

PROBLEM

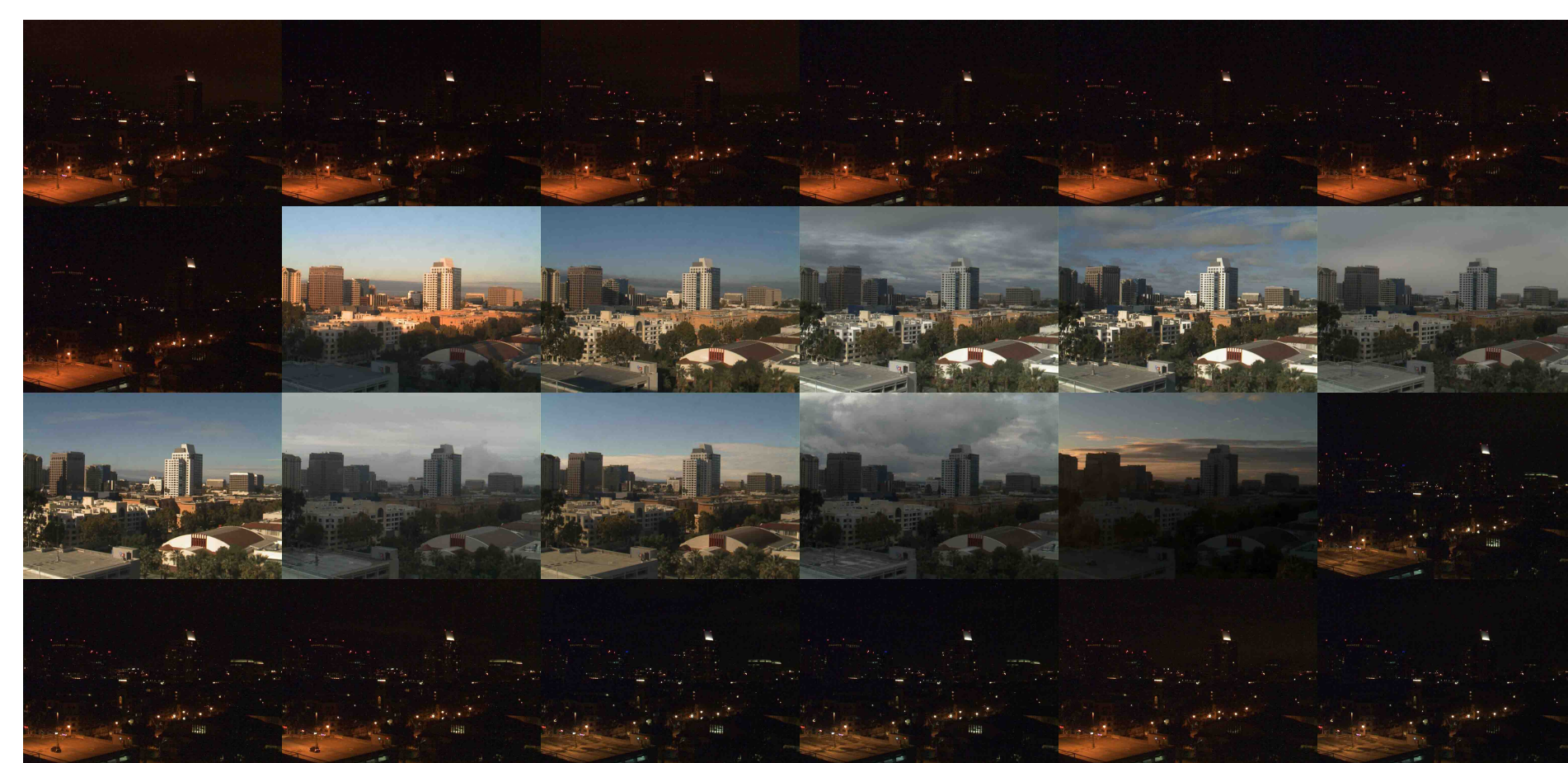
Day-night image matching is important (e.g. for large-scale localization and place recognition).

Current performance is far from satisfactory.

This work evaluated local features under day-night illumination changes to answer:

1. How seriously are detectors affected by day-night illumination changes?
2. Is repeatability the main challenge of day-night matching?
3. Is there room to improve day-night matching?

DATASET



The data we used are:

- (1) Collected from AMOS dataset [1].
- (2) Taken by a fixed webcam.
- (3) Taken at different times of the day.
- (4) Available at <http://www.umiacs.umd.edu/~hzhou/dnim.html>.

EVALUATION

Feature detectors used:

1. DoG, Hessian, HessianLaplace, MultiscaleHessian, HarrisLaplace, MultiscaleHarris from vlfeat.
2. TILDE [2] and its extended version: MultiscaleTILDE, TILDE4 and MultiscaleTILDE4.

