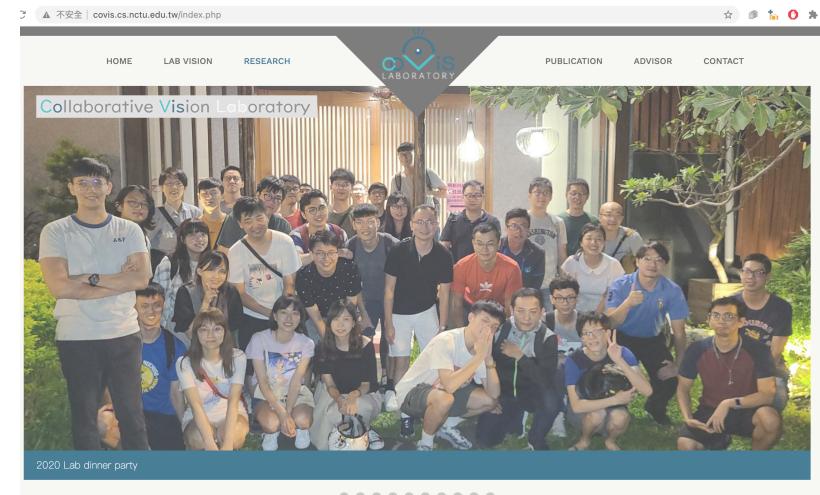


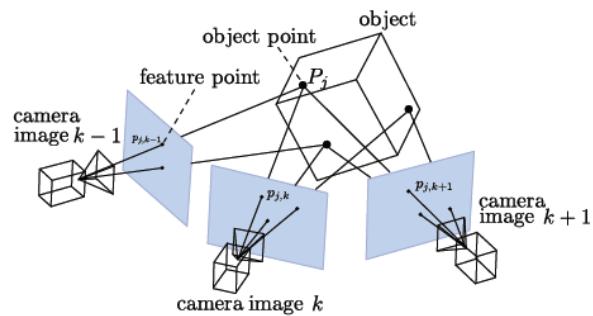
CoVis Lab

- **Collaborative Vision Lab** (協同視覺實驗室, EC223b)



<http://covis.cs.nctu.edu.tw/>

多視野影像協同 Multi-View Collaboration



視覺定位 Visual Localization



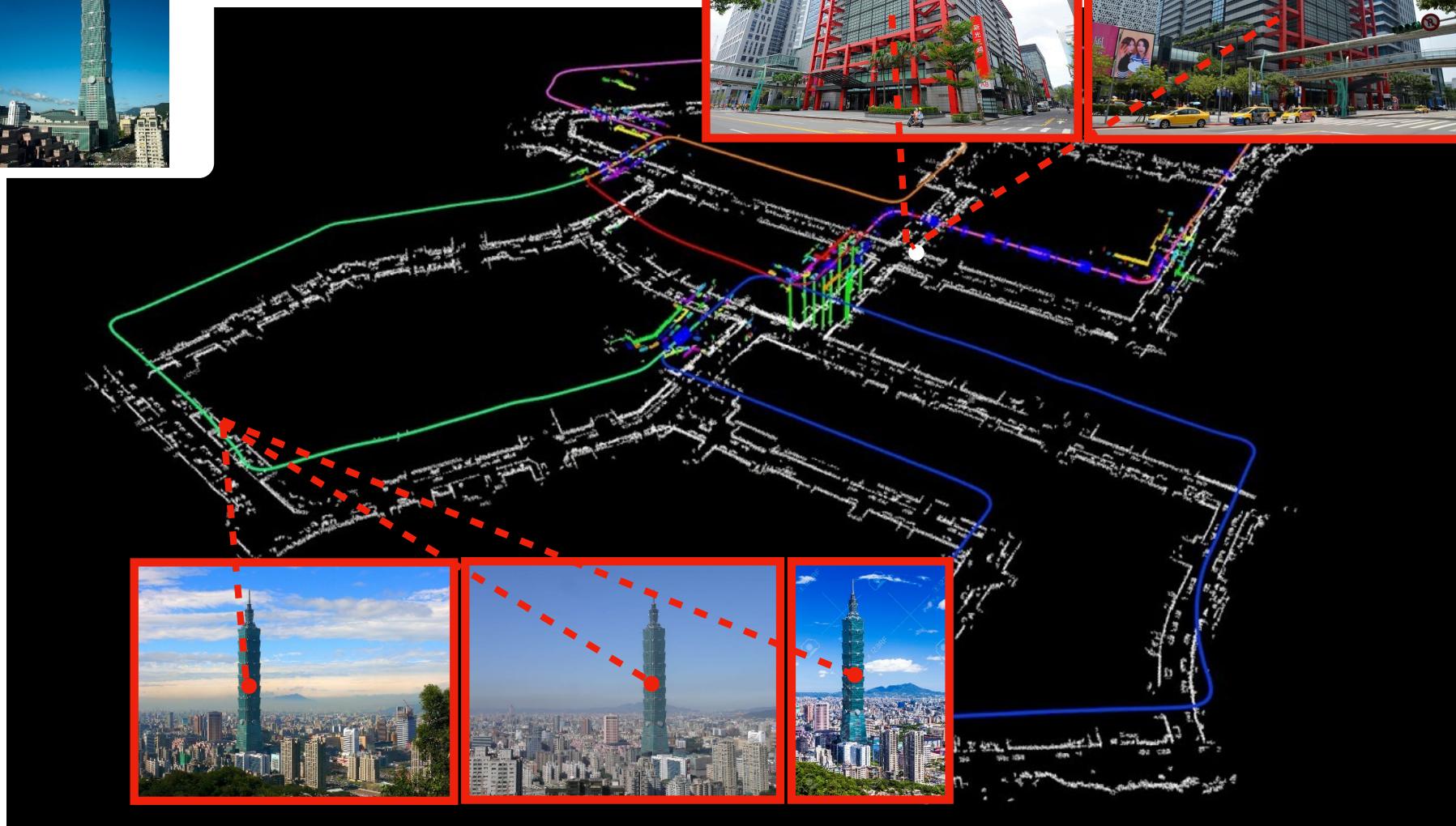
影像特徵比對 Feature Matching

場景模型重建 Scene Modeling

What's Visual Localization?



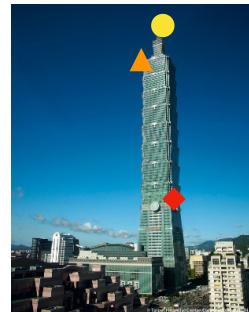
query image



How does Computer Do this?



