City Scale Image Geolocalization via Dense Scene Alignment

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Contribution

- A coarse-to-fine strategy for the city-scale image geolocalization problem that scales up well for very large datasets.

Introduction

- We focus on solving the city-scale scene geolocalization problem: Given an image, identify the exact location it was taken.
- Challenges:
  - occlusions, illumination, seasonal and structural changes,
  - scalability issues when dealing with large data.

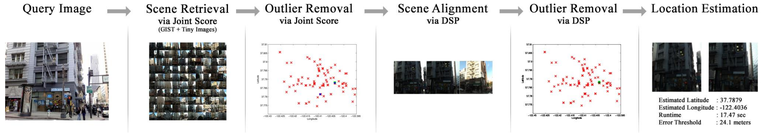
Scene Matching. *Sample query image (left) and a set of matched geo-tagged images (right).*

Aim

- Our motivation is to solve this difficult problem in a city-scale setting.
- We develop a fast and robust scene matching method that follows a coarse-to-fine strategy by employing a data-driven approach.

Method

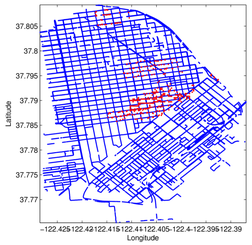
- We use local and global image cues.
- We define the similarity between the query and a related set of geotagged images at different levels of granularity.



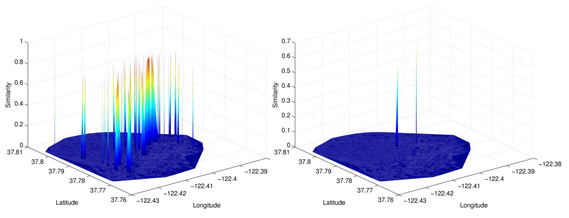
System Overview.

Our method consists of three different stages:.

- **Scene retrieval**
  - In terms of scene context, find a set of images that are visually similar to the query.
  - Remove the outliers with the worst matching scores.
- **Scene alignment**
  - Refine the initial set of images by densely aligning them with the query image.
  - Remove the remaining outliers with the worst alignment scores.
- **Geolocation prediction**
  - Predict the geolocation of the query image by using the locations of the remaining scenes.

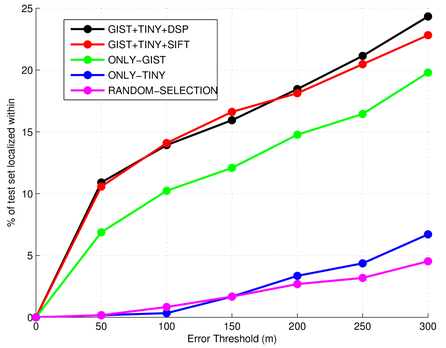


Database locations. *Reference dataset (blue dots) and query set (red dots)*



Similarities*. Joint similarity scores of the initial retrieval list (left) and the matching scores after outlier removal (right).*

Experimental Results



Recall Accuracy.

Scene Retrieval.

- 1.06M dataset images, 596 query images provided by Chen et al. (2011)
- 24% of query set is geolocalized within 300 m.
- 11 times better than chance.
- All instances of query set geolocalized within 3.9 km.
- Our suggested scheme (GIST + TINY + DSP) outperforms other schemes in recall rates for 300 m. threshold.
- Runtime, 160 sec. on average (cf. SIFT-based baseline 135 sec.)

Conclusions

- Our method combines global image descriptors with a dense scene alignment strategy.
- Proposed method successfully geolocalizes challenging query scenes taken in urban areas.
- As the dataset size increases, the overall quality increases.