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動態物件行為辨識技術在報工系統上之應用(1/2)

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行政院國家科學委員會補助專題研究計畫 □ 成 果 報 告 □期中進度報告

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計畫主持人：潘忠煜
共同主持人：王偉華、董俊良
計畫參與人員：

成果報告類型(依經費核定清單規定繳交)：■精簡報告　□完整報告

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中　華　民　國　94　年　07　月　05　日

一、 中文摘要

為了產生較佳的影像傳遞品質，我們提出一種新的方法來改進 SPIHT 漸進式影像傳遞。在原本應用 SPIHT 壓縮技術的漸進式影像傳輸技術中，是將經過 SPIHT 之每一階段切割所得到的位元串列，當作每一階段的傳輸，而在每一次的切割當中，它都有對當次切割的重要係數作精煉及對前面每一次切割所得的重要係數做再精煉，然而本篇論文則是提出一個方法，即是在其中幾個階段的傳輸中，先不傳送精煉及再精煉位元，而是將這些位元以下一階段切割所得之擷取重要係數所產生的位元串列去取代，而這些精煉位元則是在後面階段的傳輸中再做傳送，也就是原本在下一階段才看得到的影像，有些可以在前一階段就先看到了。根據我們的實驗結果，新的漸進式影像傳遞法有較佳的影像品質。

二、 英文摘要

To generate optimal transmission quality for images, we present a new technique to improve the progressive image transmission (PIT) of SPIHT in this report. The original approach about the progressive image transmission is that SPIHT regards the bit streams acquired from every truncation as a transmission in every phase; in every truncation, SPIHT not only refine the significant coefficients from this truncation but also re-refine the significant coefficients extracted from the previous phases. These refinements and re-refinement are not worth in many situations. The method we introduced in this paper is that, in some transmission phases, the refined and re-refined bit streams will not be transmitted immediately and will be replaced by the bit streams derived from the significant coefficients of the next truncation. These refined bit streams will be sent late. According to the experimental results, the new method has the better image quality in each PIT phase than the original SPIHT.

三、 報告內容

In this information era, Internet becomes more and more important and prevalent. Nowadays, people almost absorb new knowledge or gather data via Internet. However, while many people are browsing some data, they spend much waiting time and dialing fees due to insufficiency of the bandwidth and the traffic jam of the network. Especially for those who want to browse images via Internet, they have to wait for the whole image or above two thirds image to be received to confirm if this image is necessary or not. Nevertheless, in order to quickly confirm if this image is necessary or not, progressive image transmission (Tzou, 1987; Sridharan et al.,1992; Chung and Tseng, 2001) is an acceptable concept to solve this problem.

The so called PIT is to divide the image data into parts and transmit them in different phases, and the receiver has to combine the image data received in every phase to make the image clearer and clearer. However, in the preceding phases, the most important data of the image has to be transmitted first, then receiver can know the general outline of the image and make sure if the image is requested. By using this technique, users can spend less time and money on transmitting.

The technique of Set Partitioning in Hierarchical Trees (SPIHT) (Said and Pearlman, 1996; Chang et al., 2000) based on Discrete Wavelet Transformation (DWT) (Craizer et al., 1999; Chen et al., 2001) is to make use of DWT to interchange the image data of the spatial domain with the image of the frequency domain. Because of the transmission via DWT, the image data of high frequency, medium frequency and low frequency will be generated. Human being's eyes are especially sensitive to the low frequency coefficients, so the low frequency coefficients are the most important information in an image. After DWT, SPIHT compresses those DWT coefficients according to their importance in the different phases. The basic ideas of SPIHT are based on the concepts of Zerotree (Accame and Granelli, 1999; Wang and Huo, 1997) and quadtree (Munteanu et al., 1999) methods and a receiver will retrieve the significant coefficients in order. Moreover, SPIHT will refine and re-refine the significant coefficients in every phase. Thus SPIHT has the PIT ability intuitively. However, by using SPIHT, a transmitting image cannot be seen clearly enough in the preceding phases. Because of this disadvantage, we propose an improvement for SPIHT in this paper. We see that, according to our experiences, the refined and re-refined bit streams of SPIHT, especially for the preceding phases, are not more important than the bit streams derived from the important coefficients in the next phase. This means that, if we do not transmit the refined and re-refined bit streams in the preceding phases and replace them with the bit streams derived from the important coefficients in the next phase, we can see the image more clearly in the preceding phases than that of the original SPIHT. This is the major idea of this report.

