A new method for the compression of complex signals presented

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Scientists from Universidad Carlos III de Madrid and the University of Southern California have developed a compression method that improves the compacting of video signals, and which could be used to study brain function by analyzing the electric signals the brain produces. Credit: Image courtesy of Ricardo Cuppini

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The study, which was carried out by Eduardo Martinez Enrique and Fernando Díaz de María, of UC3M's Department of Signal Theory and Communications and Antonio Ortega, of USC-Los Angeles's Electrical

Engineering Department, recently received the Best paper award at the International Conference on Image Processing 2011 (ICIP 2011), the most important international conference in the scientific field of image and video processing, whose most recent conference received 2,245 articles from 67 different countries.

This article, entitled "Video encoder based on lifting transforms on graphs", presents a new type of transform for compact representation of video sequences. "A transform," Eduardo Martinez explained, "is a mathematical tool that allows us to look at an object of interest from an alternate point of view, suitable for the problem we are trying to solve. Our object of interest is the video and our problem is to compress it, that is, to represent it in the most compact manner possible," he went on. The transforms presented are capable of compacting energy more efficiently than those that have been used up until now.

The application they have used to evaluate this development is video compression, whose objective is to represent a sequence with the smallest possible rate (the one which occupies the smallest space possible) to achieve a determined quality. With this new compression method, they would be able to reduce a binary system, for example, to transmit a video using streaming (very common on the Internet) or Digital Terrestrial Television. Other possible applications for this development may include noise reduction in a video (which can improve the subjective quality of a low quality sequence), data compression in sensor networks, or the study and interpretation of brain behavior, through the transformation of brain signals – very noisy – into other types of signals that are easier to interpret and analyze.

Pixels like grains of sand

In order to explain how this compression method works, the researchers have made use of an analogy. We can see each image that makes up a

video as a handful of sand spread out on the floor: each pixel is like a grain of sand. The objective of a transform for compression is to reorganize the grains of sand in various levels above the floor. In this way, on the lowest levels a few grains of sand would be used to draw the softest forms, like a sketch of the image. Moving upward, the rest of the grains of sand would be used and more details would be added. And if the structure collapsed, the grains would fall and the original image of the video would be drawn again. "Once the grains of sand are reorganized in this manner," Eduardo Martinez explained, "compressing is simple: we would remove levels from the top down as needed."

To sum up, this research presents a new way of reorganizing those grains of sand so that the highest levels scarcely affect the final structure of the video. When the images are represented in compact form, the edges of the objects turn out to be the most complicated part as that is where the image changes noticeably, and as a result more resources are needed to represent that part. "In this case," the researcher pointed out, "the levels of sand in relation to the detail (the highest) become very important, and eliminating them could appreciably degrade image quality." Currently, in scientific literature, we can find research related to methods that can transform images without crossing the edges of the objects, that is, following specific directions. "Our transform," he added, "extends this concept to video sequences, because it can follow the most suitable directions throughout a sequence of images, also taking into account the temporal dimension."

More information: Study: Video encoder based on lifting transforms on graphs Authors: E. Martinez Enrique, F. Díaz de María, Antonio Ortega Presented at: The International Conference on Image Processing 2011

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