(19) **Europäisches Patentamt**

European Patent Office

Office européen des brevets

(11) **EP 1 703 461 A1**

(12) **EUROPEAN PATENT APPLICATION**

(72) Inventors:
• **Baum, Peter Georg**
30539, Hannover (DE)
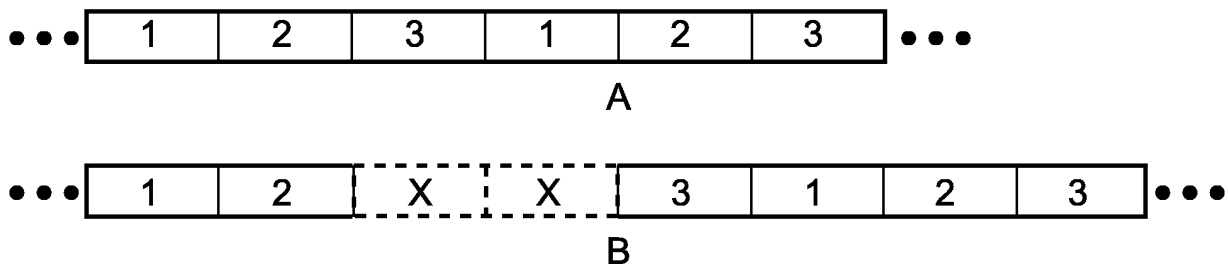• **Voessing, Walter**
30455, Hannover (DE)

(74) Representative: **Hartnack, Wolfgang**
Deutsche Thomson-Brandt GmbH
European Patent Operations
Karl-Wiechert-Allee 74
30625 Hannover (DE)

(54) **Method and apparatus for encoding and decoding symbols carrying payload data for watermarking an audio or video signal**

(57) Watermark information (denoted WM) consists of several symbols which are embedded continuously in an audio or a video signal. At decoder site the WM is regained using correlation of the received signal with an m-sequence if Spread Spectrum is used. In some watermark technology the watermark information is transmitted asynchronously, i.e. it is continuously tested whether or not WM can be embedded imperceptible within the audio or video signals. Only if this is true a WM frame is transmitted. But a WM frame consists of some tens of symbols, each carrying one or more bits which are transmitted synchronously. That means, if the period in which the WM can be embedded is shorter than the frame length, some symbols cannot be recovered at receiver side. According to the invention, each WM symbol carries an ID item in addition to its normal payload, and it is already tested in the encoder whether or not the signal is good enough so that the embedded symbol can be recovered at decoder side. If true, it is embedded. If not true, no WM is embedded for the length of one symbol and the test is repeated for the following symbol. The sequence of IDs is known at the encoder which can therefore detect using the ID whether or not a symbol has been skipped.

Fig.4

Description

[0001]　The invention relates to a method and to an apparatus for encoding symbols carrying payload data for watermarking an audio or video signal, and to a method and to an apparatus for decoding symbols carrying payload data of a watermarked audio or video signal.

Background

[0002]　Watermark information (denoted WM) consists of several symbols which are embedded continuously in the carrier content, e.g. in (encoded) audio or video signals, e.g. in order to identify the author of the signals. At decoder site the WM is regained, for example by using correlation of the received signal with a known m-sequence if spread spectrum is used as underlying technology. In some watermark technology the watermark information is transmitted asynchronously, i.e. it is continuously tested whether or not WM can be embedded imperceptible within the (encoded) audio or video signals. Only if this is true a WM frame is transmitted. But a WM frame consists of some tens of symbols, each carrying one or more bits which are transmitted synchronously. That means, if the period in which the WM can be embedded is shorter than the frame length, some symbols cannot be recovered at receiver side.
Most WM technologies therefore transmit redundancy bits for error correction. But such error correction has a limited capacity only. An error correction can correct some symbols, if one or more symbols cannot be directly recovered at receiver side. But if the capacity of the error correction is exceeded, the WM can not be recovered.

[0003]　Secondly, additional redundancy bits increase the length of the WM frame, which results in a higher probability that the frame is longer than the signal length in which the WM frame can be transmitted. Thirdly, error correction is mostly independent of the signal to be watermarked which results, due to the necessary parity bits, in a lower than necessary net bitrate for a 'good' signal and still not enough error correction for 'bad' signals. A 'good' signal can be recovered at decoder side whereas a 'bad' signal can not be recovered.