Feature descriptors used: RootSIFT

Evaluation methods:

Repeatability: for feature detectors.

Precision and recall: for feature detectors + descriptors.

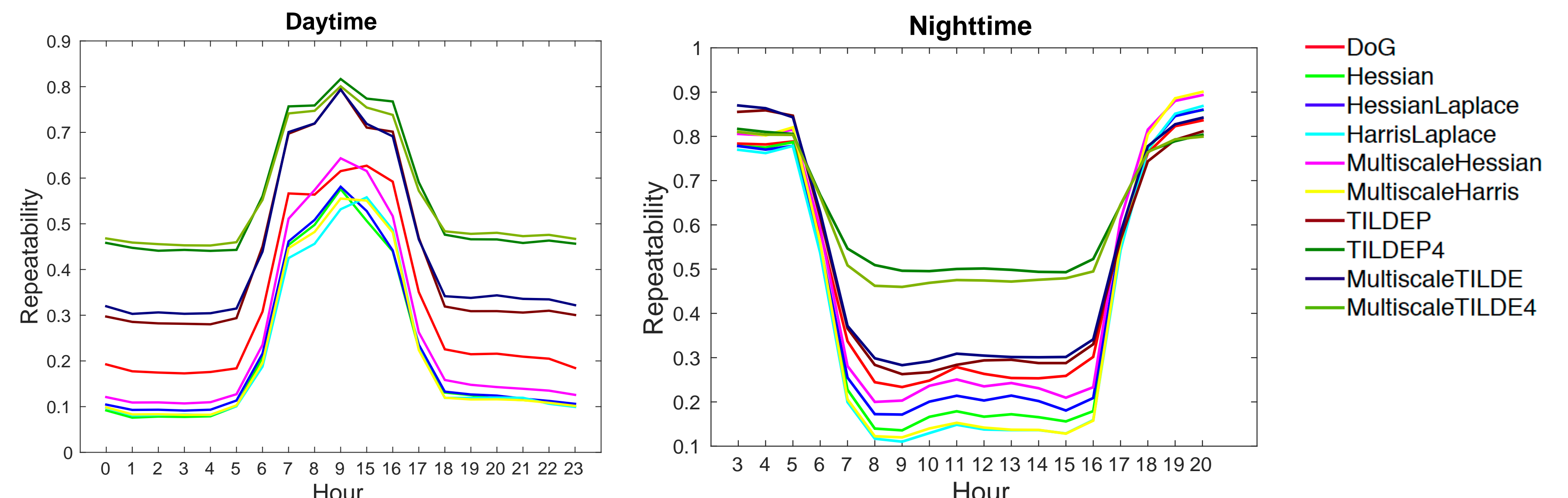
REFERENCES

- [1] N. Jacobs, N. Roman and R. Pless. Consistent Temporal Variations in Many Outdoor Scenes. In *CVPR '07*
- [2] Y. Verdie, K.M. Yi, P. Fua and V. Lepetit. TILDE: A Temporally Invariant Learned DETector. In *CVPR '15*
- [3] K. Mikolajczyk, T. Tuytelaars, C. Schmid, A. Zisserman, J. Matas, F. Schaffalitzky, T. Kadir and L.V. Gool. A Comparison of Affine Region Detectors. *IJCV '05*

REPEATABILITY OF DETECTORS

Question: how seriously are detectors affected by day-night illumination changes?

Method: select time periods to get “ground truth” feature points and compute repeatability of points w.r.t. different times.



Left: repeatability of different feature detectors w.r.t. daytime ground truth.

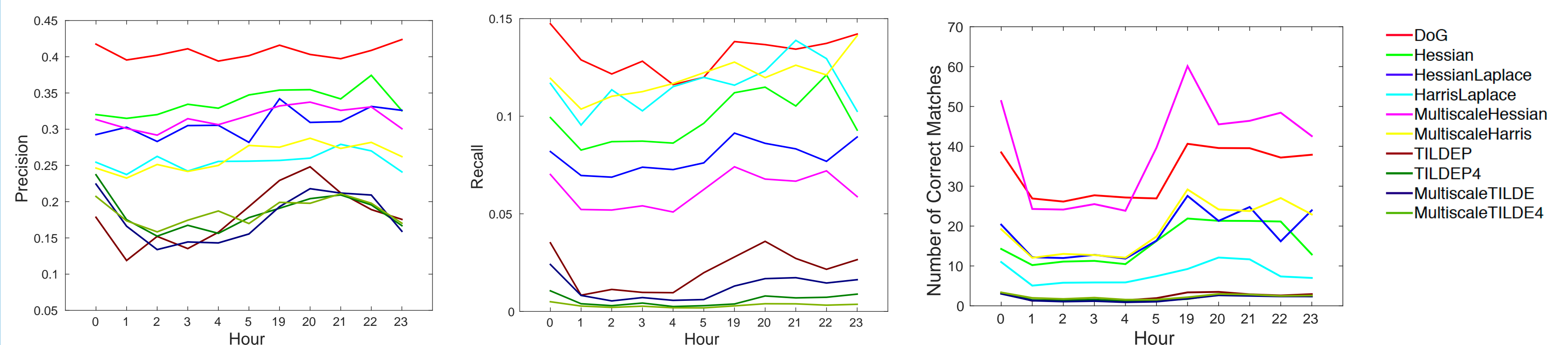
Right: repeatability of different feature detectors w.r.t. nighttime ground truth.