Haar function (Haar, 1955; Andrews, 1970; Shore, 1973) is usually used to calculate DWT. For example, in Fig. 1 and 2, there is a 4×4 image be translated by Haar wavelet transformation.

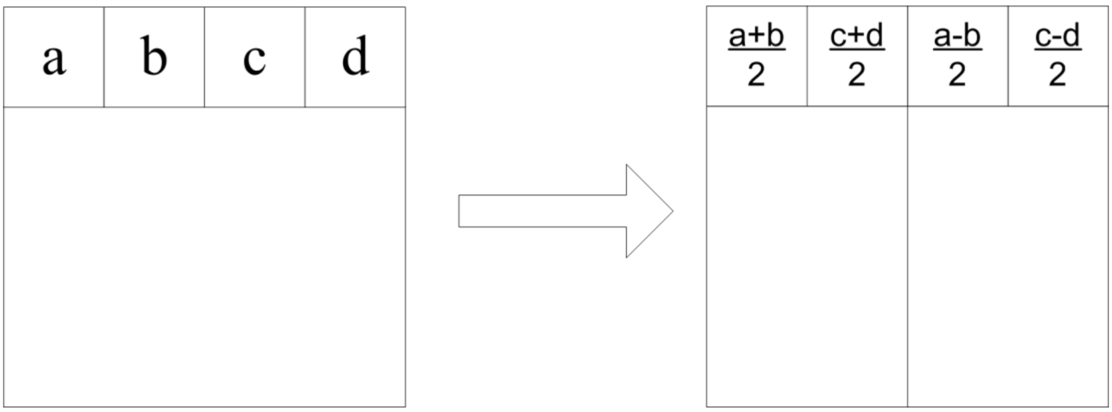

Fig. 1. the first horizontal truncation of a 4×4 image

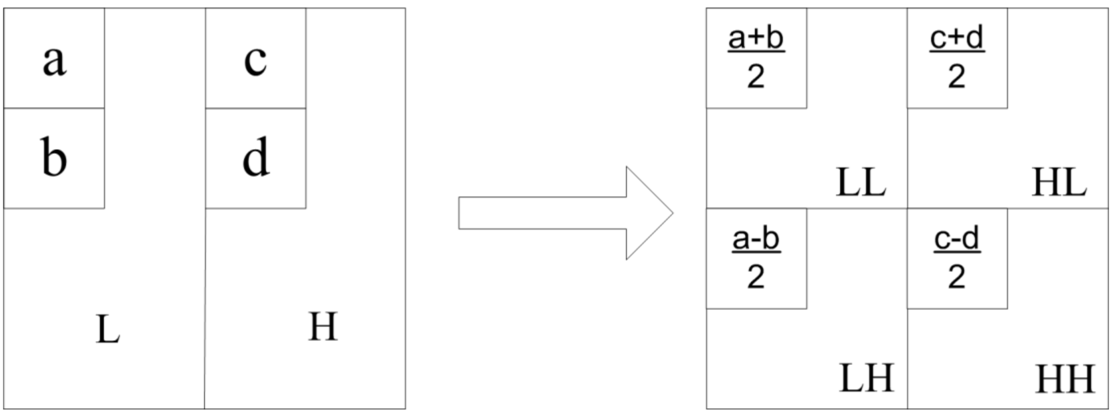

Fig. 2. the first vertical truncation of a 4×4 image

SPIHT separates the image coefficients translated by DWT into different phases according to their corresponding importance for image quality and the truncation policy of SPIHT. Next, the progressive image transmission employs the feature of SPIHT to transmit the bit streams phase to phase to the receiver. Once the receiver receives the bit streams, it combines them with the previous received data and decompresses them. Thus the receiver can make the image clearer and clearer. Meanwhile, during the transmissions, the receiver can decide if this image is necessary or not without waiting for the whole image data to be received.