[0004]　WO-A-01/06755 shows an energy level-dependent insertion of watermark data.

Invention

[0005]　In known WM systems the signal in which the WM is embedded must be 'good' for a time period that is at least as long as a frame length, with not more 'bad' parts than the error correction can cope with.

[0006]　A problem to be solved by the invention is to provide a watermarking in which the available time periods for transmitting WM are exploited as far as possible, without spending unnecessary additional redundancy bits for error correction purposes. This problem is solved by the methods disclosed in claims 1 and 3. Apparatuses that utilise these methods are disclosed in claims 2 and 4.

[0007]　According to the invention, each WM symbol carries an identification data item (denoted ID) in addition to its normal payload, and it is already tested in the encoder whether or not the signal is 'good' enough so that the embedded symbol can be recovered at receiver or decoder side. If true, it is embedded normally. If not true, no WM is embedded for the length of one symbol and the test is repeated for the following signal and the same symbol. The sequence of IDs is known at the encoder, which can therefore detect using the ID whether or not a symbol has been skipped.

According to the invention, the signal must be 'good' only for a time period that is as long as a symbol length. If not, it is transmitted later when the content is better suited for embedding it. This makes a big difference in signals having many silent periods (i.e. pauses), e.g. speech signals.
The invention makes watermarking of critical sound signals much more robust, which may make the difference between receiving WM and receiving no WM at all. The above tests carried out in the encoder cost more processing power since multiple correlations are to be calculated following empty blocks. But advantageously, for non-critical sound signals, i.e. signals in which no empty blocks are inserted and which result in a clear peak in the correlation with a predetermined data sequence, the inventive processing does not even use more processing power in the decoder.

[0008]　The invention is not limited to using spread spectrum technology. Instead e.g. carrier based technology or echo hiding technology can be used for the watermarking coding and decoding.

[0009]　In principle, the inventive method is suited for encoding symbols carrying payload data for watermarking therewith an audio or video signal, said watermarking using for example spread spectrum modulation whereby said symbols can be recovered by de-spreading and demodulation using correlation with a known data sequence, whereby said symbols can be recovered at decoding side, and whereby at least one of said symbols and at least one synchronisation block are combined to form a current watermark frame, said method including the steps:

　a) encoding said payload data, thereby generating an evolving ID data item for each one of said symbols;
　b) checking at encoder side whether or not a current one of said symbols can be correctly decoded in a corresponding decoder:

if true, arranging said current symbol in said current frame together with said ID data item, and if said current frame has not been processed completely, continuing with step a), or if not true, skipping said current symbol in said current frame by arranging an empty symbol in said current frame that does not include the corresponding one of said ID data items, and if said current frame has not been processed completely, continuing with step a) using the ID data item that was intended for the symbol at the location of said empty symbol;

c) after said current frame has been processed completely, outputting said current frame embedded in said audio or video signal, and continuing the processing with the next frame.

[0010] In principle the inventive apparatus is suited for encoding symbols carrying payload data for watermarking therewith frame-by-frame an audio or video signal, said watermarking using for example spread spectrum modulation whereby said symbols can be recovered by de-spreading and demodulation using correlation with a known data sequence, whereby said symbols can be recovered at decoding side, and whereby at least one of said symbols and at least one synchronisation block are combined to form a current watermark frame, said apparatus including:

- means being adapted for encoding said payload data, thereby generating an evolving ID data item for each one of said symbols;
- means being adapted for checking whether or not a current one of said symbols can be correctly decoded in a corresponding decoder, which means:

  if true, arrange said current symbol in said current frame together with said ID data item, and if said current frame has not been processed completely, continue the processing in said encoding means,
  or if not true, skip said current symbol in said current frame by arranging an empty symbol in said current frame that does not include the corresponding one of said ID data items, and if said current frame has not been processed completely, the processing in said encoding means using the ID data item that was intended for the symbol at the location of said empty symbol;

- means being adapted for outputting, after said current frame has been processed completely, said current frame embedded in said audio or video signal.

