

Deep Learning for Electron Microscopy Image Stitching

Petr Šilling, xsilli01@stud.fit.vutbr.cz

Supervisor: Ing. Michal Španěl, Ph.D.

Consultant: Ing. Oldřich Kodým, Ph.D., TESCAN 3DIM s.r.o.

Motivation

- Grids of overlapping EM images need to be stitched together
- Current methods tend to use SIFT
- Issues with low-texture regions
- Could CNNs increase robustness?

SIFT: 85 matches

LoFTR: 624 matches

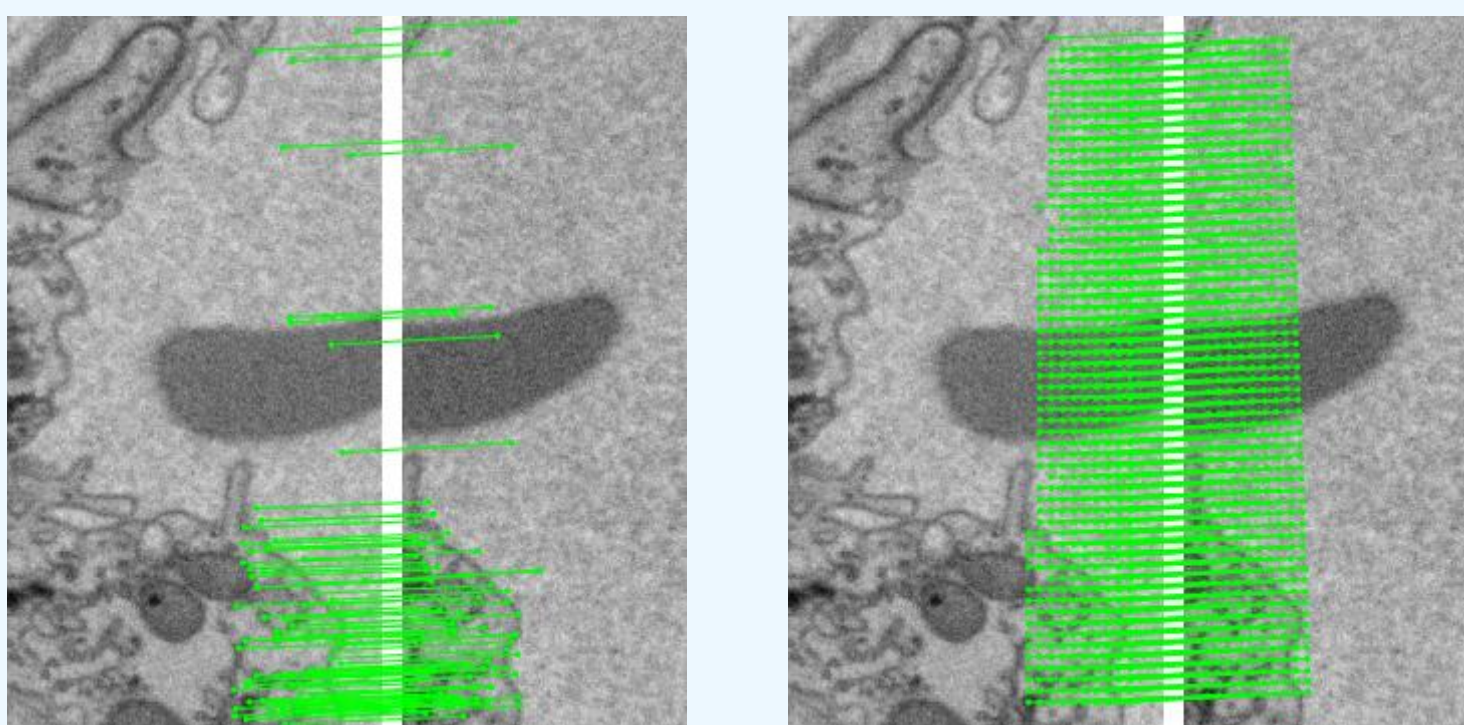


Figure 1

Proposed Solution – DEMIS

- Standard feature-based stitching pipeline with SLAM global optimisation and feature matching by LoFTR.