Detectors are affected by day-night illumination changes to a large extent.

PRECISION AND RECALL

Question: is repeatability the main challenge of day-night matching?

Method: compute precision $\frac{N_c}{N_f}$ and recall $\frac{N_c}{N}$ for every day-night image pair.



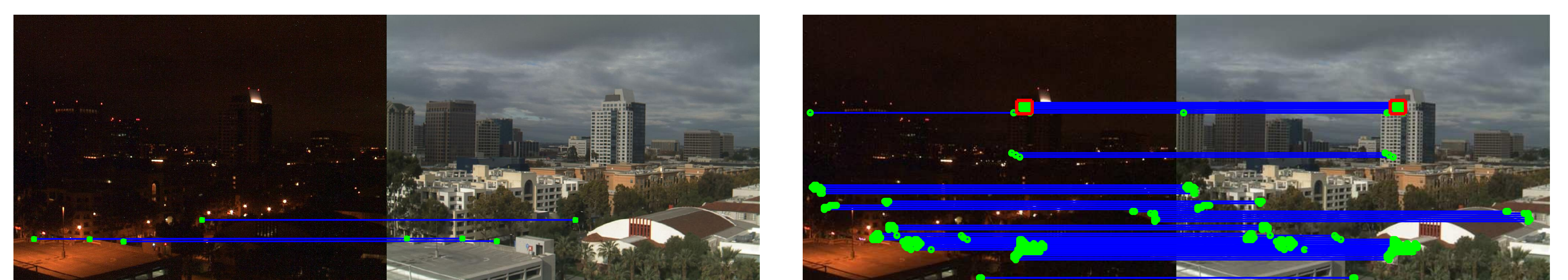
Left: precision. Middle: recall. Right: number of correctly matched features.

High repeatability of detector \neq good performance (e.g. TILDE).

ROOM FOR IMPROVEMENT IN DETECTORS

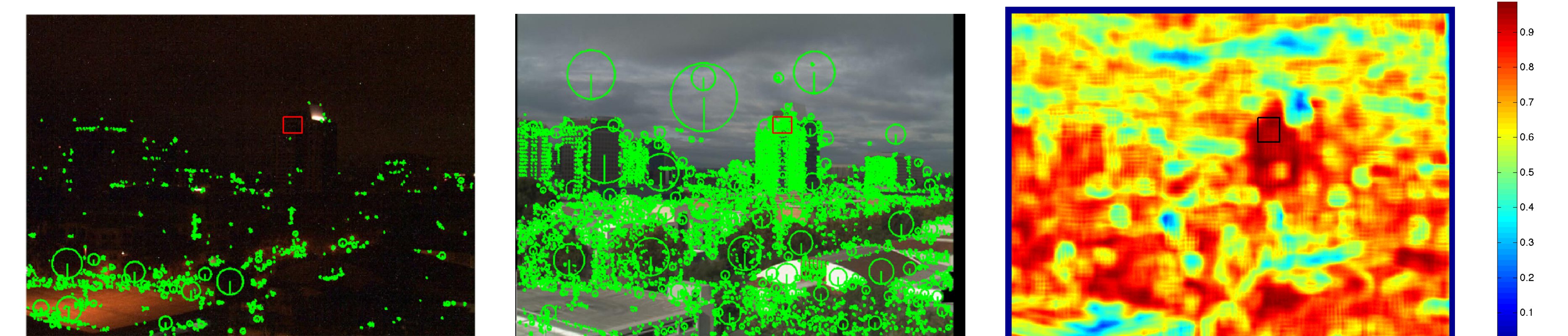
Question: is there potential to improve detectors?

Method: extracting dense RootSIFT for matching.



Left: correct matches found by DoG + RootSIFT.

Right: correct matches found by dense RootSIFT.



Left and center: features detected by DoG. Right: heat map of cosine distance for RootSIFT.

There is great potential for improving detectors for night images.

POTENTIAL OF DESCRIPTORS

Question: is there potential to improve descriptors?

Low recall means a lot of detected features cannot be matched by descriptors, meaning **there is still potential to improve descriptors.**

CONCLUSION

1. Feature detectors are severely affected by day night illumination changes.
2. Repeatability is not enough for evaluating feature detectors.
3. There is great potential for improving both detectors and descriptors.