[0011] In principle, the inventive method is suited for decoding symbols carrying payload data of a watermarked audio or video signal, said watermarking using for example spread spectrum modulation, whereby at least one of said symbols and at least one synchronisation block were combined to form a current watermark frame, for example by de-spreading and demodulating using correlation with a predetermined data sequence, and whereby said audio or video signal was watermarked by:

a) encoding said payload data, thereby generating an evolving ID data item for each one of said symbols;
b) checking whether or not a current one of said symbols could be correctly decoded in a corresponding decoder:

  if true, said current symbol was arranged in said current frame together with said ID data item, and if said current frame had not been processed completely, the processing was continued with step a),
  or if not true, said current symbol was skipped in said current frame by arranging an empty symbol in said current frame that does not include the corresponding one of said ID data items, and if said current frame had not been processed completely, the processing was continued with step a) using the ID data item that was intended for the symbol at the location of said empty symbol;

c) after said current frame was processed completely, outputting said current frame embedded in said audio or video signal, and continuing the processing with the next frame, and in that said decoding method includes the further step:

- following a decoding processing of a current symbol with a predetermined data sequence that is related to a current one of said ID data items, determining whether or not said decoding processing yields an explicit result:

  if true, providing said processed current symbol of said current frame,
  or if not true, skipping said current symbol in said current frame,

wherein said decoding processing is for example a correlation with a predetermined data sequence.
[0012] In principle the inventive apparatus is suited for decoding symbols carrying payload data of a watermarked audio or video signal, said watermarking using for example spread spectrum modulation, whereby at least one of said

symbols and at least one synchronisation block were combined to form a current watermark frame, and whereby said decoding apparatus includes decoding means being adapted for recovering said symbols, for example by de-spreading and demodulating using correlation with a predetermined data sequence, and wherein said audio or video signal was watermarked by:

a) encoding said payload data, thereby generating an evolving ID data item for each one of said symbols;
b) checking whether or not a current one of said symbols could be correctly decoded in a corresponding decoder:

if true, said current symbol was arranged in said current frame together with said ID data item, and if said current frame had not been processed completely, the processing was continued with step a),
or if not true, said current symbol was skipped in said current frame by arranging an empty symbol in said current frame that does not include the corresponding one of said ID data items, and if said current frame had not been processed completely, the processing was continued with step a) using the ID data item that was intended for the symbol at the location of said empty symbol;

c) after said current frame was processed completely, outputting said current frame embedded in said audio or video signal, and continuing the processing with the next frame, and whereby said decoding apparatus further includes means being adapted for determining, following a decoding processing of a current symbol that is related to a current one of said ID data items, whether or not said decoding processing yields an explicit result which means:

if true, provide said demodulated current symbol of said current frame,
or if not true, skip said current symbol in said current frame,

wherein said decoding processing is for example a correlation with a predetermined data sequence.

[0013]   Advantageous additional embodiments of the invention are disclosed in the respective dependent claims.

Drawings

[0014]   Exemplary embodiments of the invention are described with reference to the accompanying drawings, which show in:

Fig. 1 inventive watermark encoder;
Fig. 2 inventive watermark decoder;
Fig. 3 frame composition;
Fig. 4 frame sequence according to the invention.

Exemplary embodiments

[0015]   The smallest self-containing unit of a watermark is called a frame. Fig. 3 shows three successive frames FR_{n-1}, FR_n and FR_{n+1}. A frame consists of a number of synchronisation blocks SYNBL (at least one synchronisation block) which are needed to detect the start of the frame at decoder side, and a number of payload blocks PLBL (at least one valid payload block or symbol) which carry the actual information. Frames are inserted synchronously or asynchronously in the audio stream, dependent on the technology. The insertion of the payload blocks is done consecutively, i.e. synchronised after the SYNBL blocks. Each payload block holds one or more bits of information. A payload block is therefore also called a symbol. The payload symbols include the information to be inserted into the WM, and optionally contain redundancy information used for error correction. A typical setting is for example 5 synchronisation blocks and 36 payload blocks per frame, each payload block carrying 2 bits, whereby 24 of these 72 bits are used for error correction resulting in a net payload of 48 bits per frame.

[0016]   In the watermarking encoder in Fig. 1 payload data PLD to be used for watermarking an audio signal AS is input to an error correction and/or detection encoding stage ECDE which adds redundancy bits facilitating a recovery from erroneously detected symbols in the decoder. In a downstream modulation and spectrum spreading stage MS an identification data item ID is combined with the signal. The output signal of stage MS is fed to a psycho-acoustical shaping stage PAS which shapes the WS signal such that the WM is not audible or visible, and which feeds its output signal to a signal adder and decision stage SAD and to a decoder stage DEC. The decoder stage DEC implements a decoder according to Fig. 2. Stages PAS and SAD each receive the audio stream signal AS and process the WM frames symbol by symbol. Stage SAD determines whether the payload data PLD have been decoded correctly in decoder DEC for a current WM frame FR_n. If true, the psycho-acoustical shaped WM symbol is added to the current frame. If not true, the current symbol in the current frame FR_n is skipped. Thereafter the processing continues for the next symbol following

the current symbol. After the processing for a WM frame is completed a correspondingly watermarked frame WAS embedded in the audio signal is output. Thereafter the processing continues for the frame FR_{n+1} following the current frame.