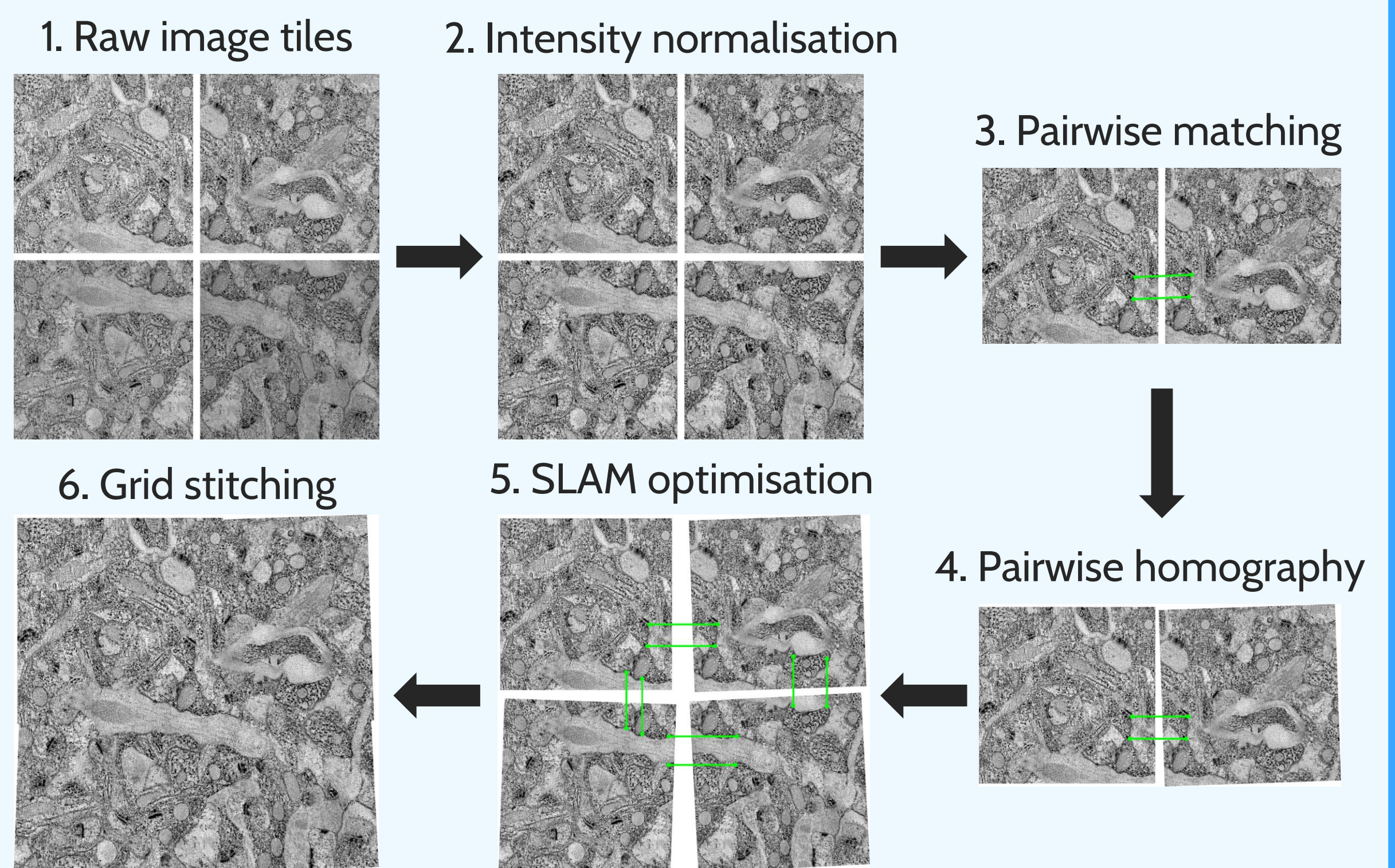


Figure 3

Synthetic Dataset

- 424 images from EMPIAR and CIL split into grids of image tiles
- Random brightness, contrast, translation, rotation, and Gaussian noise applied to each tile

