STEGANALYSIS OF AAC USING CALIBRATED MARKOV MODEL OF ADJACENT CODEBOOK

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PROBLEM

AAC (Advanced Audio Coding) is the most popular audio compression standard and used widely in recent years.

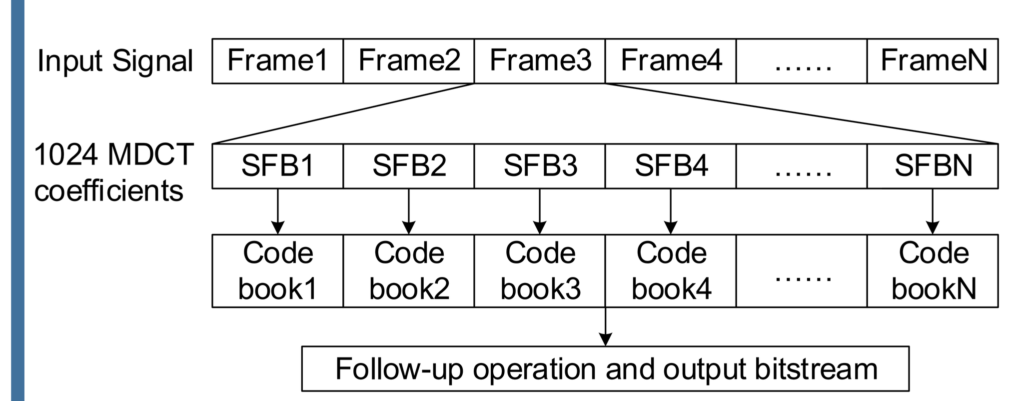
1. The steganography schemes of AAC emerge gradually.
2. The AAC steganography about Huffman codebook have large capacity and good imperceptivity.
3. Steganalysis which against Huffman coding for AAC and MP3 remain unexplored.

OUR CONTRIBUTION

We proposed a novel steganalysis method to detect AAC steganography of Huffman codebook. This is the first piece of work on detecting on AAC Huffman steganography.

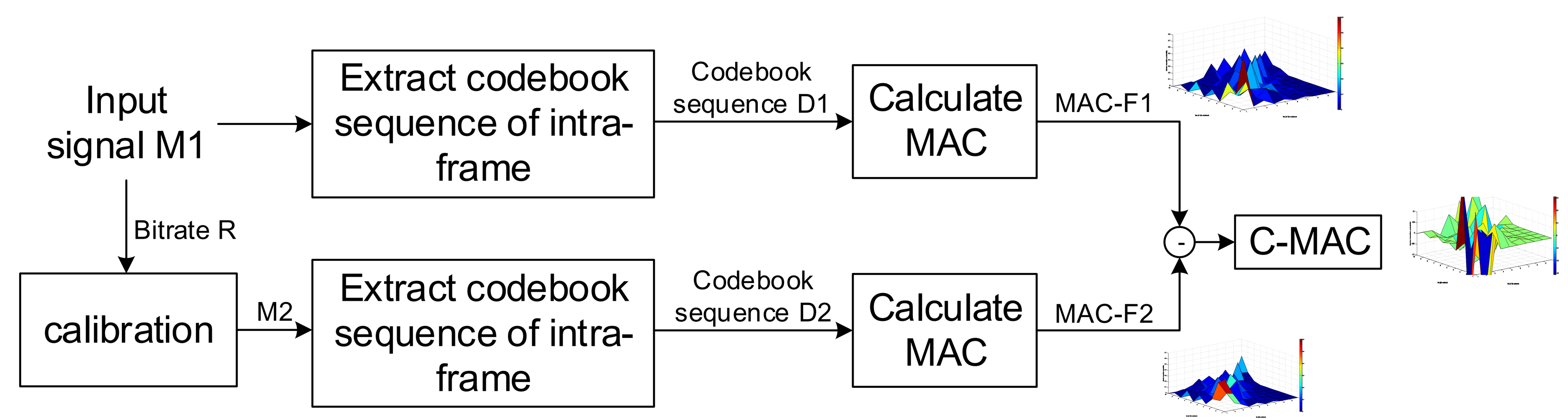
The modification of AAC Huffman codebook can cause significant diversity between cover and stego. Via the analysis and experiments, we find C-MAC feature is useful and effective to attack the steganography of Huffman codebook.