[0017] In the watermarking decoder in Fig. 2 a watermarked frame WAS of the audio signal passes through a spectral whitening stage SPW (which reverses the shaping that was done in stage PAS) and a de-spreading and demodulation stage DSPDM (which retrieves the embedded data from the signal WAS) to an ID evaluation and skip stage IDESK. In stage IDESK it is checked whether or not a received symbol or block of a received WM frame has a correct ID, i.e. whether or not the received ID is in a chronological order. If not true, the corresponding WM symbol is skipped. If true, the WM symbol is passed to an error correction and/or detection decoding stage ECDD that outputs the valid payload data PLD.

[0018] The watermark is shaped block wise according to psycho-acoustic principles, i.e. the ratio between watermark and audio energy may change from symbol to symbol. For some signals the possible quality of the embedded watermark is so poor, that it is known already at encoder side that symbols which are embedded in these signals cannot be recovered correctly at decoder side.

[0019] According to the invention for each symbol to be embedded in the audio signal it is decided in the encoder, whether or not it can be recovered correctly in a decoder. If the probability that it can be recovered is high, it is inserted in the audio. If not, no additional WM signal is inserted for a time duration of one symbol length, or an empty symbol representing zeroes only is inserted, and the test is repeated until the signal is suitable for embedding of the next WM item. Each empty symbol inserted increases the frame length by one symbol length, such that each frame carries the same number of payload bits per frame.

[0020] Fig. 4A shows an example in which the depicted part of the signal is suitable for embedding of WM. The symbols are therefore embedded continuously. In Fig. 4B the signal is not suitable for embedding a WM at the third symbol. Therefore no symbol is embedded after symbol two (instead an empty symbol is inserted), and the signal is tested at the next possible insertion point again, but the signal is still not suitable. So, the insertion of a non-empty symbol is postponed again. The next test is successful and symbol three is inserted. This means that the decoder receives symbol one, then symbol two, then two times empty symbols (i.e. a pure audio signal without watermark), then symbol number three.

[0021] The decoder must distinguish between a symbol or block which cannot be recovered due to noise or an attack between emission and reception, and a signal in which no watermark was embedded. This is facilitated by assigning to a symbol an additional ID in the encoder and evaluating it in the decoder. This can be performed by using for example a pre-determined quantity of different maximum-length data sequences in spread spectrum technology, e.g. different m-sequences. In Fig. 4 three different m-sequences are used. All symbols or blocks can be BPSK encoded, i.e. each one carries one bit of information. The first block uses the first m-sequence, the second block the second m-sequence, the third block the third m-sequence, the fourth block again the first m-sequence, and so on. The decoder uses the same m-sequence in the same order. In the example depicted in Fig. 4A, the m-sequences are used in the order 1, 2, 3, 1, 2, 3. In Fig. 4B, as an example, the correlation of the third block with m-sequence three does not show a clear result (i.e. there is no clear magnitude peak in the corresponding correlation result). This means that either the WM symbol has been disturbed or that no WM symbol was embedded. The fourth block is therefore correlated with m-sequences one and three, which in this example both give no clear correlation result. The fifth block is correlated with the m-sequences one, two and three. Only the correlation with sequence three gives a clear peak, which means that the two previous blocks (3rd and 4th block) were empty and did not carry a WM symbol.

