EXPOSING THE DOUBLE COMPRESSION IN MP3 AUDIO BY FREQUENCY VIBRATION

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Motivation

MP3 Double compression detection

MP3 is one of the most commonly used format. Many methods have been proposed to detect MP3 double compression, but they are limited in two ways:

1.Many methods have a limited performance in detecting a **down-transcoded** issue.

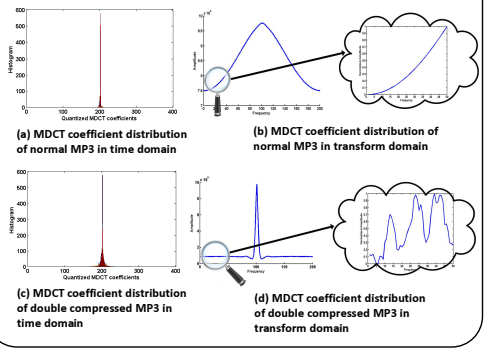
2.Many methods based statistical features are limited in application as their **high computation complexity**.

Main Idea

By introducing **FVV** (frequency vibration value) to measure the changes caused by MP3 double compression, we can

1.Solve up-transcode much better, but also has higher accuracy in down-transcode.

2.Reduce the computational complexity with only one-dimensional feature



(a) MDCT coefficient distribution of normal MP3 in time domain

(b) MDCT coefficient distribution of normal MP3 in transform domain

(c) MDCT coefficient distribution of double compressed MP3 in time domain

(d) MDCT coefficient distribution of double compressed MP3 in transform domain

Approach

Analysis of double MP3 compression

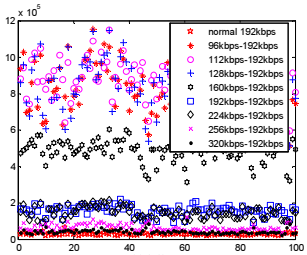
- It is difficult to tell whether the MDCT distribution obey Laplace for a normal MP3 audio.
- If we look into the **transform** domain, the normal MP3 audio has a smooth side lobe, while a double compressed MP3 has apparent vibration.

Calculation of frequency vibration value

- **We Define:**

$$T = \int y dx - \int y' dx \approx \sum_{i=1}^{m} |Y(i) - Y'(i)|$$

- **Where** y is the MDCT coefficient in frequency domain, y' is a fitting line. $Y'(i)$ and $Y(i)$ are the discrete form of y and y'.

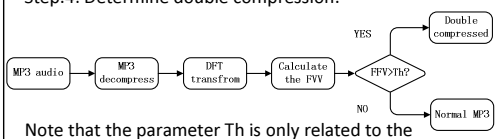


Comparison of the proposed feature FVV

The figure above the effect of FVV. The feature of normal MP3 are all near to zero, whereas double compressed are all lager than zero.

algorithm pipeline

Step.1: Decompress the MP3 audio file to get the quantized MDCT coefficients;
Step.2: Transform it by DFT;
Step.3: Calculate the FVV;
Step.4: Determine double compression.



Note that the parameter Th is only related to the property of normal and double compressed MP3 files. Its value can be predetermined through experiment with any fixed first bitrate and second bitrate.

Results

Detection accuracy of double compression

Table 1 Detection accuracy of our method

BR2 vs BR1	64	96	128	160	192
64	100	77.7	58.3	53	53
96	100	100	77.7	74	95
128	100	100	100	100	99
160	100	100	100	100	100
192	100	100	100	100	100

Table 2 Detection accuracy of [7]

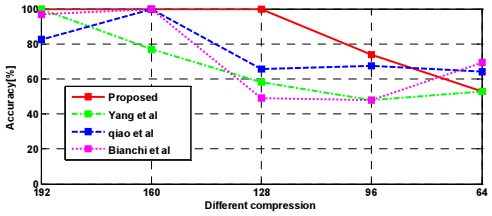
BR2 vs BR1	64	96	128	160	192
64	100	49.9	49.9	53	54
96	99.9	100	49.9	48.1	53
128	100	100	100	58	57.8
160	100	99.8	100	77	67.4
192	99.3	100	100	100	100

Table 3 Detection accuracy of [5]

BR2 vs BR1	64	96	128	160	192
64	100	53.4	64.9	64.1	59.1
96	70.9	100	63.7	67.6	64.9
128	96.7	93.2	100	65.6	70
160	98.6	99.3	93	100	75
192	99.4	99.4	95.5	82.5	100

Table 4 Detection accuracy of [10]

BR2 vs BR1	64	96	128	160	192
64	100	49.9	49.9	69.5	56.1
96	100	100	49.9	47.9	66.4
128	100	100	100	49.1	57.8
160	100	100	100	100	67.4
192	100	100	100	96.7	100



Detection accuracy of different method with BR1=160Kbps

As we can see above, all of the four methods get worse with the BR2 declining. But our method still achieves the better performance. Besides, the proposed work with only one-dimensional feature.

Reveal the Real Bit-Rate

E vs R	64	96	128	160	192
64	99.6	0	0	0	0
96	0.4	95.8	1.4	0	0
128	0	3.2	90.8	3.5	4.4
160	0	1.0	8.8	95.5	10.6
192	0	0	0	1.0	85.0

The estimate result shows that the proposed method could reveal the real bit-rate of double compressed MP3.

References

[5] Qiao M, Sung A H, Liu Q. Improved detection of MP3 double compression using content-independent features [C]. In ICSPCC, 2013.

[7] Yang R, Shi Y Q, Huang J. Detecting double compression of audio signal [C]. International Society for Optics and Photonics, 2010.

[10] Bianchi T, De Rosa A, Fontani M, et al. Detection and classification of double compressed MP3 audio tracks [C]. Proceedings of the first ACM workshop on Information hiding and multimedia security, 2013.