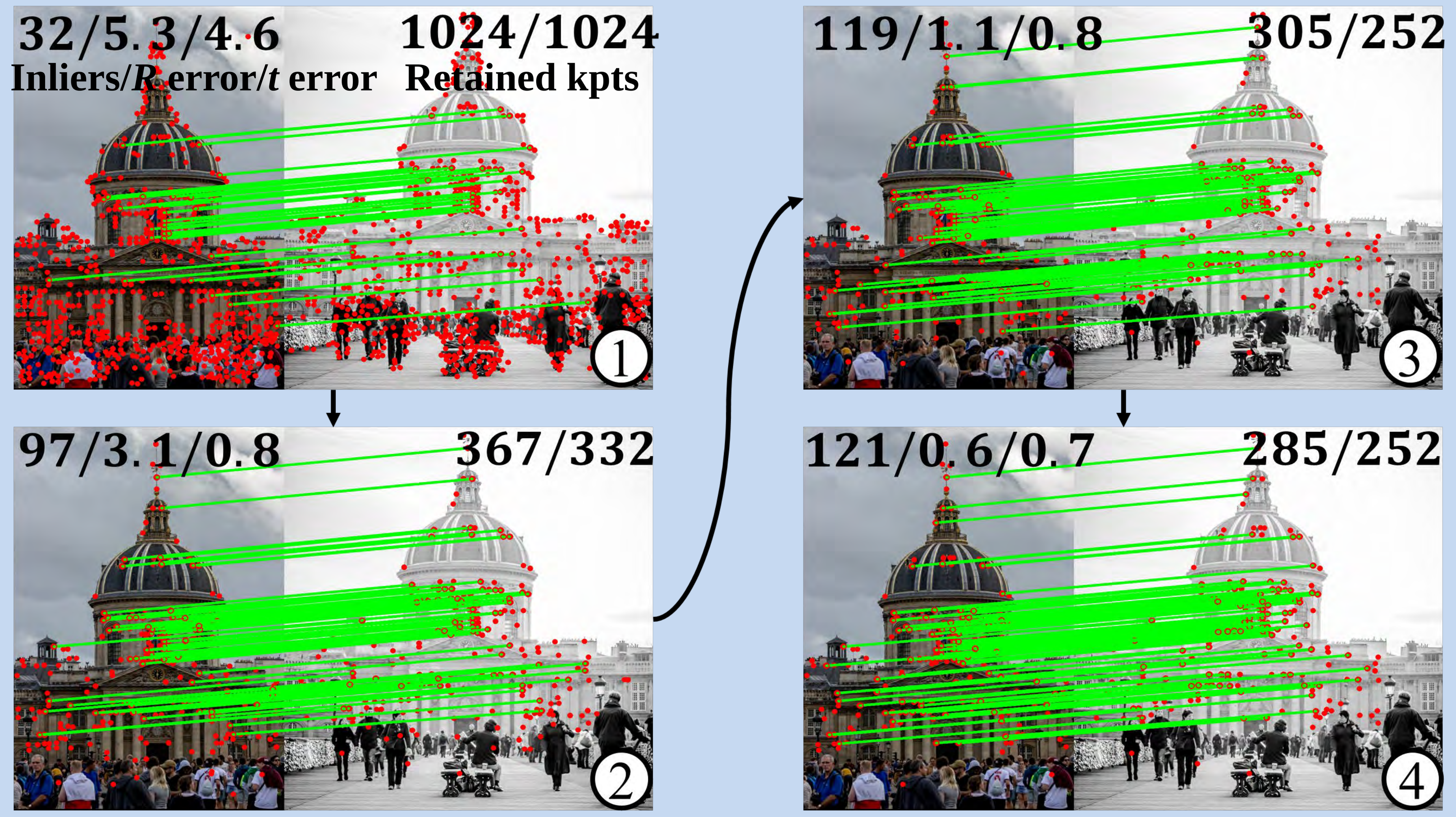
IMP: Iterative Matching and Pose Estimation with Adaptive Pooling