Now, let's describe the truncation policy of SPIHT as follows. First, SPIHT selects a threshold based on the maximum DWT coefficient. A DWT coefficient is significant if it is greater than the threshold. This is the first truncation of SPIHT. After the first truncation of SPIHT, we acquire the bit streams composed of 0 and 1 from the significant coefficients and the refined bit streams of the significant coefficients in the first phase. After the first transmission, the receiver who acquires the bit streams from the first truncation, decompresses the received bit streams with SPIHT decompression process and takes the outline of the image because the most significant coefficients have been extracted and transmitted from the first truncation. Next, the sender of SPIHT decreases the threshold value and creates the significant coefficients for the second truncation. Then, the sender gathers the bit streams of the second truncation for processing the second transmission. The bit streams of the second truncation include the bits acquired from the significant coefficients in the second phase and the re-refined significant coefficients of the first and second phase. As for the receiver, after the receiver combines them with the former received bit streams and decompresses them, the receiver can get a clearer image than that gotten after the first phase. The later phases follow the same rules as the former one as illustrated in Fig. 3. In SPIHT, we can evaluate the number of transmitting phases by formula (1). In this formula, C_{ij} is a coefficient after DWT, i and j are the positions of the coefficients, $\max(C_{ij})$ is the largest coefficient after DWT, and N is the total number of the transmitting phases.

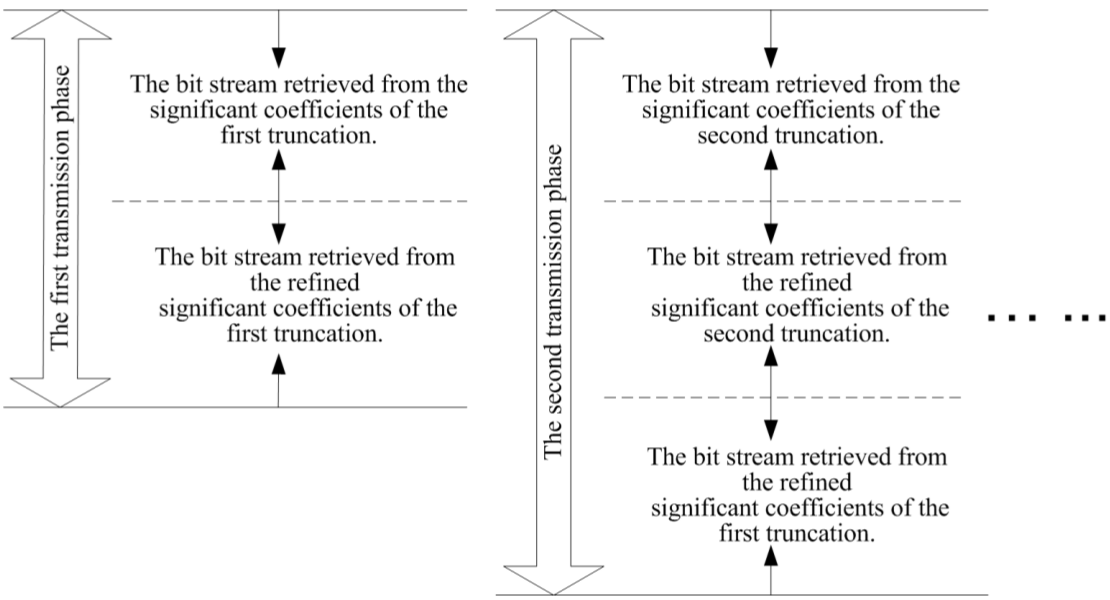

Fig. 3. The distribution of the transmission

$$N = \lfloor \log_2(\max(C_{ij})) \rfloor \qquad (1)$$

We take a block with 8×8 pixels from the image "Toys" for example. As illustrated in Fig. 4, after DWT and SPIHT, we obtain the bit streams composed of 0 and 1 as illustrated in Fig. 5. There are seven truncations and seven transmission phases in this example. SPIHT configure the first bit string as the first transmission, the second bit string as the second transmission, the third bit string as the third transmission, and so on, until all transmissions are completed. When the receiver obtains the bit stream in every phase, she/he must combine it with the previous received bit streams, decompress them and return the "original" DWT. Hence the receiver can see the received image more and more clearly.