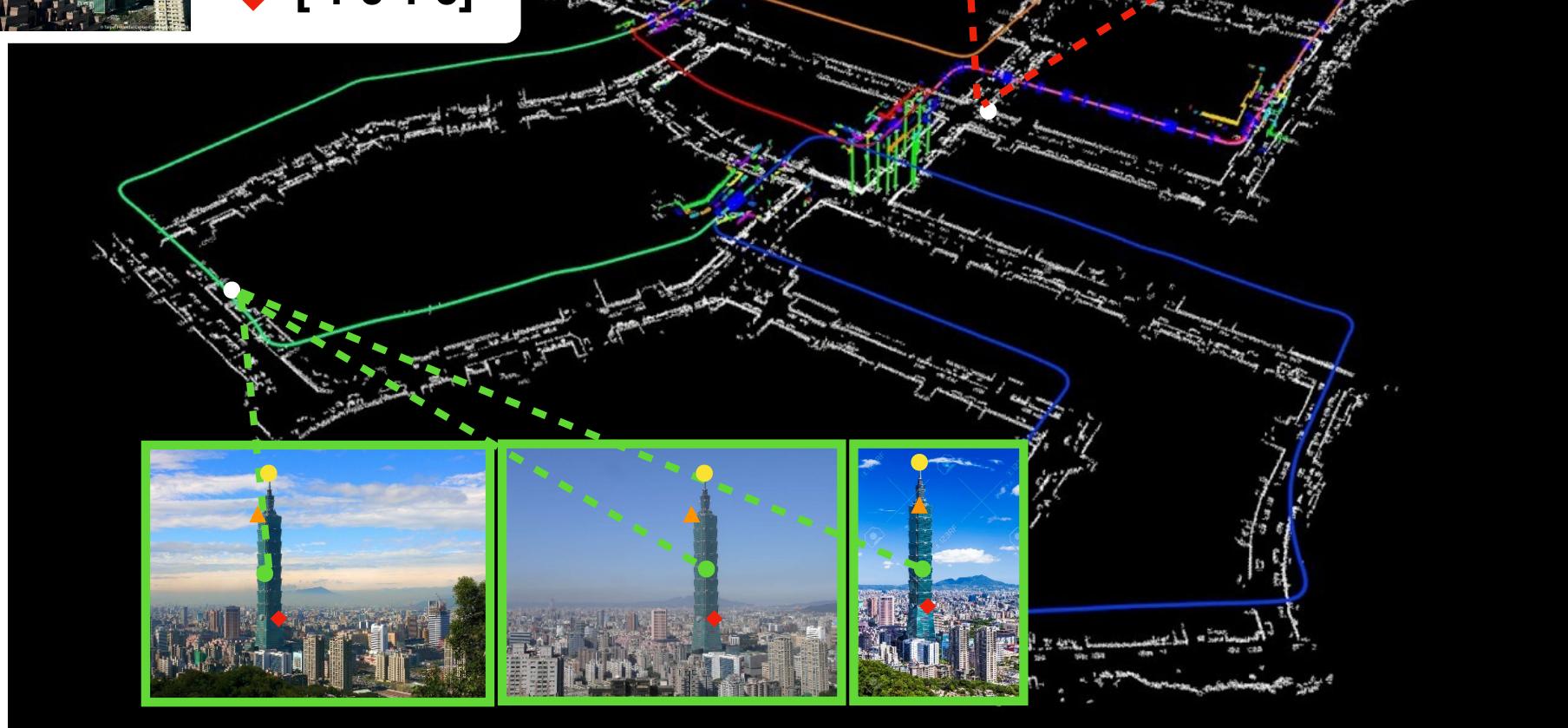
query image



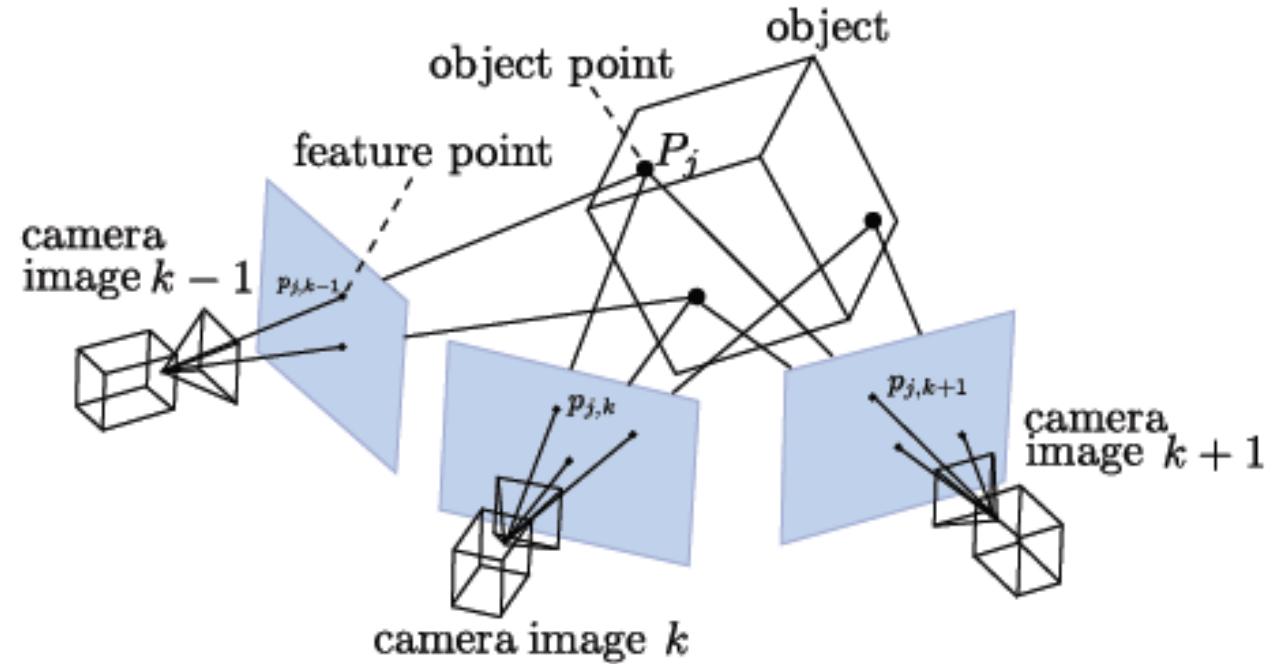
● [0 0 1 1]

▲ [0 1 0 1]

◆ [1 0 1 0]