Fei Xue, Ignas Budvytis, Roberto Cipolla

UNIVERSITY OF CAMBRIDGE

JUNE 18-22, 2023 CVPR VANCOUVER, CANADA

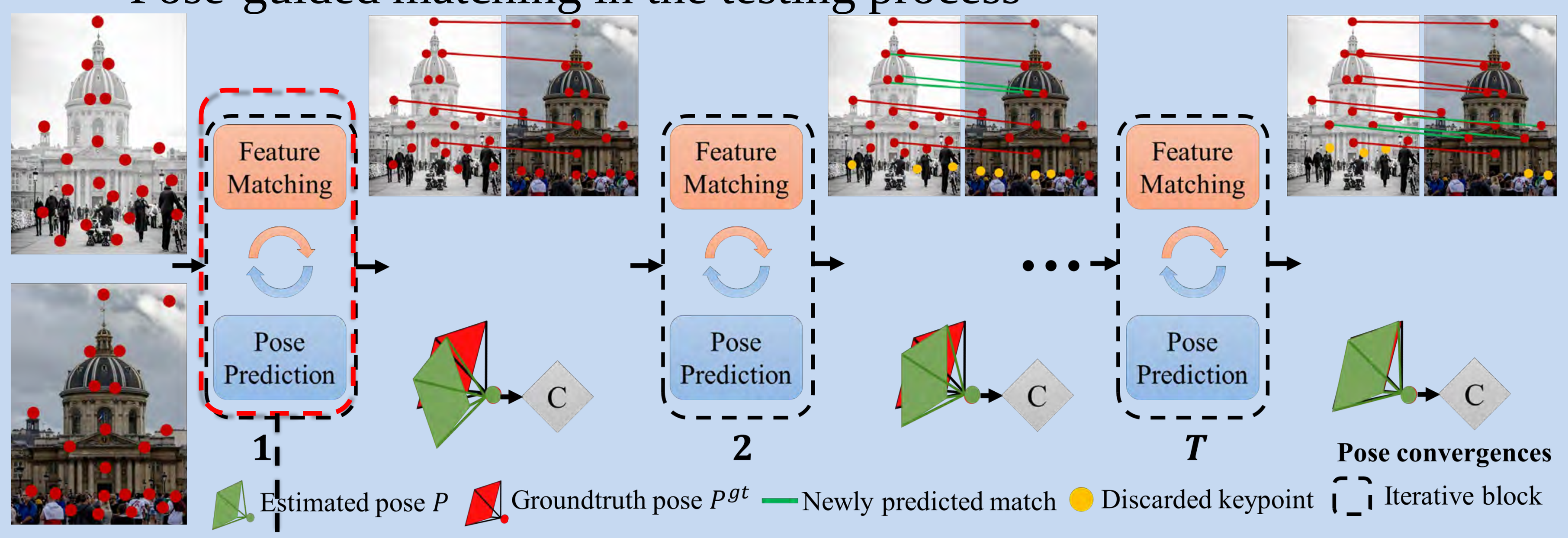
- **Problem**
  - Relative pose estimation via keypoints matching
- **Limitations of prior methods**
  - Matching and pose estimation are independent
  - Geometric information is ignored
  - Graph-based matchers have good performance but suffer from high computational cost
- **Motivation**
  - Iterative matching and pose estimation
  - Adaptively discarding keypoints without correspondences
  - Robust pose-guided pooling