Claims

1. Method for encoding symbols (PLBL) carrying payload data (PLD) for watermarking therewith an audio or video signal (AS), whereby said symbols can be recovered at decoding side and whereby at least one of said symbols and at least one synchronisation block are combined to form a current watermark frame (FR_n), **characterised by** the steps:

   a) encoding said payload data (ECDE, MS, PAS), thereby generating an evolving ID data item (ID) for each one of said symbols;
   b) checking at encoder side whether or not a current one of said symbols can be correctly decoded (DEC) in a corresponding decoder:

   if true, arranging said current symbol in said current frame together with said ID data item, and if said current frame has not been processed completely, continuing with step a),
   or if not true, skipping said current symbol in said current frame by arranging an empty symbol in said

current frame that does not include the corresponding one of said ID data items, and if said current frame has not been processed completely, continuing with step a) using the ID data item that was intended for the symbol at the location of said empty symbol;

c) after said current frame has been processed completely, outputting (SAD) said current frame embedded in said audio or video signal (WAS), and continuing the processing with the next frame.

2. Apparatus for encoding symbols (PLBL) carrying payload data (PLD) for watermarking therewith frame-by-frame (FR_{n-1}, FR_n, FR_{n+1}) an audio or video signal (AS), whereby said symbols can be recovered in a decoder and whereby at least one of said symbols and at least one synchronisation block are combined to form a current watermark frame (FR_n), said apparatus including:

- means (ECDE, MS, PAS) being adapted for encoding said payload data, thereby generating an evolving ID data item (ID) for each one of said symbols;
- means (DEC) being adapted for checking whether or not a current one of said symbols can be correctly decoded in a corresponding decoder, which means:

if true, arrange said current symbol in said current frame together with said ID data item, and if said current frame has not been processed completely, continue the processing in said encoding means,
or if not true, skip said current symbol in said current frame by arranging an empty symbol in said current frame that does not include the corresponding one of said ID data items, and if said current frame has not been processed completely, the processing in said encoding means using the ID data item that was intended for the symbol at the location of said empty symbol;

- means (SAD) being adapted for outputting, after said current frame has been processed completely, said current frame embedded in said audio or video signal (WAS).

3. Method for decoding symbols (PLBL) carrying payload data (PLD) of a watermarked audio or video signal (AS), whereby at least one of said symbols and at least one synchronisation block were combined to form a current watermark frame (FR_n), **characterised in that** said audio or video signal was watermarked by:

a) encoding said payload data (ECDE, MS, PAS), thereby generating an evolving ID data item (ID) for each one of said symbols;
b) checking whether or not a current one of said symbols could be correctly decoded (DEC) in a corresponding decoder:
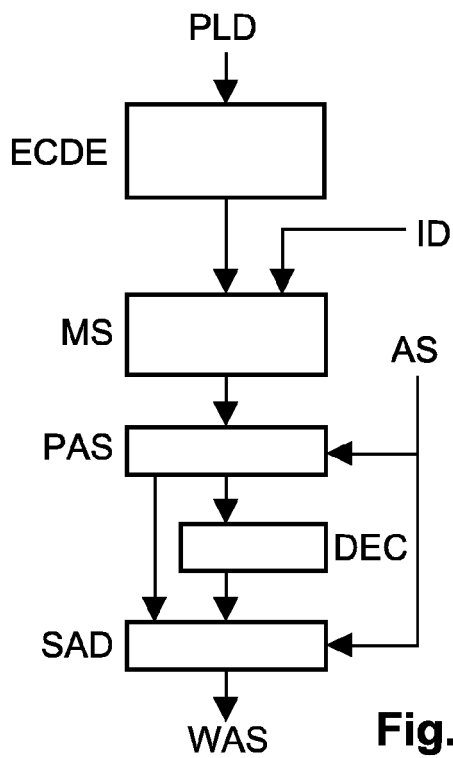
if true, said current symbol was arranged in said current frame together with said ID data item, and if said current frame had not been processed completely, the processing was continued with step a),
or if not true, said current symbol was skipped in said current frame by arranging an empty symbol in said current frame that does not include the corresponding one of said ID data items, and if said current frame had not been processed completely, the processing was continued with step a) using the ID data item that was intended for the symbol at the location of said empty symbol;

- after said current frame was processed completely, outputting (SAD) said current frame embedded in said audio or video signal (WAS), and continuing the processing with the next frame,

and **in that** said decoding method includes the further step:

- following a decoding processing of a current symbol that is related to a current one of said ID data items, determining (IDESK) whether or not said decoding processing yields an explicit result:
if true, providing said processed current symbol of said current frame,
or if not true, skipping said current symbol in said current frame,

wherein said decoding processing is for example a correlation with a predetermined data sequence.