Visual Localization \approx Feature Matching



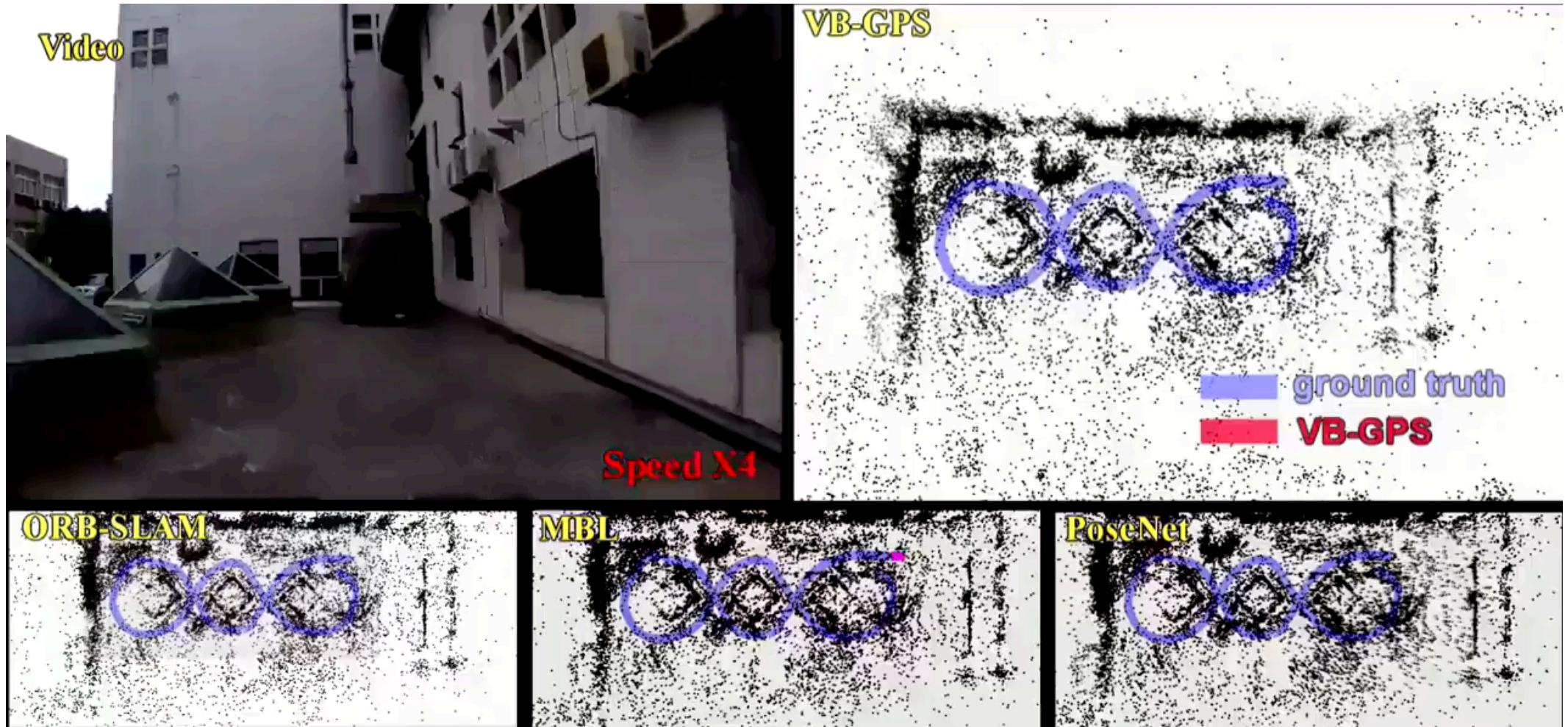
Solve PnP problem to estimate 6 DoF camera pose

VISUAL LOCALIZATION



V-Eye: A Vision-based Navigation System for the Visually Impaired

P.-. Duh, Y.-C. Sung, L.-Y. Fan Chiang, Y.-J. Chang, and K.-W. Chen, *IEEE T-MM*, 2020

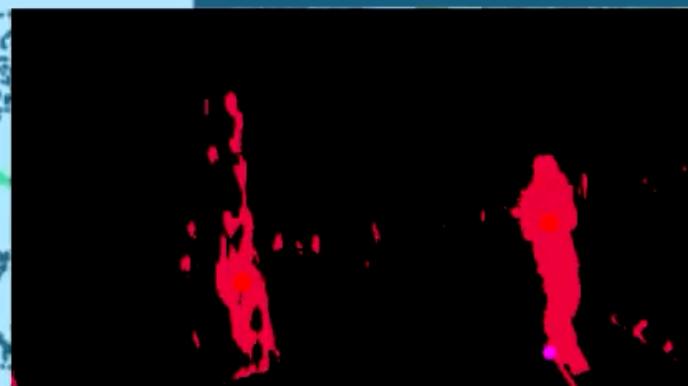
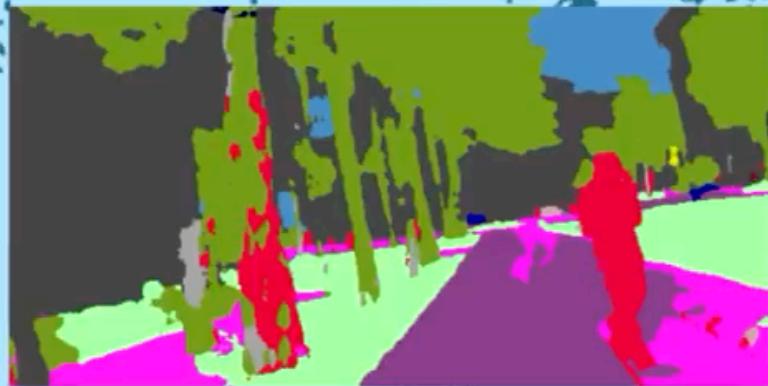


We compare VB-GPS with ORB-SLAM、Model-Based Localization(MBL) and PoseNet. Testing sequence and ground truth produced by SfM are shown on the top left corner.

Navigation system for the visually impaired

Right pedestrian

get the careful message from
our segmentation server



Speed x4

VISUAL LOCALIZATION - DRONE AUTOPILOT



1. 聯合報 - 交大無人機送公文 只要3分鐘
<https://udn.com/news/story/11319/4206138>
2. 自由時報 - 酷！交大用無人機送公文 教授笑：以後或許能外送鬆餅
<https://news.ltn.com.tw/news/life/breakingnews/2999307>
3. Hinet生活誌 - 交大無人機送公文 送件快速省時省力
<https://times.hinet.net/news/22683562>
4. 東森新聞雲 - 飛鴿傳書2.0！交大用無人機傳公文 教授笑：哪天也能送外賣
<https://www.ettoday.net/news/20191205/1594794.htm>
5. 人間福報 - 交大送公文 出動無人機
<http://www.merit-times.com.tw/NewsPage.aspx?unid=570513>
6. 蘋果日報 - 交大打造智慧校園無人機送公文3分鐘搞定
<https://tw.news.appledaily.com/life/realtme/20191205/1673263>

