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Video Information Processing Based on the Method of Scaling Images

E.B Tashmanov.,Yu.R Mambetsharipov
(Public security University of the Republic of Uzbekistan)

The article discusses the problems of ensuring high compression ratios of video information and proposes a method for preliminary scaling of the original images to increase the coding efficiency.

Keywords: image compression, compression ratio, image scaling, bilinear interpolation.

There is a significant global interest in image compression. While building wireless video surveillance systems as well as in television technologies, it becomes necessary to transmit large amounts of video data in real time.For this purpose, hardware or software codecs are used that provide efficient compression of video data for transmitting video streams over existing communication channels.However, at high video compression ratios, there is a significant deterioration in the quality of the displayed images.Therefore, more efficient methods and algorithms of compressors are required in order not to degrade the quality of images.

Currently, the most widely used codecs for compressing video streams are MPEG-4/AVC, H.264, H.265 and the like, in which the main video data compression is provided by eliminating interframe differences based on motion compensation of the block structure of images.

The methods of block compensation for the motion of video objects at its time made it possible to dramatically increase the compression ratio of the video stream while maintaining the visual quality of the decoded images, but they also have a number of significant drawbacks:

- the mechanism for searching for a new position of identical blocks of pixels in adjacent frames has low performance, and an increase in the accuracy of motion compensation even more significantly reduces the acceleration of image processing
- Due to the fact that in television, frames must be processed in real time, that is, in no more than one frame (40 ms), then building video codecs requires powerful and expensive multiprocessor devices and computers.
- The movement of blocks during motion compensation entails the formation of an additional array of metadata containing the coordinates of the movement of blocks necessary to restore the original sequence of blocks when decoding images.

However, when compressed 80 or more times, large blocks are not able to approximate video objects of arbitrary shape, therefore, in the MPEG-4 AVC and H-264 standards, the block size is reduced to 8x8 or even 4x4 pixels. In this case, the number of blocks will increase to 25920, which increases the size of the metadata to 52 KB, and this can completely negate all the benefits of motion compensation.

Therefore, to ensure the amount of compression of a video stream by a factor of 100 or more, methods and algorithms with a minimum amount of metadata or no metadata are needed[1].

The results of the analysis of open literature sources showed that one of the interesting mechanisms for efficient coding of video data in real time can be the use of pre-scaling of images.A feature of the proposed option is the image compression method based on reducing the size of the original images during encoding with subsequent restoration of their sizes during decoding.This is because the final amount of compressed image data is directly related to the amount of data in the original image.In this regard, if, for example, its size in width and height is reduced by 2 times, then its data volume will be reduced by 4 times and, accordingly, the volume of video data of the encoded image will decrease.However, when increasing the size, it is necessary to add the appropriate number

of pixels, which are not in the reduced image.Therefore, usually, the value of the missing pixels is calculated from the values of the known neighboring pixels using various interpolation methods.

An important part of the effective use of prescaling is the choice of the post-decompression interpolation algorithm.Interpolation, or interpolation, in computational mathematics is a method of finding intermediate values of a quantity from an available discrete set of known values.The interpolation algorithm must provide the maximum picture quality with the minimum time consumption, and the running time of the algorithm must satisfy the symmetry requirement. One of the most common interpolations is bilinear interpolation [2].

In computational mathematics, bilinear interpolation is an extension of linear interpolation for functions in two variables. To calculate the unknown brightness value of the desired pixel, 4 neighboring pixels are used. First, in accordance with the coordinates of the desired pixel, the valuesof the auxiliary points are linearly interpolated along the abscissa axis, then linear interpolation is carried out between these points along the ordinate.

Due to the fact that the reduction of the image size is performed by removing a part of the pixels (the arithmetic mean, geometric mean and clipping methods), the reverse interpolation addition of pixels does not provide a complete restoration of the original image. That is, image recovery is performed with errors and distortions.Moreover, in fine-structured images, distortion is manifested much stronger than in images with large objects.Therefore, to assess the accuracy of restoring video data of scalable images, 3 types of test images of various scenes were selected (Fig. 1)

a) Airplane b) APC

c) Armored vehicle

Fig.1.TestImagesforEvaluatingtheAccuracyofRe-scaling

To experimentally check the effectiveness of the use of interpolators for wavelet transformations, special software was created on which it was possible to preliminarily reduce the size of images, and then restore their original size [3].

The developed video codec has a user-friendly interface that allows you to work with both individual images and a sequence of frames of a video stream. Codec operation modes are controlled by setting the corresponding pointers in the control windows of the graphical interface.

At the same time, the quality of the restored images was assessed both visually and by calculating the average values of the pixel brightness of the original and restored images, as well as the image processing time.The results of the experimental data is provided in table 1.

Table 1.

The value of the average pixel brightness of the original and restored images by bilinear interpolation algorithms and the image processing time

№	Test picture	Compression mode	Time processing	The value of the average brightness of the image pixel	
				Original	Revived
1	Airplane	Average	01,73	102.73	102.73
		Geometric mean	01.73	102,73	102,64
		Tenderloin	01.65	102,73	102,74
2	APC	Average	01,71	143,59	143,49
		Geometric mean	01.73	143,59	143,25
		Tenderloin	01.64	143,59	143,61
3	Armored vehicle	Average	01.72	130.7	130.9
		Geometric mean	01.73	130,7	130,69
		Tenderloin	01.64	130,7	130,84

The studies have shown that good results in terms of time and accuracy (the value of the average brightness of an image pixel) of restoring the original image sizes when compressing video data are provided by the clipping method.

Experimental studies have shown that on images without small details, the use of this method with a resultant compression by tens of times makes it possible to ensure good image quality.However, in fine-structure images with pixel decimation, there is a noticeable decrease in clarity due to the loss of information that cannot be fully restored using interpolation with reverse scaling.

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