93	29	56	-4	5	1	1	-1
0	0	47	1	20	-1	2	-2
21	34	-16	4	21	-16	17	-7
-15	-16	20	2	16	1	15	2
8	72	73	70	-14	0	1	1
0	-1	-4	-3	0	2	-2	-2
0	-2	8	-7	0	1	0	6
6	10	-9	-5	0	10	4	-3

Fig. 4. a 8×8 image block after DWT three times

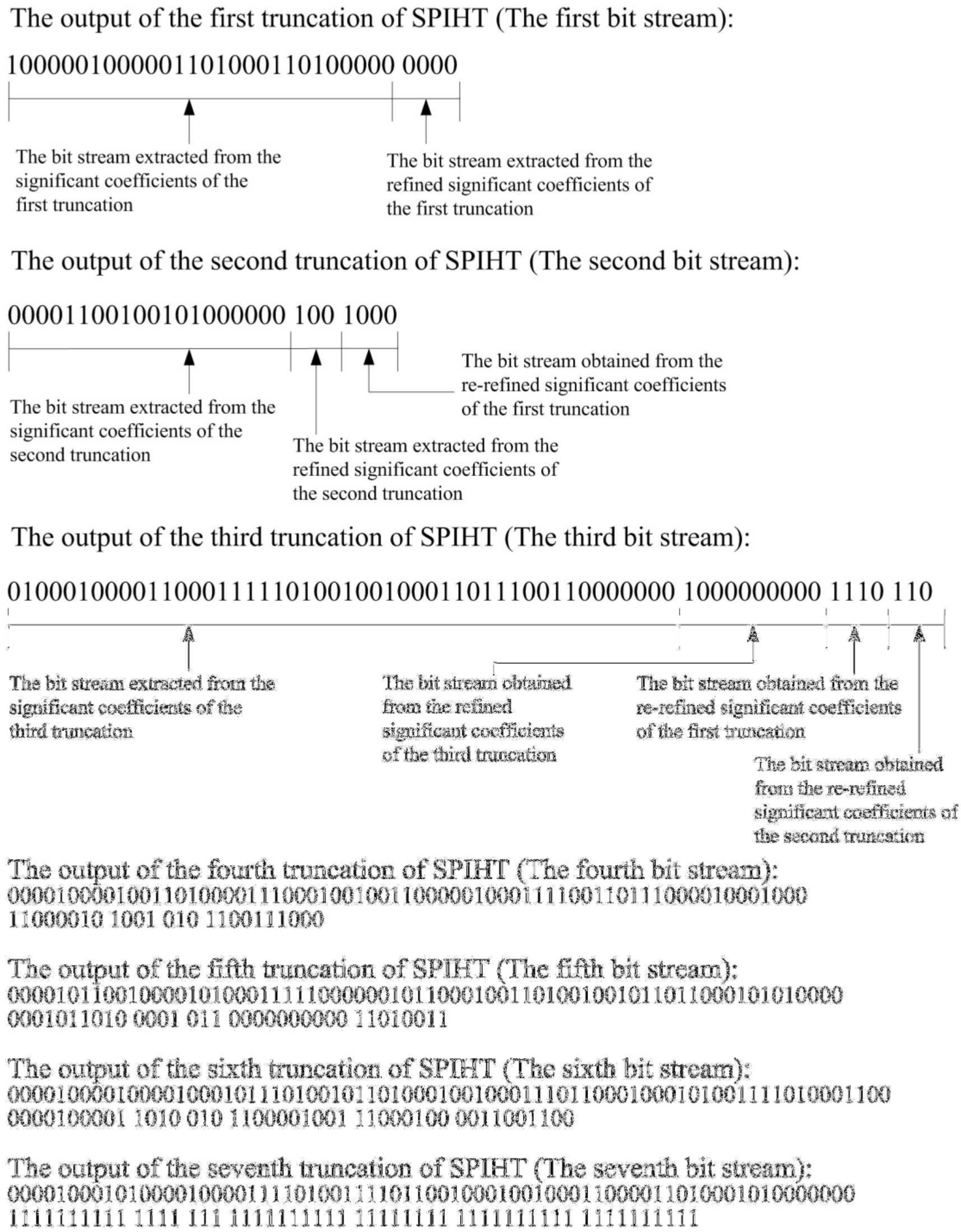

Fig. 5. Output bit streams of SPIHT

With the same amount of the transmission, we propose an improvement for SPIHT in this paper. In order to see the clearer image in the preceding phases of SPIHT, we observe that, according to the experiences, it is worth to transmit part of the significant coefficients of the next phase rather than refining the retrieved coefficients in advance. Thus the proposed method will replace the bit streams derived from the refined significant coefficients with the bit streams generated from the next truncation we illustrate the idea in Fig. 6.