交大無人機送公文 只要3分鐘



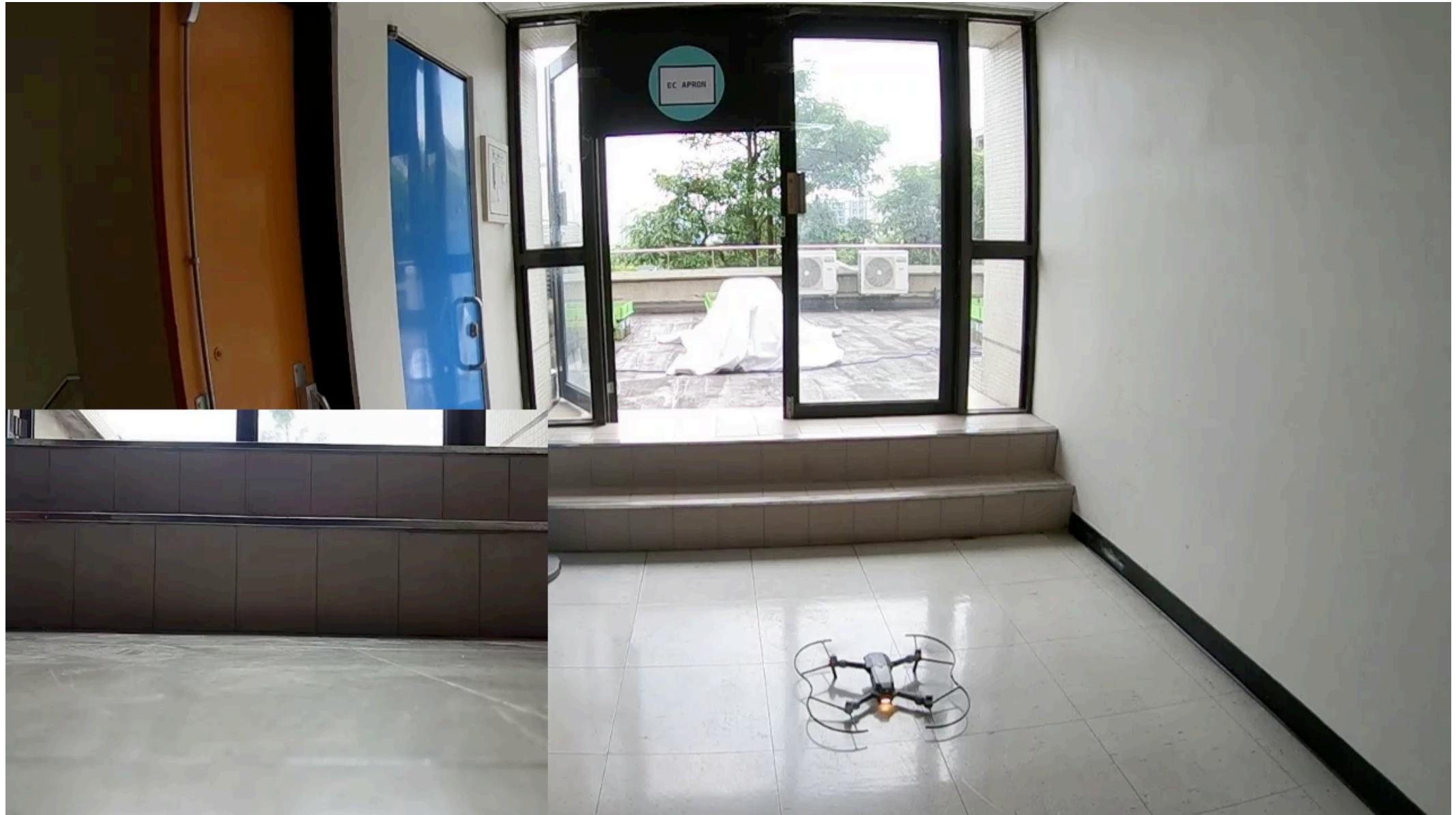
A- A+

2019-12-05 00:07 聯合報 記者張雅婷／新竹市報導 讚 176 分享

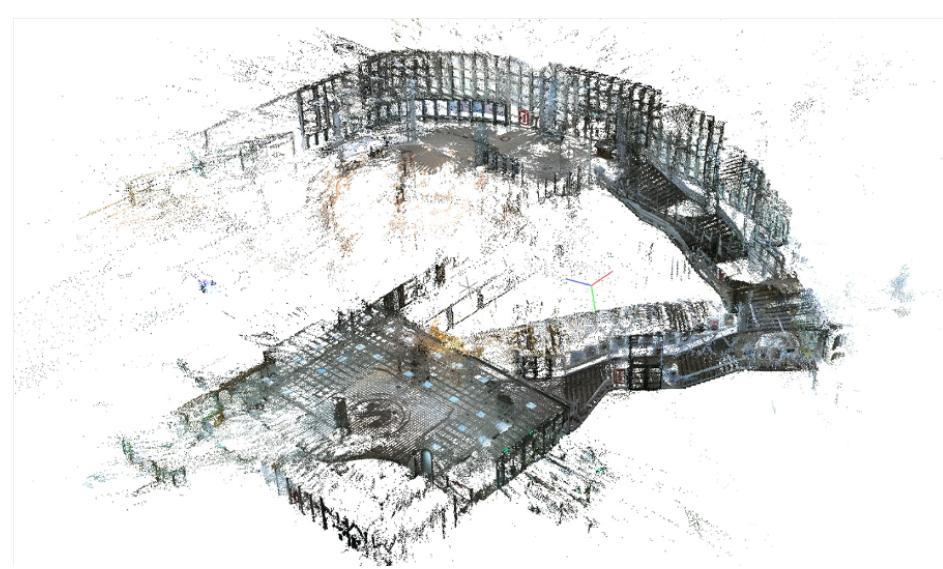
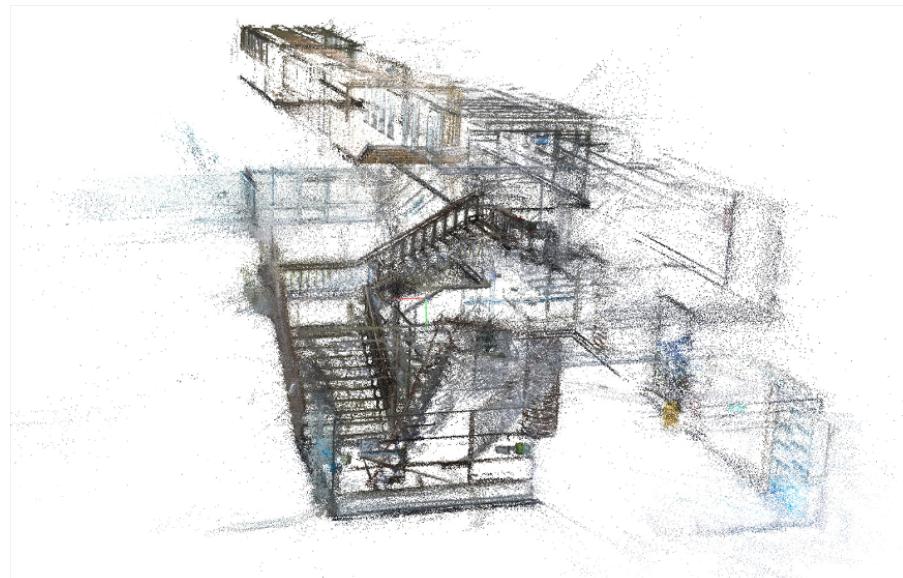
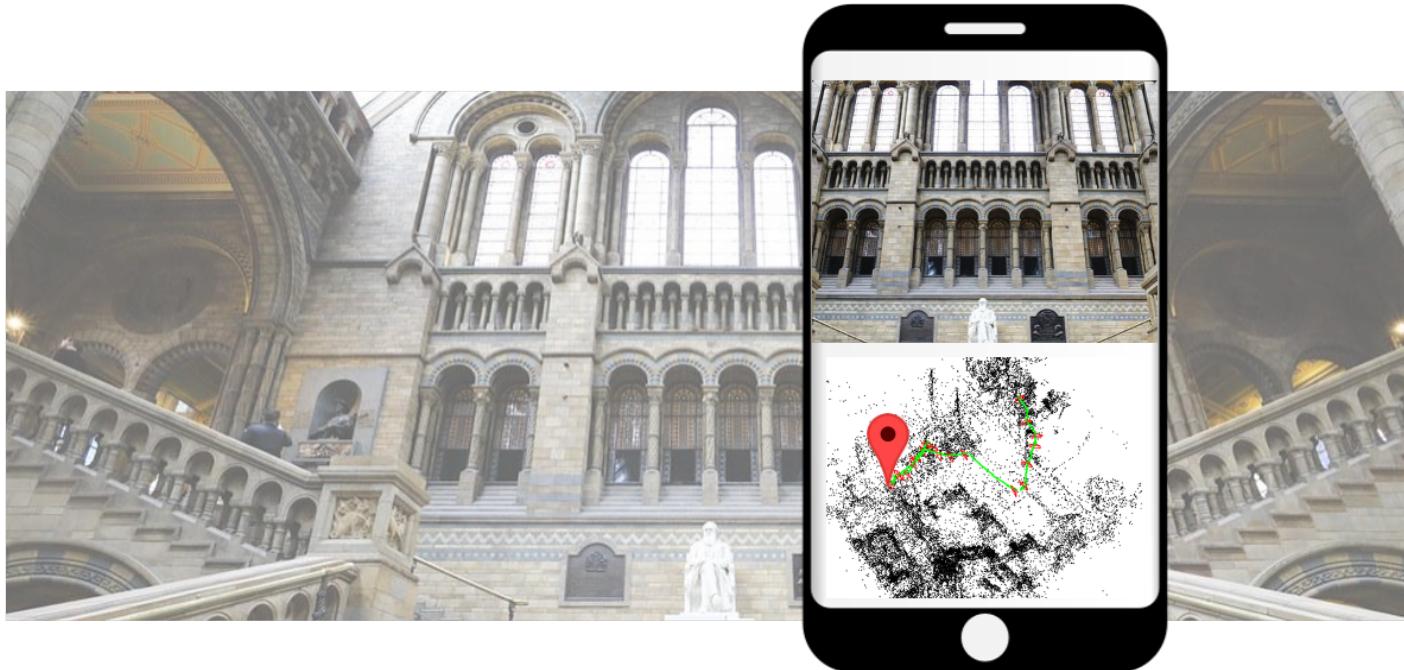