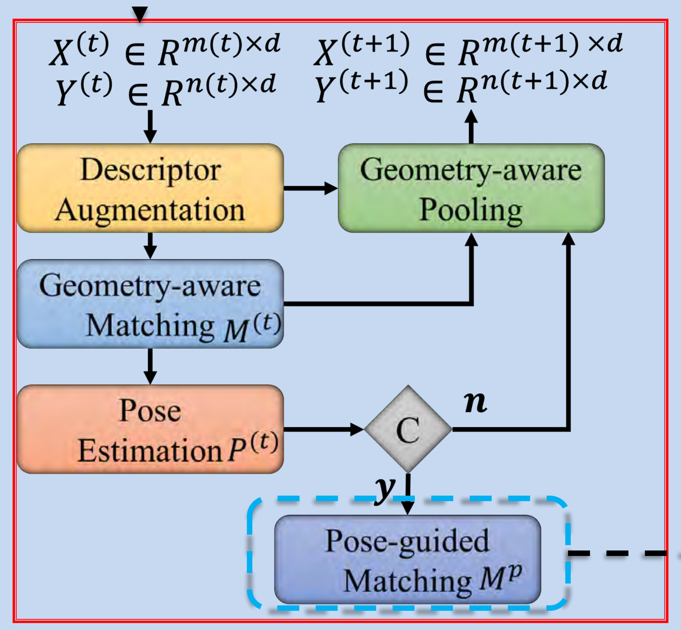


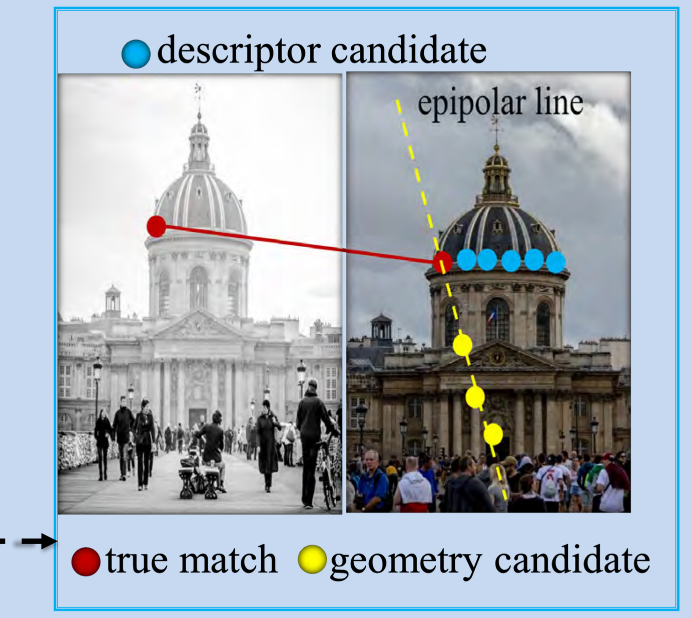
Iterative matching and pose estimation
(more matches, more precise poses, fewer keypoints)

[1] SuperGlue, Sarlin et al, CVPR 2020
[2] SGMNet, Chen et al., ICCV 2021
[3] CLNet, Zhao et al., ICCV 2021
[4] YFCC, Thomee et al., Communications of the ACM, 2016
[5] Suerpoint, DeTone et al., CVPRW 2018

- **Approach**
- **Iterative matching and pose estimation**
  - Transformer-based recurrent module
  - Pose-aware loss in the training process
  - Pose-guided matching in the testing process