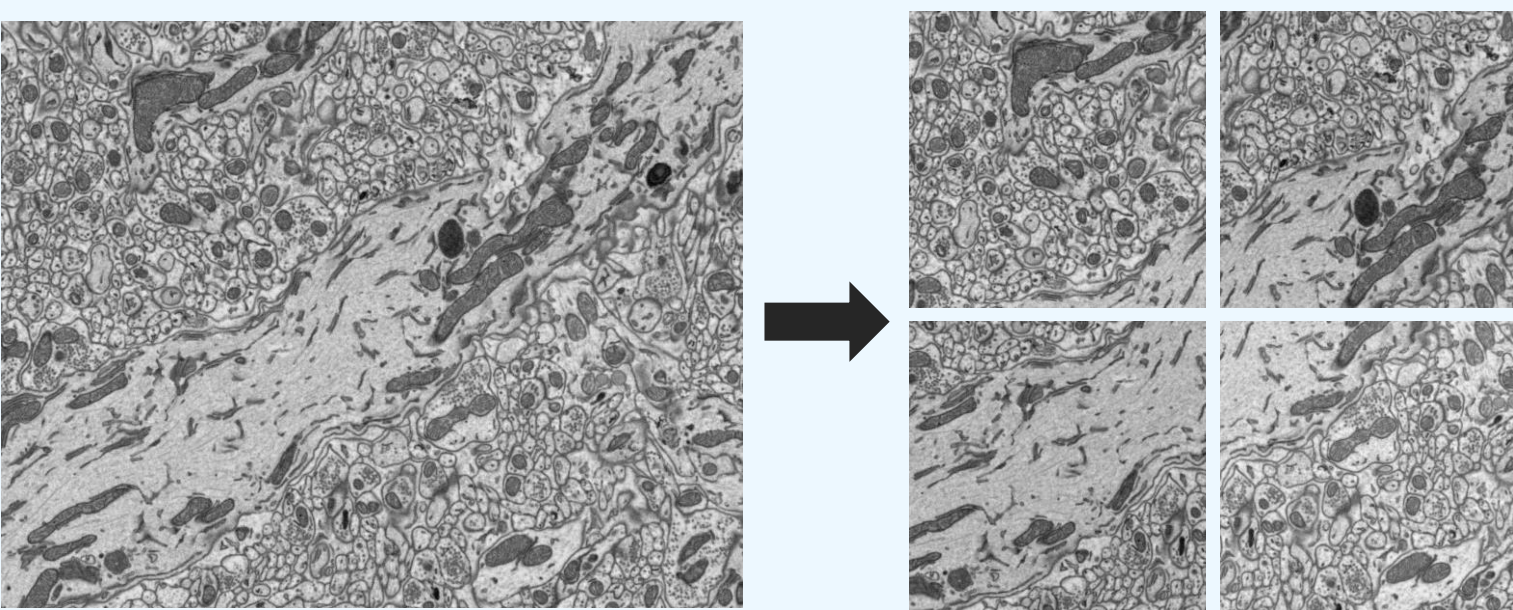


Figure 2

Local Feature Transformer (LoFTR)