4. Apparatus for decoding symbols (PLBL) carrying payload data (PLD) of a watermarked audio or video signal (AS), whereby at least one of said symbols and at least one synchronisation block were combined to form a current watermark frame (FR_n), and whereby said decoding apparatus includes decoding means (SPW, DSPDM) being

adapted for recovering said symbols, **characterised in that** said audio or video signal was watermarked by:

a) encoding said payload data (ECDE, MS, PAS), thereby generating an evolving ID data item (ID) for each one of said symbols;
b) checking whether or not a current one of said symbols could be correctly decoded (DEC) in a corresponding decoder:

if true, said current symbol was arranged in said current frame together with said ID data item, and if said current frame had not been processed completely, the processing was continued with step a),
or if not true, said current symbol was skipped in said current frame by arranging an empty symbol in said current frame that does not include the corresponding one of said ID data items, and if said current frame had not been processed completely, the processing was continued with step a) using the ID data item that was intended for the symbol at the location of said empty symbol;

c) after said current frame was processed completely, outputting (SAD) said current frame embedded in said audio or video signal (WAS), and continuing the processing with the next frame,
and **in that** said decoding apparatus further includes means (IDESK) being adapted for determining, following a decoding processing of a current symbol that is related to a current one of said ID data items, whether or not said decoding processing yields an explicit result which means:
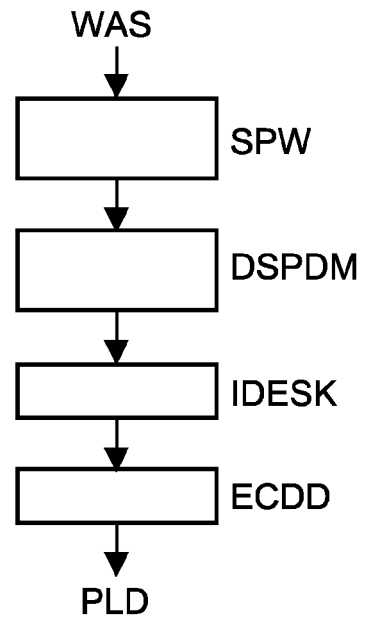
if true, provide said processed current symbol of said current frame,
or if not true, skip said current symbol in said current frame,

wherein said decoding processing is for example a correlation with a predetermined data sequence.
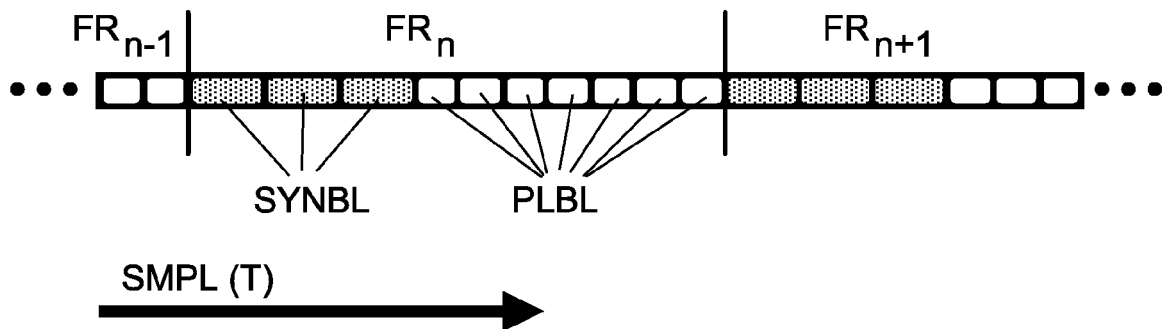
5. Method according to claim 1, or apparatus according to claim 2, wherein said encoding of said payload data (PLD) is a modulation and spreading (MS) and wherein on said payload data an error correction and/or detection encoding (ECDE) is carried out before said modulation and spreading.

6. Method according to claim 1 or 5, or apparatus according to claim 2 or 5, wherein said encoding of said payload data (PLD) is a modulation and spreading (MS) and wherein the output signal of said modulation and spreading is psycho-acoustically shaped (PAS) before said checking (DEC, SAD) is carried out.

7. Method according to claim 3, or apparatus according to claim 4, wherein following said checking and complete processing of said current frame (FR_n) an error correction and/or detection decoding (ECDD) is carried out on said payload data.

8. Method according to claim 3 or 7, or apparatus according to claim 4 or 7, wherein said decoding is a de-spreading and demodulation of said symbols, using correlation with a known data sequence, and wherein before said de-spreading and demodulation a spectral whitening (SPW) is carried out on said watermarked audio or video signal (WAS) .

