Large-Scale Historical Watermark Recognition: dataset and a new consistency-based approach

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1. École des Ponts ParisTech  2. École Nationale des Chartes  3. Valeo AI
Watermark?

Looking through old paper
Watermark?

Mold for paper fabrication

Looking through old paper
Watermark?

Looking through old paper

Mold for paper fabrication

Watermark Catalog
Contributions

• A large public dataset

• Consistency based local matching score

• Weakly supervised feature fine-tuning
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Classification dataset

100 classes: 50 images / class for training and 10 images / class for validation.
One-shot dataset

100 other classes with 3 images per class: 1 reference without any text + 2 cluttered query photographs
Cross-domain dataset

- **140** training classes with **1** drawing as reference + **1-7** query photographs.
- **100** testing classes with **1** drawing as reference + **2** query photographs.
Our contribution

• A large public dataset

• Consistency based local matching score

• Weakly supervised feature fine-tuning
Global feature matching

Cosine similarity between global pooled features

ResNet-18 trained on classification dataset
## Performances

<table>
<thead>
<tr>
<th>Dataset, Ref.</th>
<th>One-shot Real</th>
<th>Cross-domain Drawing</th>
<th>Cross-domain Synthetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref.</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
</tr>
<tr>
<td>Global (Average Pool)</td>
<td>69%</td>
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Local feature matching (Conv4)
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Local feature matching (Conv4)
Local matching score

\[ S(I_1, I_2) = \sum_{i \in I} \left( e^{-\frac{||x_1^i - x_2^i||^2}{2\sigma^2}} \right) \left( \cos(f_1^i, f_2^i) \right) \]

Spatial Consistency

Feature Similarity
Local matching score

See paper for comparisons to few-shot methods

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Contributions

• A large public dataset

• Consistency based local matching score

• Weakly supervised feature fine-tuning
Local matching-based domain adaptation

\[ \mathcal{L}(\theta) = \frac{1}{N} \sum_{n_1, n_2 \in \mathcal{N}} \max(1 - \lambda, \cos(f_\theta(n_1), f_\theta(n_2))) - \frac{1}{\mathcal{P}} \sum_{p_1, p_2 \in \mathcal{P}} \min(\lambda, \cos(f_\theta(p_1), f_\theta(p_2))) \]

Negative Pairs:
- Different classes

Positive Pairs:
- Same class
- Similar location
# Fine-tuning results

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<td>72%</td>
</tr>
<tr>
<td>Fine-tuning + Local matching (Ours)</td>
<td>75 %</td>
<td>83 %</td>
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Qualitative results

Query

Local (conv 4)

1\textsuperscript{st} Match 2\textsuperscript{nd} Match 3\textsuperscript{rd} Match 4\textsuperscript{th} Match 5\textsuperscript{th} Match

Local Matching

Local Matching + F.T.
Summary

• Dataset and a consistency based approach for historical watermark recognition


• Web application: [https://filigranes.inria.fr/](https://filigranes.inria.fr/)

A Web Application for Watermark Recognition
2020 Journal of Data Mining & Digital Humanities
Oumayma Bounou, Tom Monnier, Ilaria Pastrolin, Xi Shen, Christine Benevent, Marie-Françoise Limon-Bonnet, François Bougard, Mathieu Aubry, Marc Smith, Olivier Poncet, Pierre-Guillaume Raverdy