PROCESS OF AAC HUFFMAN CODEBOOK



Literature[1,2] modify the codebook of each SFB to embed secret message, which disturb the correlations between adjacent codebook of SFBs.

OUR METHOD



FEATURE ANALYSIS

Due to short-range dependence of audio, in cover audios, the codebook of adjacent SFB should be strongly related. For stego audios, due to the randomness of secret message, the continuity and correlation will be weakened.

We use Markov transition probability matrix of adjacent codebook feature (MAC) to measure the continuity and correlation between adjacent SFB's codebook.

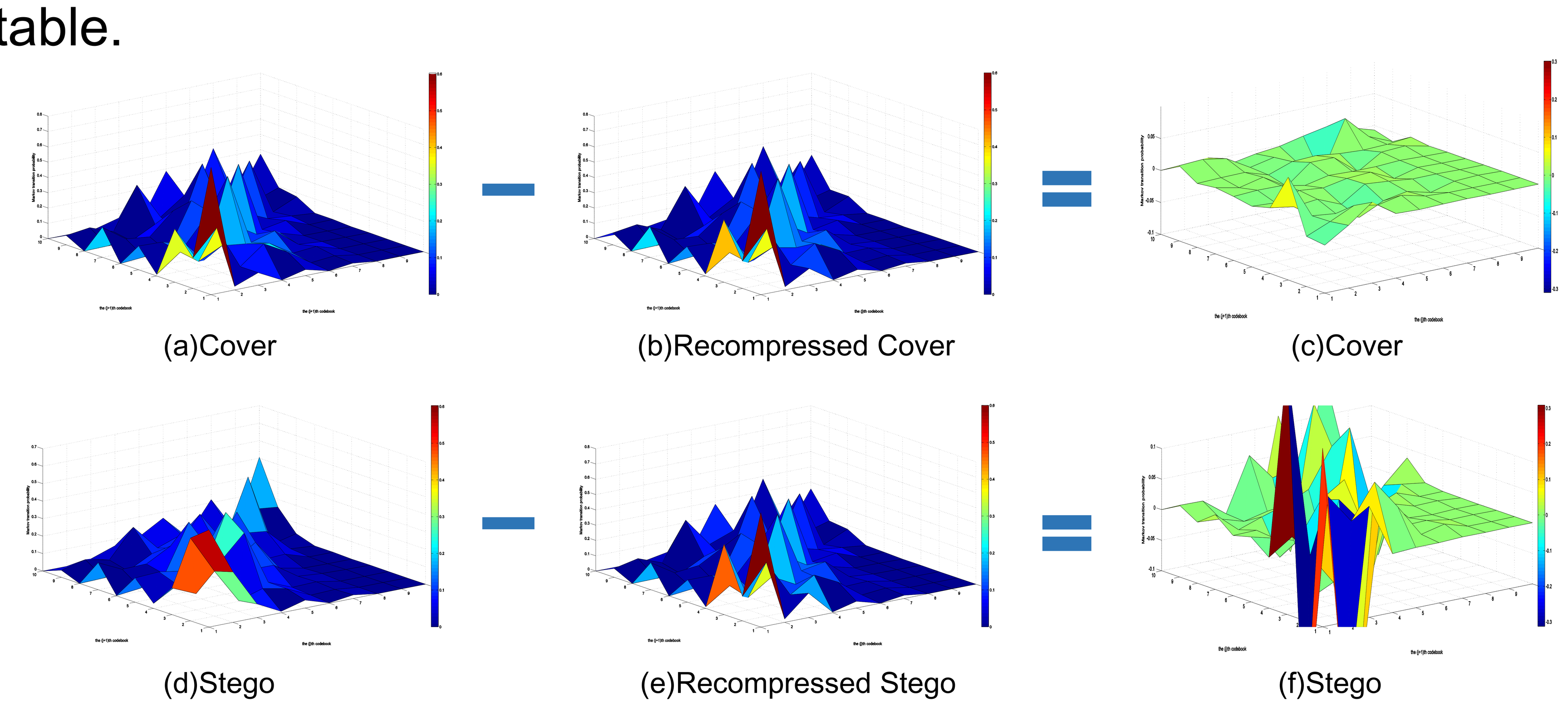
$$Pr_{\alpha/\beta} = \frac{\Pr(c_{j+1} = \alpha, c_j = \beta)}{\Pr(c_j = \beta)}, \quad (1)$$