9. Method or apparatus according to one of claims 1 to 8, wherein each empty symbol inserted in said current frame (FR_n) increases the length of said current frame by one symbol length, such that each frame carries the same number of payload bits per frame.

10. Method or apparatus according to one of claims 1 to 9, wherein said evolving ID data item (ID) is represented by different maximum-length data sequences and said correlation is carried out using said different maximum-length data sequences, for example a pre-determined quantity of different m-sequences, wherein said m-sequences can be BPSK encoded and each one carries one bit of information.
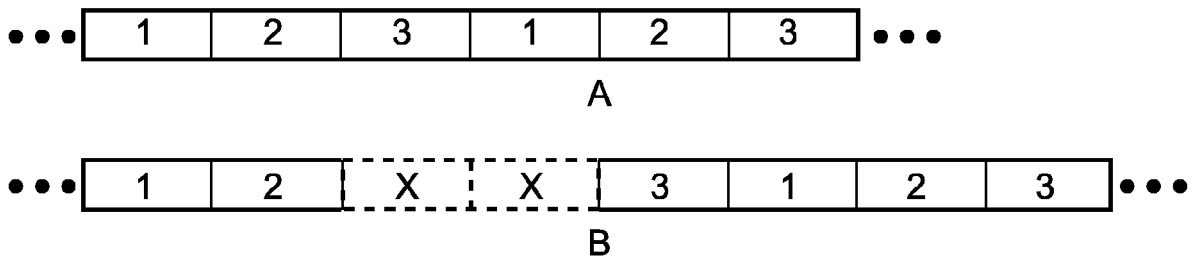
Fig.1

Fig.2

Fig.3

Fig.4

European Patent Office

EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	LOBOGUERRERO A ET AL: "Iterative informed audio data hiding scheme using optimal filter" COMMUNICATION TECHNOLOGY PROCEEDINGS, 2003. ICCT 2003. INTERNATIONAL CONFERENCE ON APRIL 9 - 11, 2003, PISCATAWAY, NJ, USA,IEEE, vol. 2, 9 April 2003 (2003-04-09), pages 1408-1411, XP010644113 ISBN: 7-5635-0686-1 * page 1408, right-hand column, last paragraph * * section II-B, lines 1-18 * * figure 2 * * page 1410, left-hand column, last paragraph *	1-10	INV. G06T1/00
A	EP 1 220 152 A (SONY UNITED KINGDOM LIMITED) 3 July 2002 (2002-07-03) * paragraph [0030] - paragraph [0040] * * figure 1 *	1-10	
A	EP 0 913 952 A (AUDIOTRACK WATERMARK SOLUTIONS CORPORATION) 6 May 1999 (1999-05-06) * figure 1 * * paragraphs [0032], [0033], [0077] *	1-10	**TECHNICAL FIELDS SEARCHED (IPC)** G06T H04N G10L
A	EP 1 306 802 A (RICOH COMPANY LTD) 2 May 2003 (2003-05-02) * paragraph [0051] - paragraph [0053] * * figure 2 *	1-10	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	9 June 2006	dos Santos, L

2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 06 30 0165

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	YING-FEN HSIA ET AL: "Multiple-description coding for robust image watermarking" ICIP '04. INTERNATIONAL CONFERENCE ON SINGAPORE, PISCATAWAY, NJ, USA,IEEE, 24 October 2004 (2004-10-24), - 27 October 2004 (2004-10-27) pages 2163-2166, XP010786211 ISBN: 0-7803-8554-3 * Section 1, first paragraph * * Section 2 * -----	7	

TECHNICAL FIELDS
SEARCHED   (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	9 June 2006	dos Santos, L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another
    document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or
    after the filing date
D : document cited in the application
L : document cited for other reasons

....

& : member of the same patent family, corresponding
    document

2

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**   EP 06 30 0165

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-06-2006

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 1220152	A	03-07-2002	JP	2002271612 A	20-09-2002
			US	2002106105 A1	08-08-2002
EP 0913952	A	06-05-1999	AU	3549299 A	23-10-2000
			WO	0060747 A1	12-10-2000
			US	5945932 A	31-08-1999
EP 1306802	A	02-05-2003	JP	2003204429 A	18-07-2003
			US	2003133591 A1	17-07-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- WO 0106755 A **[0004]**