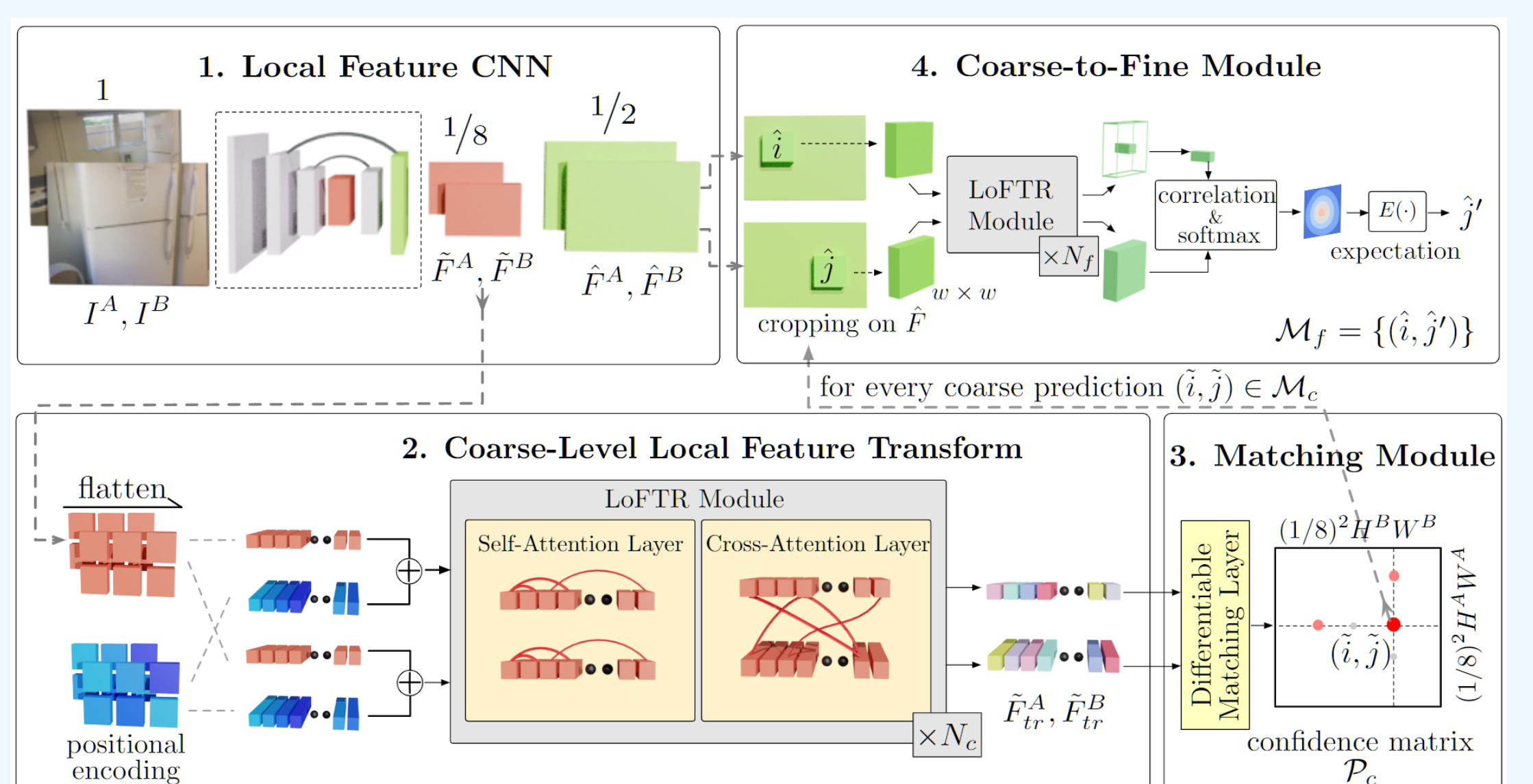


Figure 4

Results on Evaluation Images

Metric (on 1306 image tiles)	Baseline (SIFT)	DEMIS (LoFTR)
Mean matches found	652	770
Mean reprojection error	4.58 px	2.93 px
Homography est. corner error AUC at 5 px	42.68%	40.95%
PSNR	17.14	17.16
SSIM	0.31	0.30
FSIM	0.91	0.91
BRISQUE	36.32	36.33

Table 1

SIFT: 240 mts.

LoFTR: 1773 mts.