DroneTalk: An Internet-of-Things-Based Drone System for Last-Mile Drone Delivery
K.-W. Chen, M.-R. Xie, Y.-M. Chen, T.-T. Chu, and Y.-B. Lin, *IEEE T-ITS*, 2022.

VISUAL LOCALIZATION - DRONE AUTOPILOT



VISUAL LOCALIZATION - AR



Multi-Client Experiment

VISUAL LOCALIZATION - DRONE RETAKE



Drone retake

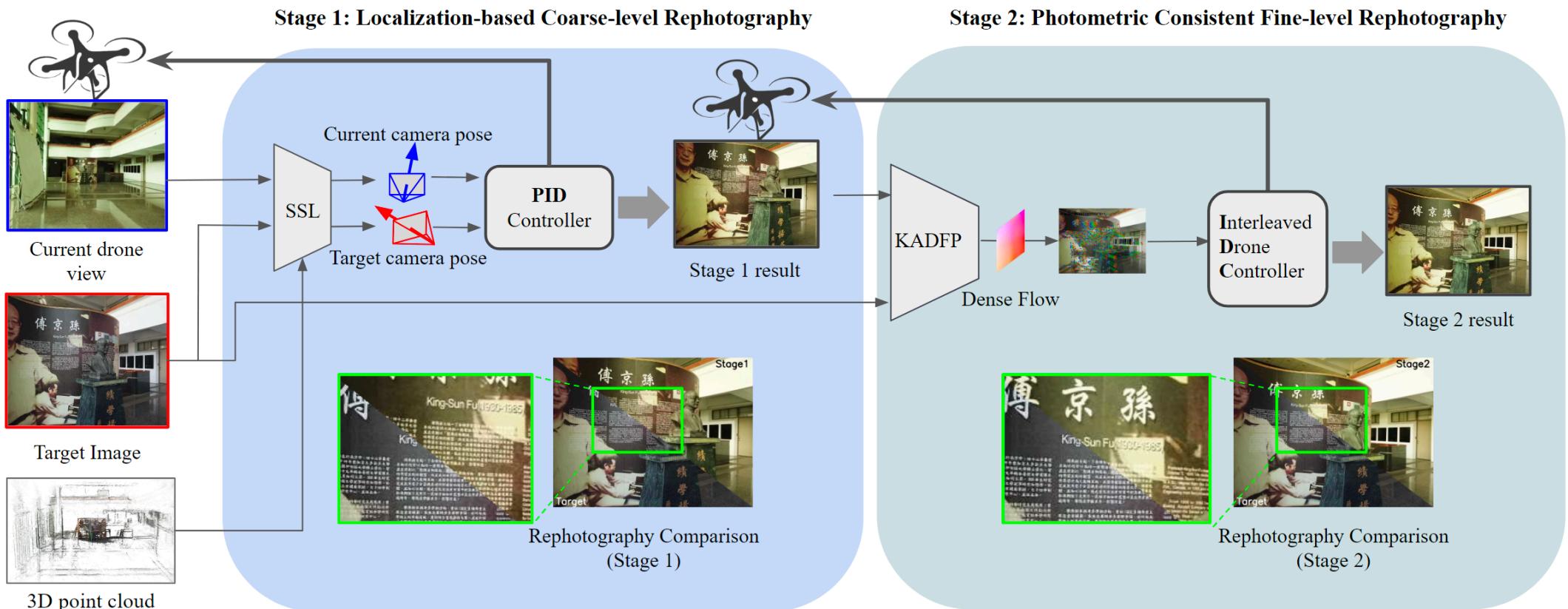


Retake image



Target image

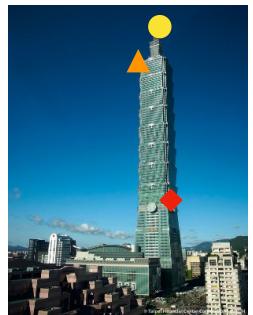
VISUAL LOCALIZATION - DRONE RETAKE



Rephotography Comparison



RESEARCH ROADMAP

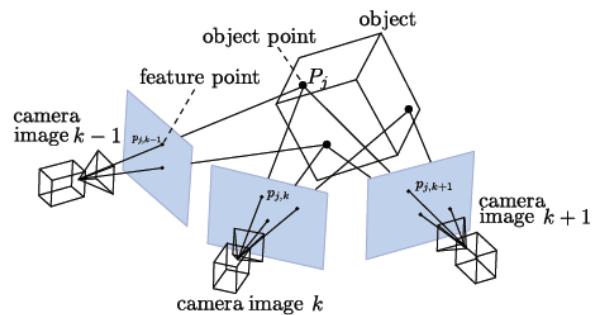


● [0 0 1 1]