$$(\alpha, \beta \in [1,10])$$

$$A = \begin{pmatrix} e_{1,1} & e_{1,2} & \cdots & e_{1,10} \\ e_{2,1} & e_{2,2} & \cdots & e_{2,10} \\ \vdots & \vdots & \ddots & \vdots \\ e_{10,1} & e_{10,2} & \cdots & e_{10,10} \end{pmatrix} \quad (2)$$

Each SFB's codebooks are denoted by S={c_1,…,c_j,...,c_N}. The feature of MAC can be calculated by (1), and we can get a 10*10 Markov feature Matrix as (2).

Recompression is adopted for recovering the correlation of adjacent SFB's codebook to the cover's to make our feature more sensitive and stable.



MAC feature C-MAC feature

EXPERIMENT RESULT

Table 1 The performance of MAC feature

Bitrate	Stenography	TPR 30%	TPR 50%	TPR 80%	TPR 100%	TNR Cover
64kb/s	Zhu[1]	87.63%	90.54%	94.13%	95.12%	88.33%
	Tang[2]	85.67%	89.67%	93.99%	94.67%	
96kb/s	Zhu[1]	90.42%	93.28%	94.34%	95.71%	90.87%
	Tang[2]	89.92%	90.67%	92.54%	94.27%	
128kb/s	Zhu[1]	92.67%	93.67%	95.03%	96.31%	92.93%
	Tang[2]	91.40%	92.99%	93.93%	94.67%	
152kb/s	Zhu[1]	92.99%	94.63%	95.03%	96.33%	92.33%
	Tang[2]	91.71%	92.99%	93.93%	95.71%	

Table 2 The performance of C-MAC feature with FAAC

Bitrate	Stenography	TPR 30%	TPR 50%	TPR 80%	TPR 100%	TNR Cover
64kb/s	Zhu[1]	96.28%	99.13%	98.93%	100%	97.33%
	Tang[2]	99.13%	99.33%	100%	100%	
96kb/s	Zhu[1]	98.67%	99.33%	99.93%	100%	99.87%
	Tang[2]	99.13%	99.67%	99.93%	100%	
128kb/s	Zhu[1]	99.13%	99.67%	100%	100%	100%
	Tang[2]	99.33%	99.93%	100%	100%	
152kb/s	Zhu[1]	99.54%	100%	100%	100%	100%
	Tang[2]	99.67%	99.93%	100%	100%	

The performance of C-MAC feature is better than MAC feature obviously, which means C-MAC feature is more efficient to detect cover and stego.

Table 3 The performance of C-MAC feature with Nero

Bitrate	Stenography	TPR 30%	TPR 50%	TPR 80%	TPR 100%	TNR Cover
64kb/s	Zhu[1]	96.54%	99.13%	98.13%	100%	99.33%
	Tang[2]	98.28%	99.33%	100%	100%	
96kb/s	Zhu[1]	99.13%	99.98%	99.93%	100%	99.87%
	Tang[2]	99.33%	100%	100%	100%	
128kb/s	Zhu[1]	99.33%	100%	100%	100%	100%
	Tang[2]	99.67%	100%	100%	100%	
152kb/s	Zhu[1]	99.93%	100%	100%	100%	100%
	Tang[2]	99.93%	100%	100%	100%	

Nero encoder is adopted as the recompressed encoder to analysis the influence of different encoder to calibration. It shows that C-MAC feature is robust to different encoders.

PREFERENCE

[1] Jie Zhu, Rang-Ding Wang, Juan Li, and Di-Qun Yan,"A huffman coding section-based steganography for aac audio",2011.

[2] Bu Tian Tang, Li Guo, and Zhen Hua Liu, "An information hiding method in advanced audio coding(aac)",2008.

CONCLUSION

We proposed a novel steganalysis method to detect AAC steganography of Huffman codebook. Experiment results show that the performance of our proposed method is perfect. Due to the similarity between MP3 and AAC, the proposed method can be applied to MP3. In the future, semi-supervised or non-supervision classification method will be adopted to practice it.