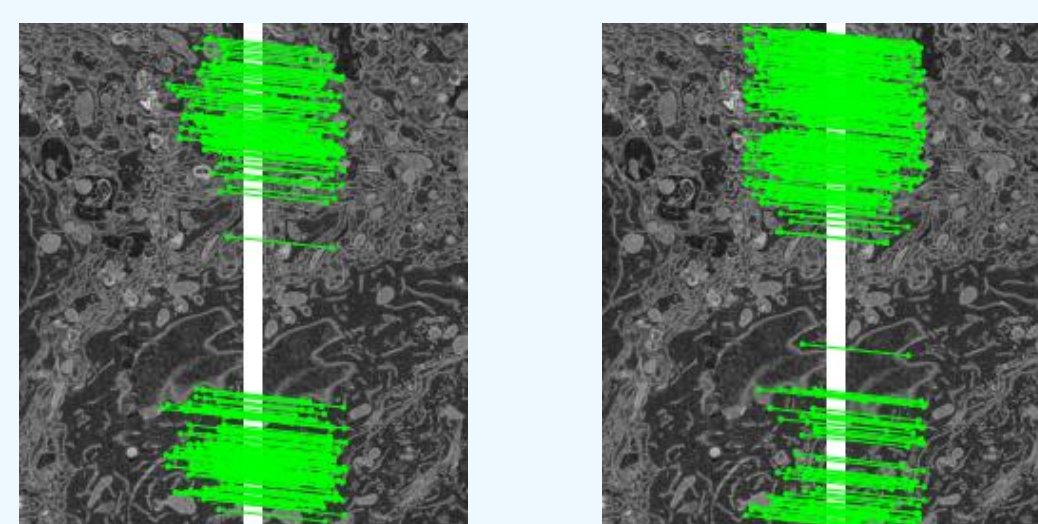


Figure 5

SIFT: 40 mts.

LoFTR: 1486 mts.

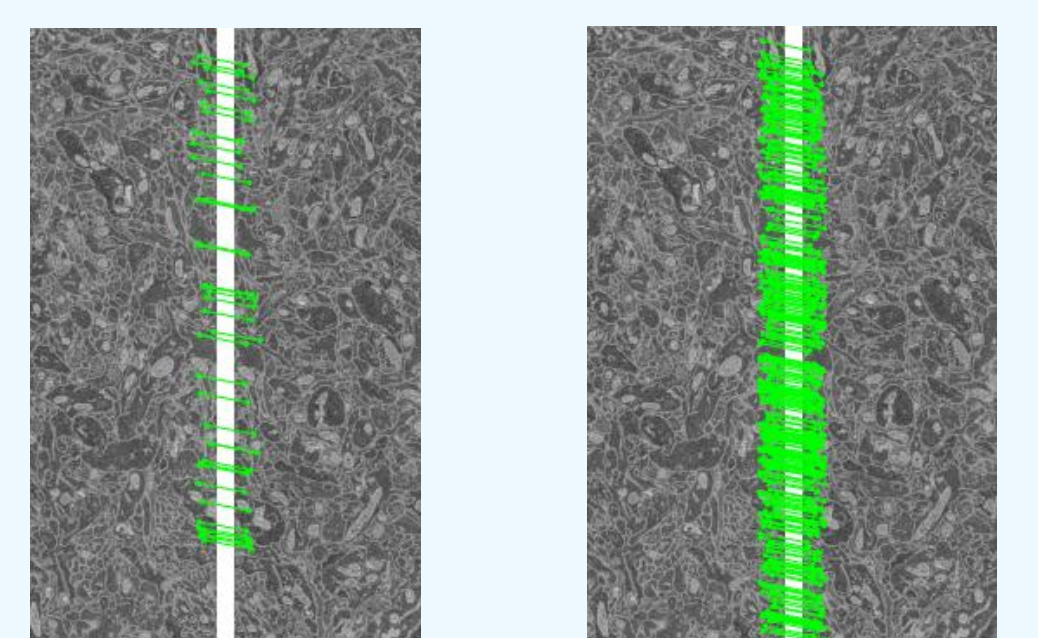


Figure 6