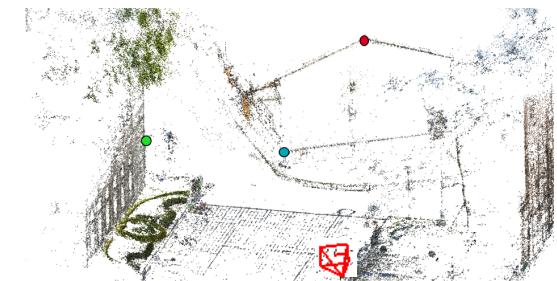
▲ [0 1 0 1]

◆ [1 0 1 0]

多視野影像協同
Multi-View Collaboration



視覺定位
Visual Localization



影像特徵比對
Feature Matching

場景模型重建
Scene Modeling

The main problem of SSL

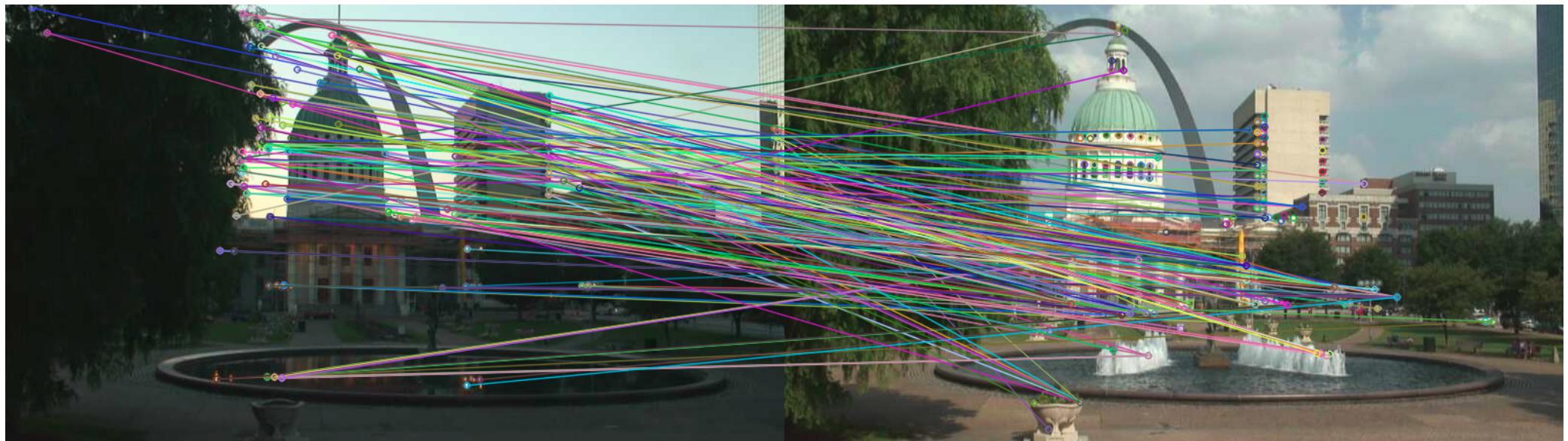
- The major problem of SSL is the changes of **lighting conditions** between **query image** and **compared sources**.
- How to effectively overcome the problems caused by illumination diversity become more and more important in the field of SSL.



Positioning Error (cm)

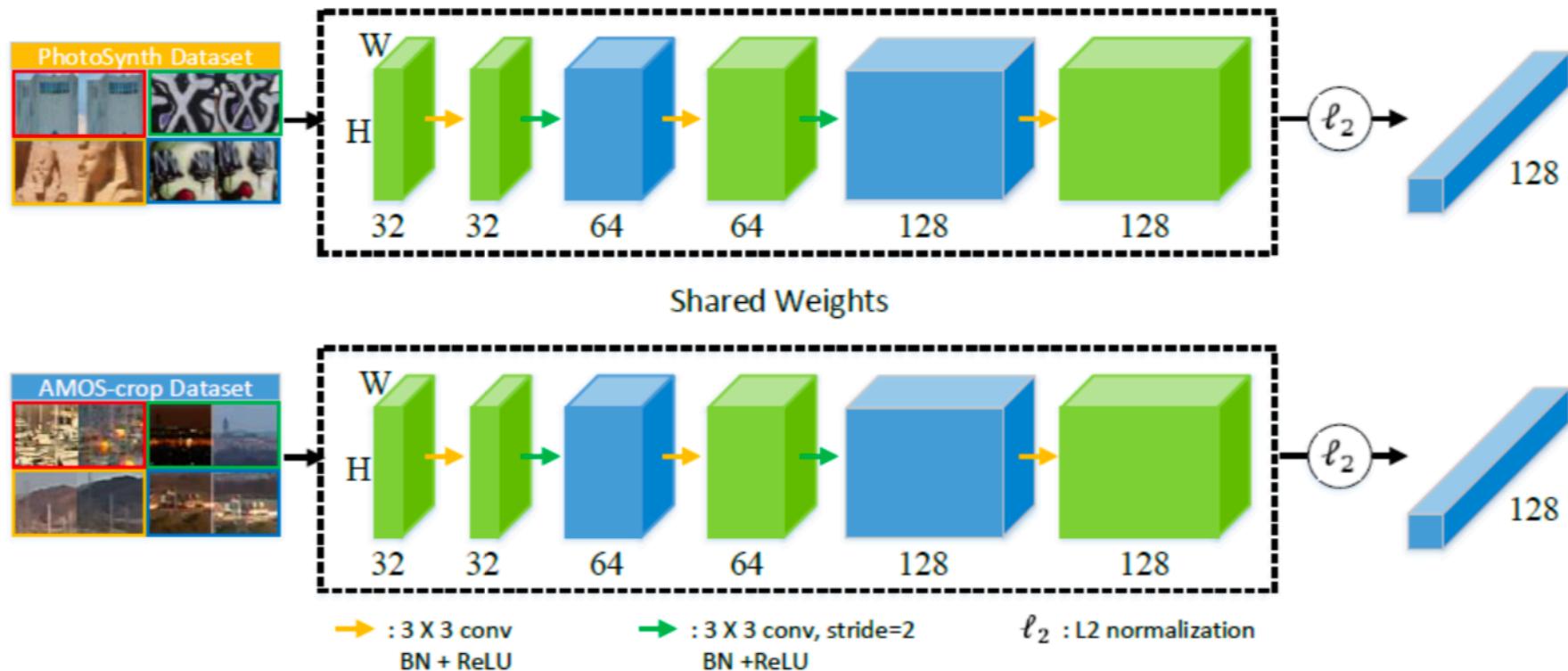
Test date & time		M2/3 10:30	M2/4 17:30	M2/5 15:00	M2/6 12:00	M2/7 14:00	M2/8 22:30	M2/9 18:30	M2/10 10:00	M3/4 14:30
Weather		Cloudy	Dusk	Sunny	Sunny	Cloudy	Night	Night	Cloudy	Rainy
Fixed model (M1/20 15:30)	Mean	72.4	NaN	74.2	171.4	91.6	1136	NaN	135.9	4107.8
	Stdev.	40.4	NaN	42.5	318.6	174.7	850	NaN	180.2	1264.7