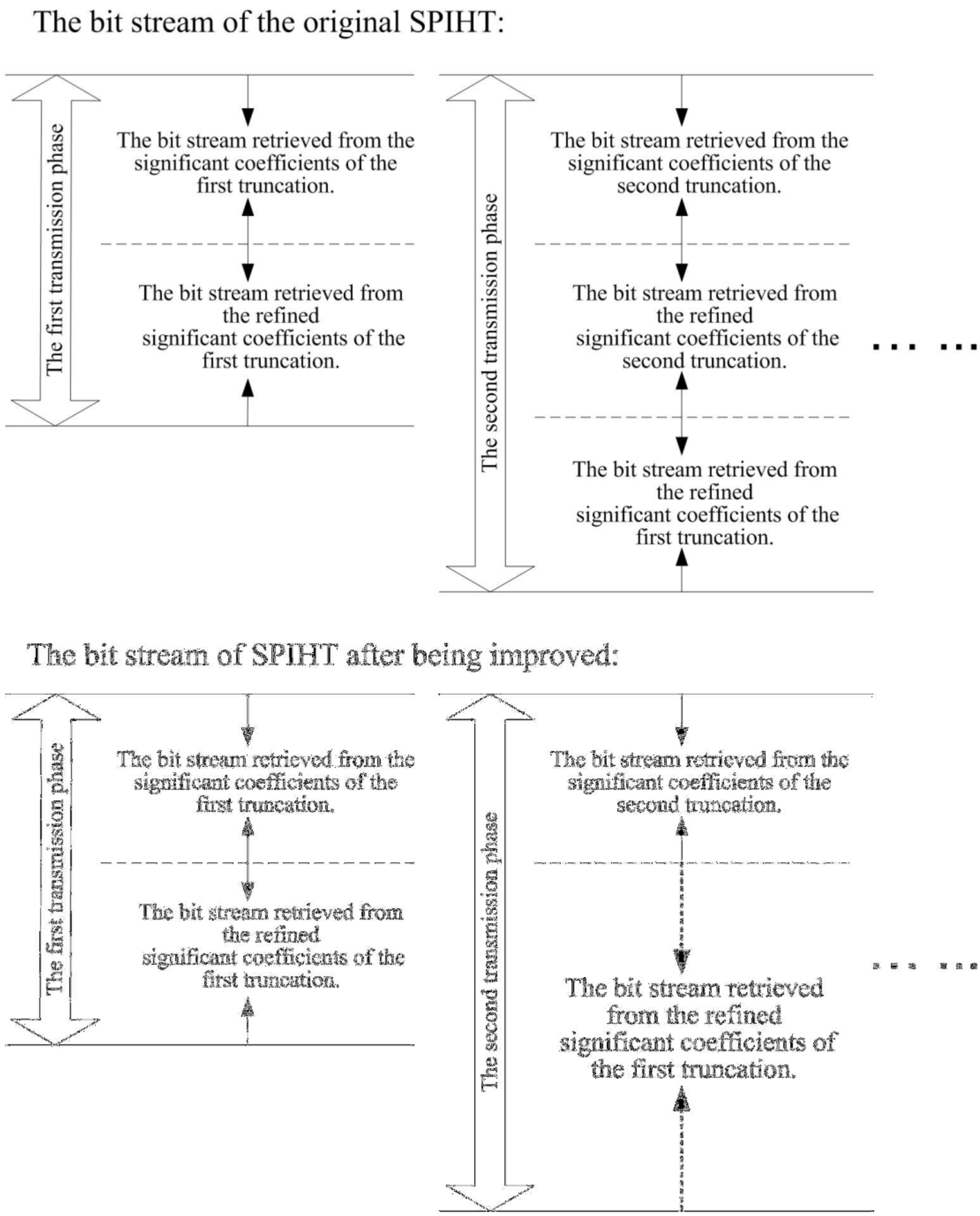

Fig. 6 The first two transmission phases of the proposed method

Let T denote the number of the transmission phase. According to the experiences, when T=1, the significant coefficients must be refined. It means that our method in the first phase is identical with the original SPIHT. When T=2, it is worth to transmit the bit streams generated from the third truncation first. The difference between this method and SPIHT is that we do not transmit the bit streams used for refining and re-refining the coefficients in the second phase. We replace them with the head of the bit stream for extracted significant coefficients in the third phase. Note that the bit length of the head shall be equal to that of the bit streams used for refining in the second phase. When T=3, the rest of the bit stream generated from the third truncation must be transmitted. In this phase, we also do not transmit the bit streams applied to refine and re-refine the significant coefficients in the previous phase. We replace them with the head of the bit stream used to extract the significant coefficients in the fourth phase. When T=4, it is necessary to transmit the rest of the bit stream generated from the fourth truncation first and then transmit the un-transmitted bit streams (i.e., the reefing and re-refining bit streams) in the second, third, and fourth phases. There is a synchronization point for the proposed method and traditional SPIHT when T=4. That is, after four phases, both of the receivers of SPIHT and the proposed method will receive the identical image.

When T=5, the bit stream retrieved from the significant coefficients of the fifth phase will be transmitted. However, according to the experiences, we cannot transmit the bit streams used to refine and re-refine the coefficients in the previous phases. We replace the refined and re-refined bit streams with the head of the bit stream of the next phase. When T=6, we have to transmit the un-transmitted bit streams and, moreover, we need to refine and re-refine the coefficients each previous truncations and transmit the un-transmitted bit streams in the previous phases. There is a synchronization point for the proposed method and traditional SPIHT when T=6. In the last phase, we must transmit all the un-transmitted bit streams to the receiver. When the receiver gets the bit streams, it combines them with the previous bit streams and decompresses the "original" image.

