



A short story about five steganalysts

Jan Kodovský, May 18, IH 2011

Background

- Steganalysts A, B, C, D, E
- Target algorithm:
 - Rongyue Zhang, Vasiliy Sachnev, and Hyoung Joong Kim, *Fast BCH Syndrome Coding for Steganography*, IH 2009.
 - Side-informed embedding, output in JPEG format
 - http://multimedia.korea.ac.kr/home/?mid=src_stegano
- Steganalysis approach:
 - Experimental evaluation of security
 - Feature-based supervised binary classification
 - For simplicity: fixed relative payload 0.10 bpac
 - Results in terms of error rate, median over 10 runs

Results

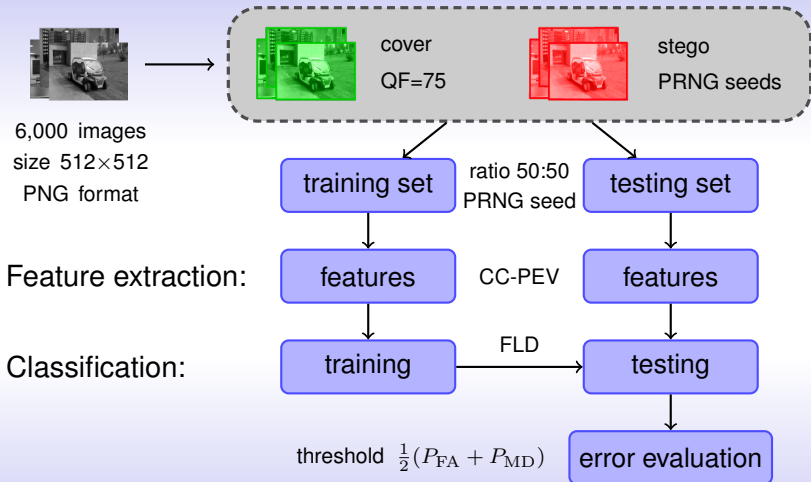
- Steganalyst A – error rate **44.0%**
- Steganalyst B – error rate **42.5%**
- Steganalyst C – error rate **39.8%**
- Steganalyst D – error rate **29.2%**
- Steganalyst E – error rate **2.6%** ← clearly the best steganalyst

Results

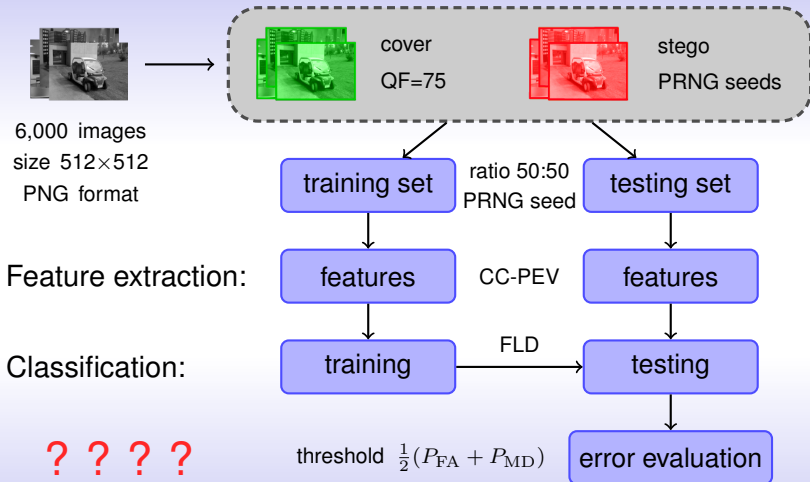
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But... the story continues.

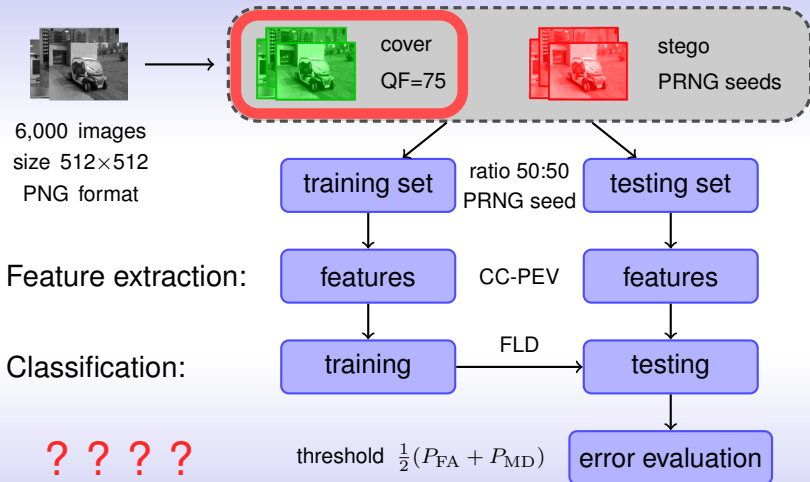
Common elements



Common elements



Common elements



Different JPEG compressors!

- Steganalyst A **44.0%** → Matlab – fft command (C library `fftw`)
- Steganalyst B **42.5%** → BatchPNGtoJPG (free SW for Windows OS)
- Steganalyst C **39.8%** → ImageMagick – convert (free command-line tool)
- Steganalyst D **29.2%** → Matlab – imwrite command (C library `wjpg8c`)
- Steganalyst E **2.6%** → XnView – fast option (free image process. tool)

Detecting JPEG compressors

	A	B	C	D	E	
Matlab (fft)	A	×	46.9%	43.4%	32.6%	2.8%
BatchPNGtoJPG	B		×	45.9%	32.8%	2.9%
convert	C			×	32.4%	3.0%
Matlab (imwrite)	D				×	2.9%
XnView	E					×

- CC-PEV features, FLD classifier, median over 10 runs.
- Matlab: A and D differ in 1.2% nnz DCT coefficients \approx nsF5 at 0.10 bpac.
Always holds: $\text{abs}(\text{imwrite}) \geq \text{abs}(\text{fft})$
- Note: imwrite seems to use a popular JPEG compressor (C library `wjjpg8c`), it is also used in IrfanView, XnView (slow option), Phil Sallee's Matlab JPEG Toolbox.

Final thoughts / questions

- What other algorithms may exhibit similar issues? ... MME
- What we are detecting doesn't have to be what we *think* we are detecting.
- Features for blind steganalysis are powerful to detect various statistical discrepancies. What can we use them for?
- Should blind steganalysis be used in practice? Wouldn't FA rate be too large?
- To what extent does the steganalyst need to have access to the cover source?