SIFT Feature Matching



Illumination-invariant Feature Network (IF-Net):

- Separation training scheme
- Reduce-Outlier-Inlier (ROI) loss function



FEATURE MATCHING



IF-Net



HardNet

FEATURE MATCHING

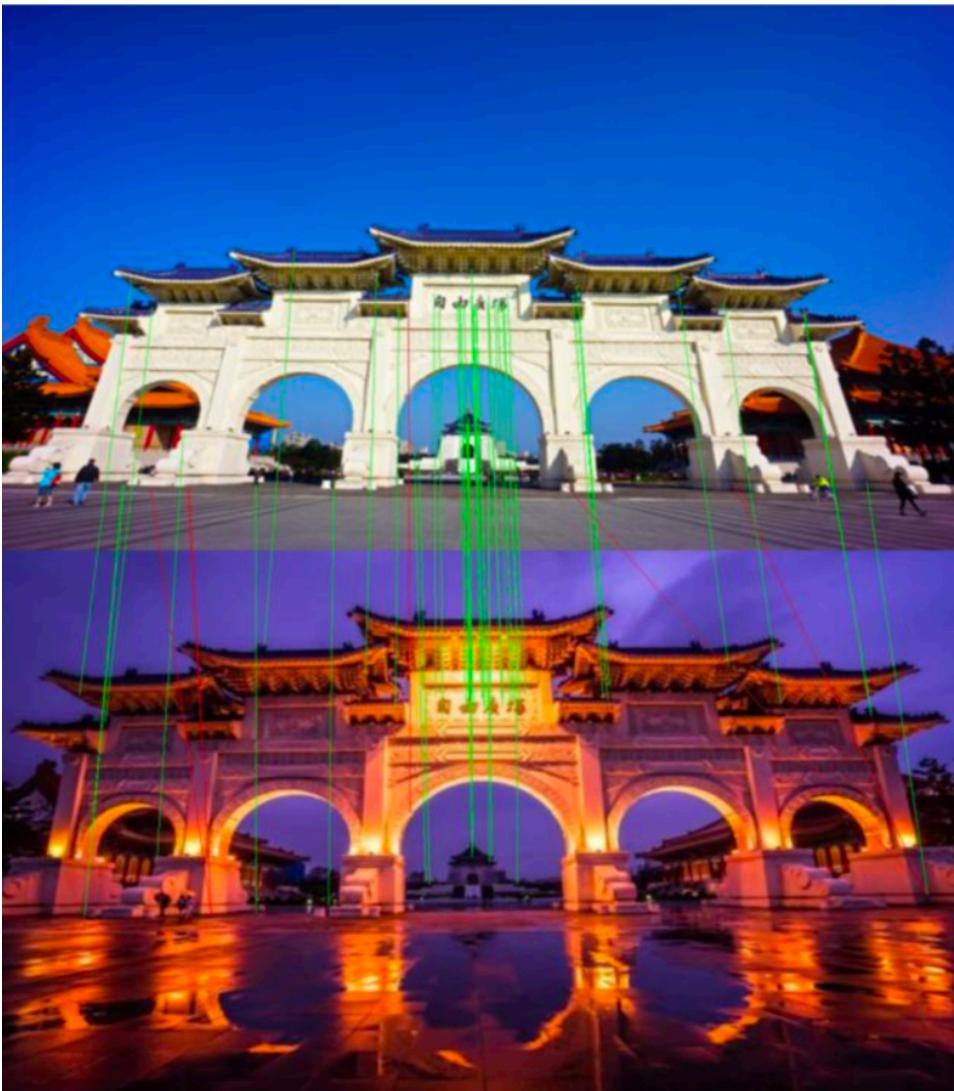


IF-Net



HardNet

FEATURE MATCHING



IF-Net

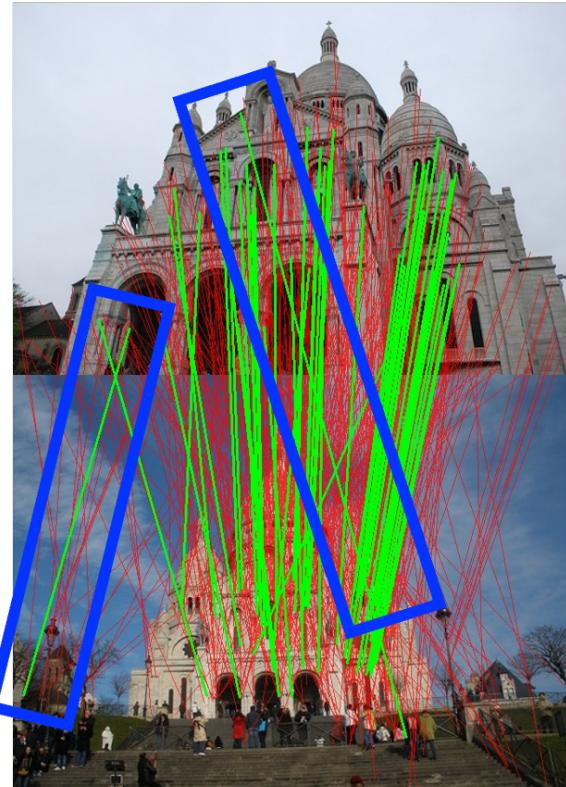


HardNet

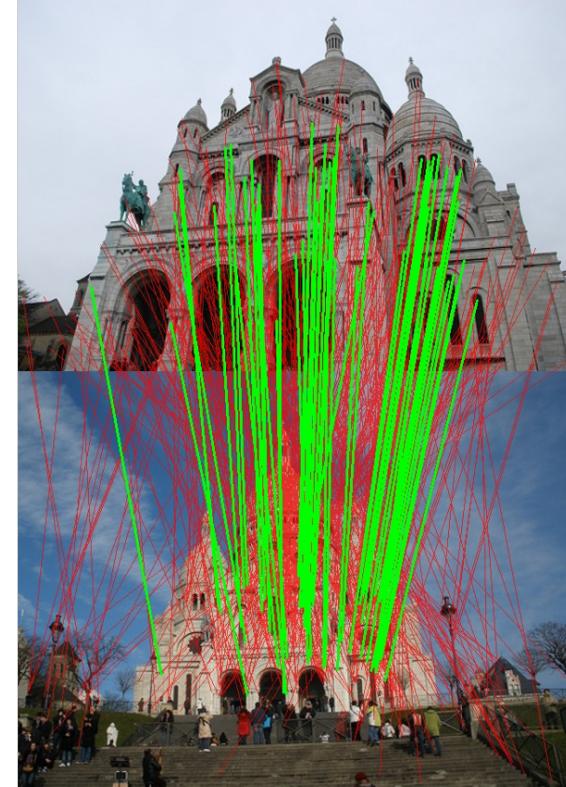
FEATURE MATCHING

LGC-Net

Obvious outliers



CLNet [5]