We illustrate the steps of the transmission method in detail as the follows. Let T denote the number of a transmission phase.

I. When T=1, transmit the bit stream of the significant coefficients and refine the coefficients in the first phase.
II. When 2≦T<4, do not refine and re-refine the coefficients in the first, the second, and the third truncations. Replace the refinement and re-refinement with the head of the bit stream generated from the next phase.
III. When T=4, transmit the rest of the bit stream of the significant bits in the fourth phase. Moreover refine and re-refine the previous significant coefficients and transmit al of the bit streams which have not been transmitted in the second, third, and fourth phases.
IV. When T=5, transmit the bit stream of the significant coefficients in the fifth phase. Do not refine and re-refine the coefficients in the first, second, third, fourth, and the fifth truncations. Replace the refined and re-refined significant coefficients with the head of the bit stream generated from the next phase.
V. When T>5, refine and re-refine the coefficients each previous truncation and transmit the bit streams, which have not been transmitted before, like the traditional SPIHT.

We also take the example shown in Fig. 4 to illustrate our method in the transmission phases and show the results in Fig. 7. In the first transmission phase, the amount of the bit stream by our method is identical with the original SPIHT. In the second transmission phase of the original SPIHT, there are seven bits used to refine and re-refine the significant coefficients. We replace them with the first seven bits generated by the significant coefficients of the third truncation and do so in the following phases. This means that the un-transmitted bits in our method are to be replaced by the same amount of the bits from the next truncation.

