it is based on the parametric modelling of the patterns that transitions generate on the distances [12]. An approach

based on Real-Time Shot Change Detection over Online MPEG-2 Video describes a software module for video temporal segmentation, which is able to detect both abrupt transitions and all types of gradual transitions in real time. [13] Comparison of several shot boundary detection and classification techniques and their variations including histograms, discrete cosine transform, motion vector, and block matching methods. The performance and ease of selecting good thresholds for these algorithms are evaluated based on a wide variety of video sequences with a good mix of transition types. [14]

In this paper we introduce a graph theoretic concept, namely dominant set for video shot boundary detection. Dominant sets are defined as a set of the nodes in a graph, mostly similar to each other and dissimilar to the others. In order to achieve this goal, shot boundaries are determined by using simply histogram difference for abrupt and standard deviation of pixel intensity using contrast change parameters for gradual transition between consequent frames. Proposed method works on nodal difference analysis that construct graph using frames in the testing sequence. Each frame in the sequence corresponds to a node in the graph, whereas edge weights between the nodes are calculated by using pair-wise dissimilarities of frames. By utilizing the complete information of the graph, its discontinuities are measured and compared against a threshold level. The threshold value is different for both abrupt and gradual transition including fade in, fade out, dissolve. The simulation results indicate that the proposed algorithm can be a promising approach for abrupt and gradual shot boundary detection.

A graph is a symbolic representation of a network and of its connectivity. It implies an abstraction of the reality so it can be simplified as a set of linked nodes. Graph theory is a branch of mathematics concerned about how networks can be encoded and their properties measured. It has been enriched in the last decades by growing influences from studies of social and complex networks. A graph represents a set of elements and a set of pair wise relationships between those elements. The elements are called nodes or vertices, and the relationships are called edges. Formally, a graph G is defined by the sets G = (V, E) where V and E represent vertex and edge respectively. We may denote the $i^{th}$ vertex as $v_i \in V$, and the i-th edge as $e_i \in E$. Since each edge is a subset of two vertices, we may also write $e_{ij} = \{v_i, v_j\}$.

Each edge is considered to be oriented and some edges additionally directed. An orientation of an edge means that each edge $e_{ij} \in E$ contains an ordering of the vertices, $v_i$ and $v_j$.

## ALGORITHM DESCRIPTION

For using this algorithm first step towards the approach is to convert test video containing edit effects like fade, cut etc into its video frame. We divide each frame into its sub component. The elements of frames are known as node or vertices and the path joining the node with other node to form a tree pattern is called edge. A graph is always represented by G = (V, E). With this node we form a tree pattern based on the number of available nodes.

The dissimarilites between the tree pattern so form results in frame difference. This difference is calculated in terms of histogram difference for abrupt change which is insensitive to changes in colour, luminance because there is a sudden change between two adjacent frames so no similarity exist there. In case of gradual, we see minute changes in luminance, colour, and motion of both camera and background which is very frequent. So for this we use standard deviation of pixel intensities in combination with contrast change feature, to calculate frame difference. It deals with colour, intensity feature including motion and luminance characteristics. Proposed algorithm is tested for several video e.g. sports, animated, wildlife, cartoon, action, movies etc.

The detection algorithm usually tries to point out the visual discontinuities by monitoring some dissimilarities computed by using a combination of the above mentioned techniques. The measured values are compared to some threshold value, and a boundary is declared if the value exceeds the threshold. Usually the value being observed during abrupt cut transitions are much larger than that during gradual transitions, and therefore higher thresholds can be used for spotting only cuts. The abrupt transition values vary from cut to cut, and sometimes all the transitions cannot be identified using a fixed threshold value. An adaptive threshold value can also be used. Adaptive threshold measure the average discontinuity within a temporal domain. Gradual transition need lower threshold values. One method to spot the gradual transitions is the twin-comparison approach, where two thresholds are defined: higher Th for abrupt cuts and lower Tl for gradual transitions. In this approach the cuts are first detected using the higher threshold, and then for the remaining video Tl are used to spot the gradual transitions. The algorithm tries to spot groups of succeeding difference values that all exceed the lower threshold. If the sum of these differences also exceeds the higher threshold value, this group is then referred as a gradual transition.