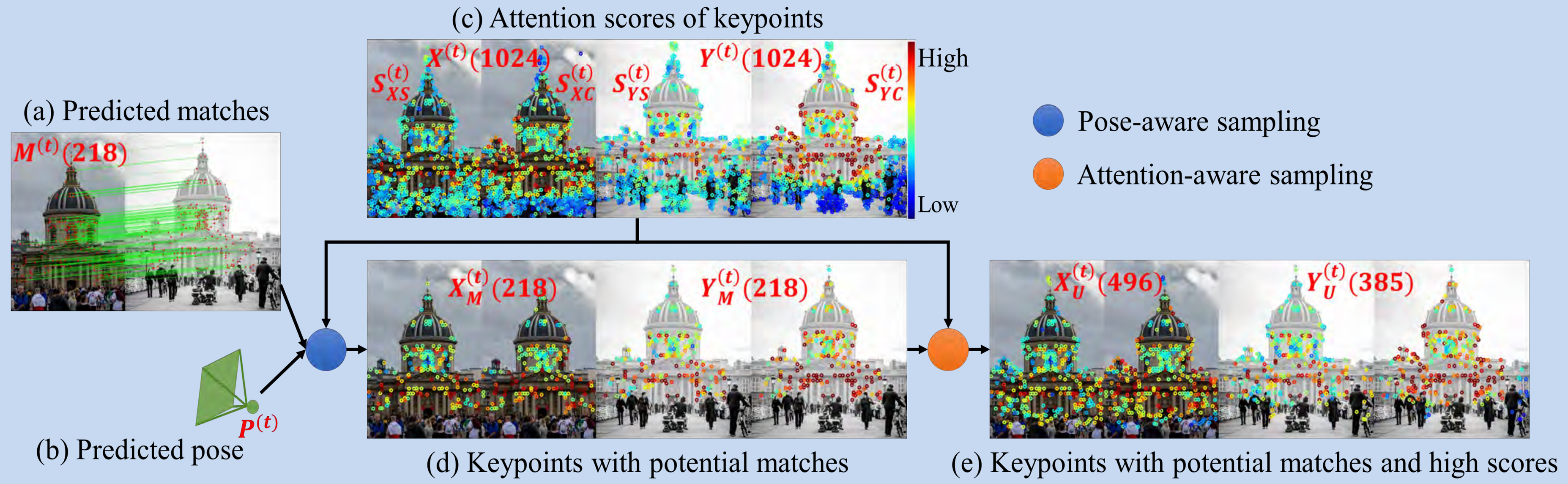






Transformer-based recurrent module **Pose-guided matching**

- **Adaptive pooling of keypoints (Efficient IMP - EIMP)**
  - Pooling with attention scores and matching matrix to remove outliers
  - Pose-guide pooling to avoid over pooling when matches are not good



Attention scores show possibilities of keypoints being inliers
Uncertainty of pose shows the quality of matches

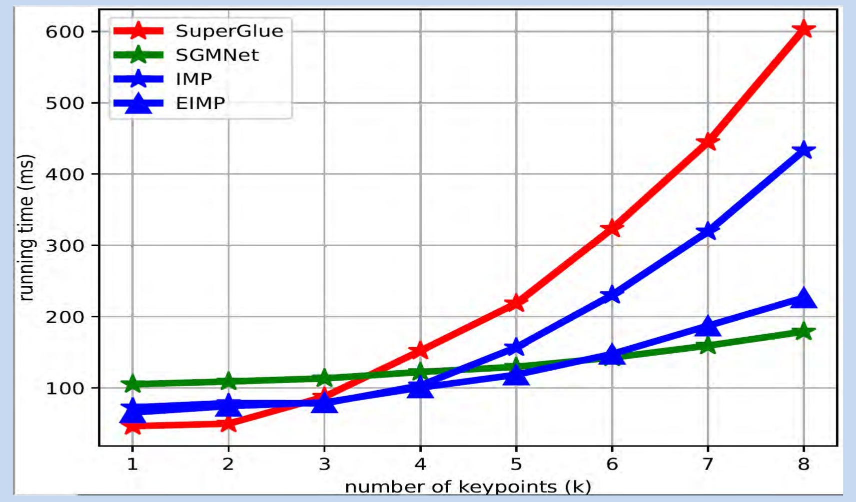
- **Results**
- **More inliers and accurate poses (matches / inliers / *R* error / *t* error)**

- **More robust (inliers) to viewpoint, illumination, and seasonal changes**

- **More accurate poses and higher efficiency**

NN	6.5	15.4	28.5
CLNet	27.8	46.4	63.8
SuperGlue	37.1	57.2	73.6
SGMNet	33.0	53.0	70.0
IMP	**39.4**	**59.4**	**75.2**
EIMP	37.9	57.9	74.0

Percentage of pose errors within 5/10/20 deg on YFCC dataset (best and second-best)



Running time