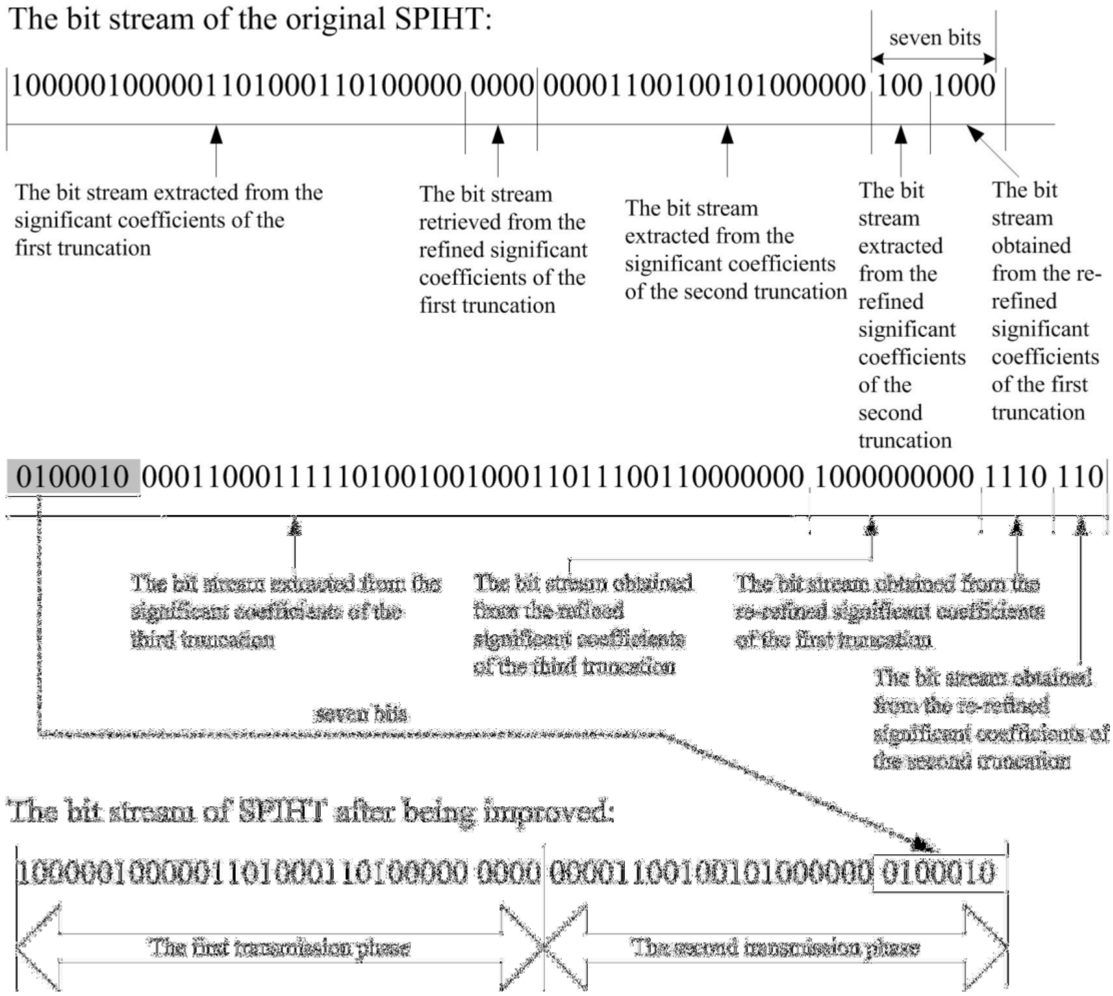

Fig. 7 An example of the bit streams of the first two transmission phases in the proposed method.

四、 討論

Although the Internet is more and more popular, there are many people still using Dial-up Connection. The transmission speed is slow, so we have to use the progressive transmission technique to transmit images. Furthermore, when we are browsing the required images, we can tell if the image is necessary or not in the previous phases by using the proposed method of this paper. If not, we can stop the transmission at once, instead of waiting for the entire transmission of the whole image. The receiver can control when she/he want to stop the transmission. As a result, the progressive image transmission can save us a lot of time to confirm the image and avoid wasting money.

The significant coefficients of the SPIHT based on DWT have been compressed in different phases. In this paper, we modify this feature to the progressive image transmission and get a better solution about PIT. The image quality in the previous phases is not good enough for the receiver; that is, the PSNR values of the reconstructed image in the preceding important phases are not high enough, so we proposed another method in this paper. We reorganize the transmitted bits between phase and phase, and let the important bits be transmitted early. We configure the amount of the bits of each transmission phase as same as that of the original SPIHT. However, the image quality of our method is really better than that of the original SPIHT in that their total sums of transmissions are the same. After the proofs of our experiments, the image quality of the preceding transmission phases of the proposed method is better than that of the original SPIHT, especially in the second, the third, and the fifth phases. To sum up, the users who want to browse the image via Internet can save lots of time and money by using this method.

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