## RESULTS

The output observe for different videos is as follows:

**For Abrupt Transition**


**Figure 1: Frames with Abrupt Transition**

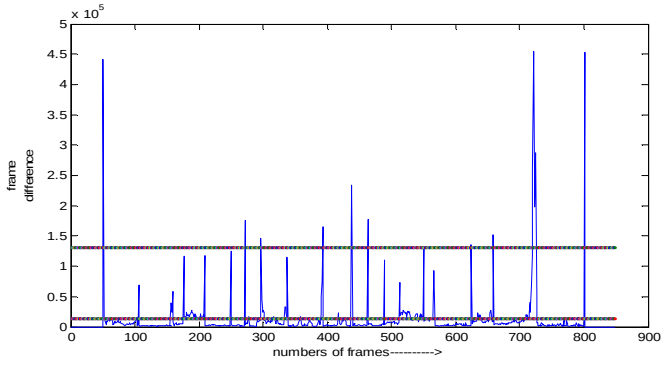


**Figure 2: Output for Hard Cut (Abrupt Transition)**

**For Video with Gradual Transition**

**Video with Dissolve Effect**


**Figure 3: Frames for Gradual Transition**

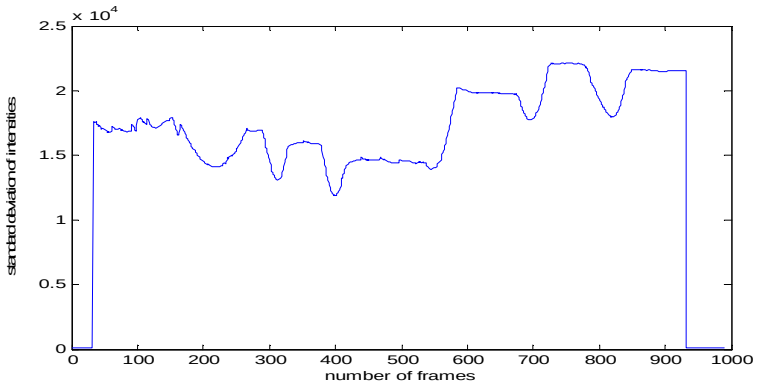


**Figure 4: Output for Dissolve Transition (Including Dissolve Effect as Well as Motion and Luminance)**


Frame-634


Frame-635


Frame-636


Frame-637


Frame-638


Frame-639


Frame-640


Frame-641


Frame-642


Frame-643


Frame-644


Frame-645


Frame-646


Frame-647


Frame-648


Frame-649


Frame-650


Frame-651


Frame-652


Frame-653


Frame-654


Frame-655


Frame-656


Frame-657


Frame-658

Frame-659

Frame-660

Frame-661

Frame-662

Frame-663

Frame-664

Frame-665

Frame-666

Frame-667

Frame-668

Frame-669

Frame-670

Frame-671

Frame-672

Frame-673


**Figure 5: Video with Fade in and Fade out Effect**

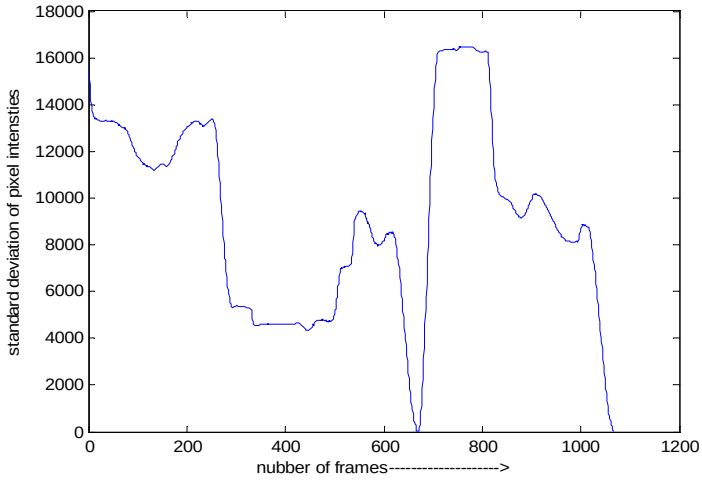


