Cover-source Mismatch in Deep Spatial Steganalysis

IWDW
2019
Outlines

1. Motivation
2. Research
3. J-Net
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2. Research
3. J-Net
1. Motivation

- Cover-source Mismatch

Training set  Testing set
Conventional Steganalysis

- Input images
- HPF
- Quantification & truncation
- Symbiotic graph & histogram
- Features

Sharp performance declining

Deep Steganalysis

- Input images
- Convolution
- Nonlinear activation
- Pooling
- Features

Rare discussions
Outlines

1 Motivation

2 Research

3 J-Net
2. Research

- **1st Step**

  Whether there is cover-source mismatch in deep steganalysis?

  - **BOSSBase** Common steganalysis dataset
  - **ImageNet** Good samples from real world scenario
  - **MIRFlickr**
2.1 Data processing

- **BossBase**
  - Select 10000 images randomly
  - Resize to $512 \times 512$
  - mini-l

- **ImageNet**
  - Select 10000 images randomly
  - Resize to $512 \times 512$
  - mini-l

- **MIRFlickr**
  - Select 10000 images randomly
  - Resize to $512 \times 512$
  - mini-M
2.1 Texture complexity

Information loss: RAW->JPEG > RAW->PGM

BOSSBase is more textured than mini-I & mini-M.
2.2 Deep steganalysis model

\[
\min_f \frac{2}{n_s} \sum_{i=1}^{n_s} (J(f(x_i), y_i))
\]
### Experimental Results

<table>
<thead>
<tr>
<th></th>
<th>BOSSBase</th>
<th>mini-M</th>
<th>mini-I</th>
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</thead>
<tbody>
<tr>
<td><strong>train:BOSSBase</strong></td>
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<tr>
<td>suni-0.4</td>
<td>81.3</td>
<td>79.9</td>
<td>87.25</td>
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<tr>
<td>wow-0.4</td>
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<td>wow-0.4</td>
<td>53.825</td>
<td>97.875</td>
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Sharp accuracy decreasing by Cover-source mismatch!
2.3 A-distance

A linear form of binary classifier error

\[ \hat{d}_A = 2(1 - 2 \times \text{error}) \]

measure the discrepancy between 2 databases in the latent space
### 2.3 A-distance

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Match the experimental results well.
3.1 Domain adaptation

Transfer the model trained on labeled source database to unlabeled target database without sharp accuracy reduction

Cover-source mismatch in steganalysis

\[ D_L(P, Q) \triangleq \|L_{Z,1:|L|}(P) - L_{Z^t,1:|L|}(Q)\|_{\otimes_{l=1}^{L} H^t}^2 \]

Measure and restrict the discrepancy between source and target domain in reproducing kernel Hilbert space
3.2 J-Net

\[
\min_f \frac{2}{n_s} \sum_{i=1}^{n_s} (J(f(x_i^s), y_i^s)) + \lambda \hat{D}_L(P, Q)
\]
Deep steganalysis model

\[
\min_f \frac{2}{n_s} \sum_{i=1}^{n_s} (J(f(x_i), y_i))
\]
3.2 J-Net

\[
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### 3.3 Results

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7%-10%!
THANK YOU!

Presented by Xunpeng Zhang