**Figure 6: Output for Fade in and Fade out Transition (Including Effect of Motion and Luminance)**

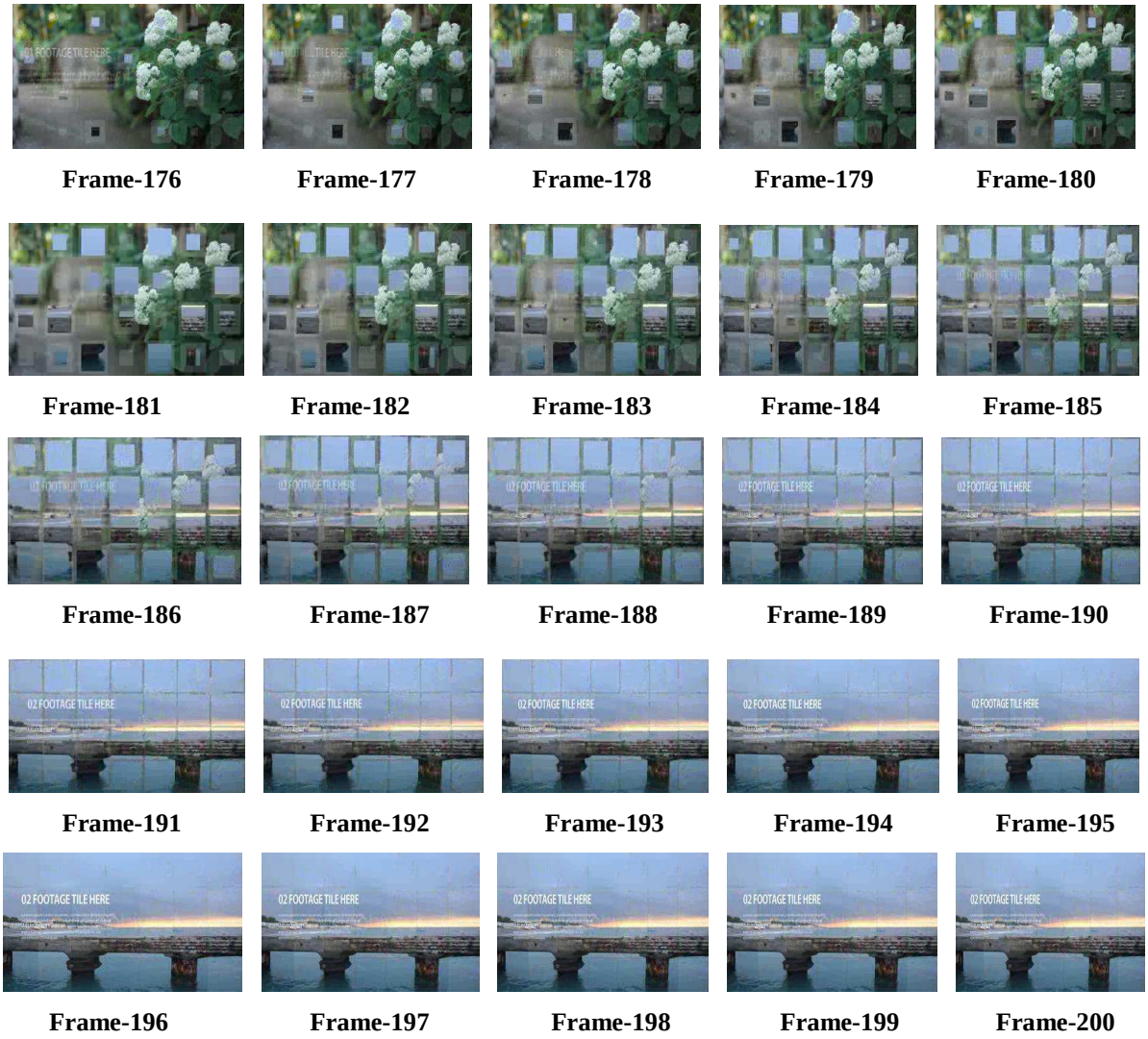


**Figure 7: Video with Wipe Transition**

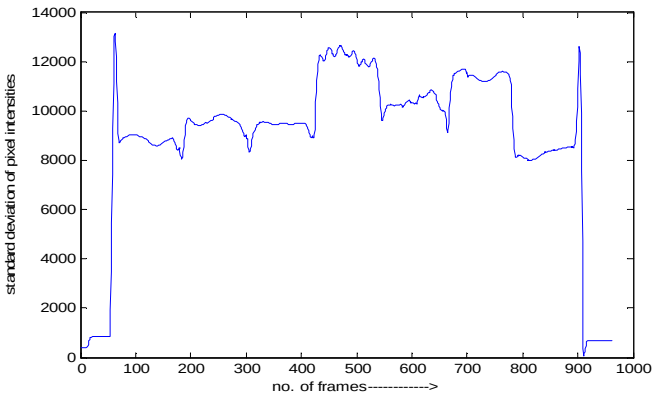


**Figure 8: Output for Wipe Transition**

## CONCLUSIONS

In this paper we proposed a newly develop method in conjunction with the advantageous feature of predefined method. Our framework has been done towards the detection problem during different occurring transitions. We used nodal analysis concept for efficient result and better accuracy. We tested on different videos and observe their result and measure its performance for various design parameters. The result presented in this paper show that nodal analysis can be

used very successfully in this area. Shot boundaries are represented with prominent high value peaks and their positions are detected using proper thresholding. If combined with text features, the shot detection performance would improve greatly in future beside this we can use other object level information like key frame extraction, audio feature.

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