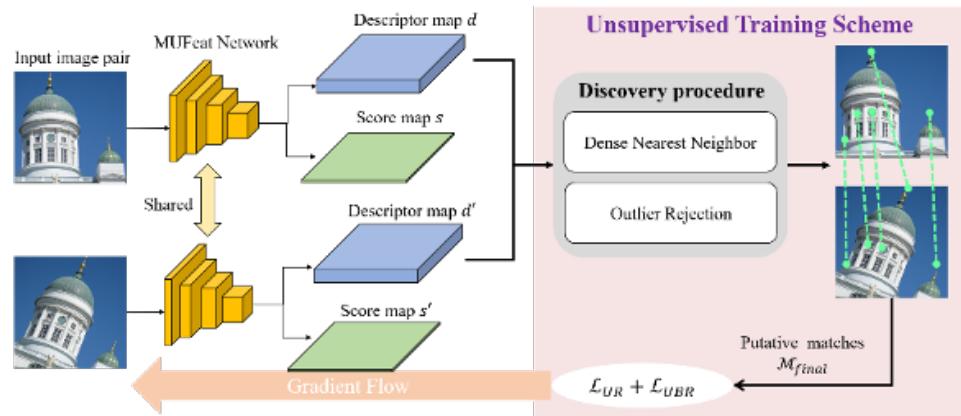
LGCNet

LGCNet: Feature Enhancement and Consistency Learning Based on Local and Global Coherence Network for Correspondence
T.-H. Wu and K.-W. Chen, *ICRA*, 2023.

FEATURE MATCHING

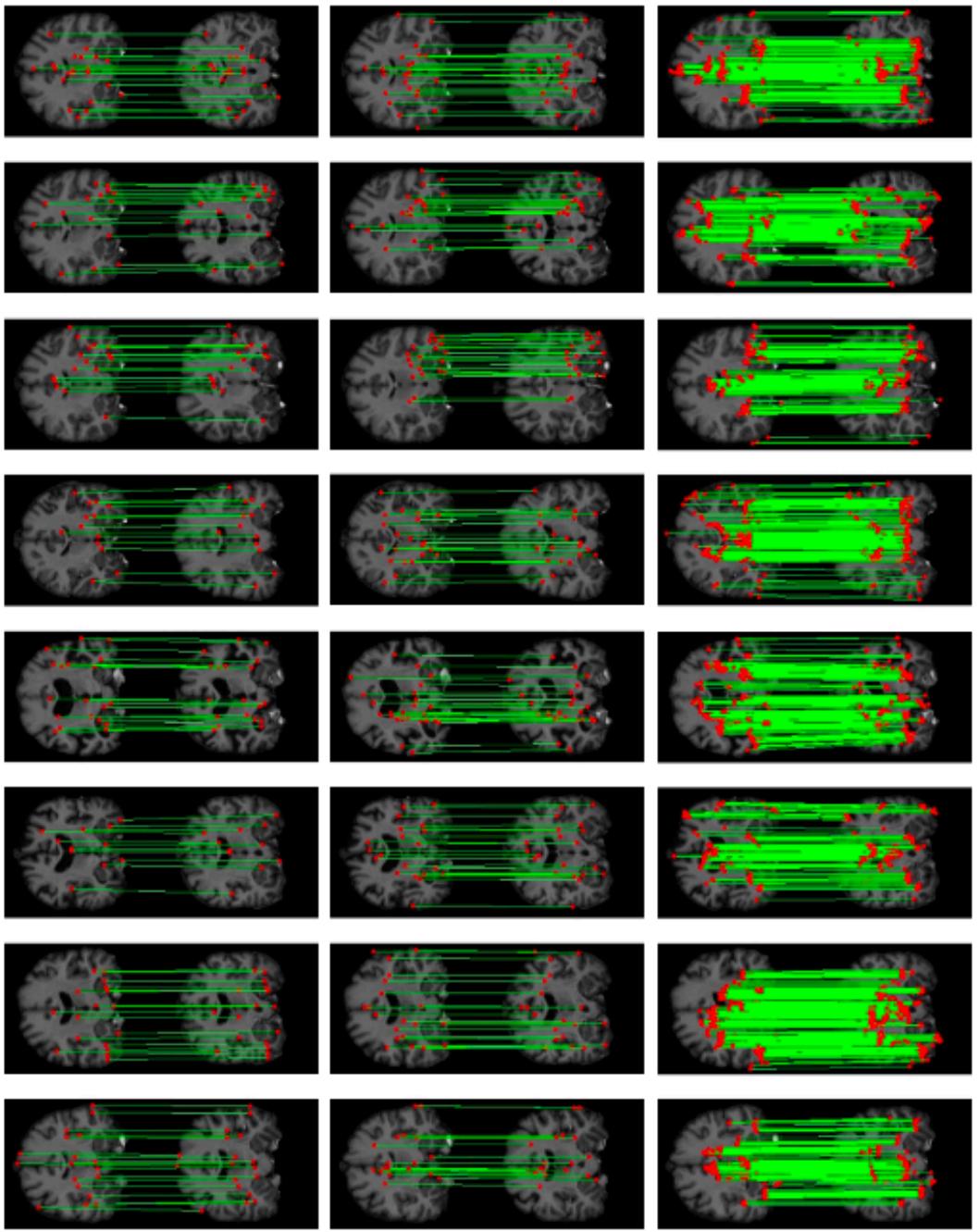


MUFeat

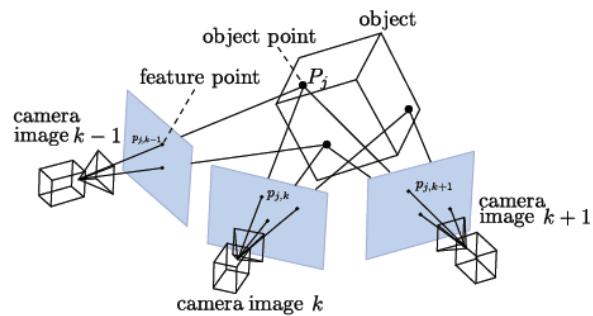


MUFeat: Multi-level CNN and Unsupervised Learning for Local Feature Detection and Description

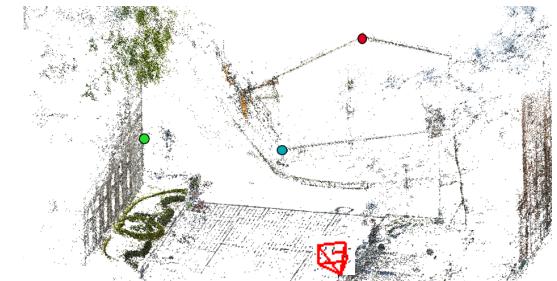
S.-H. Kuo, T.-H. Wu, Z.-Y. Chen, and K.-W. Chen, *IROS*, 2023.



多視野影像協同 Multi-View Collaboration



視覺定位 Visual Localization



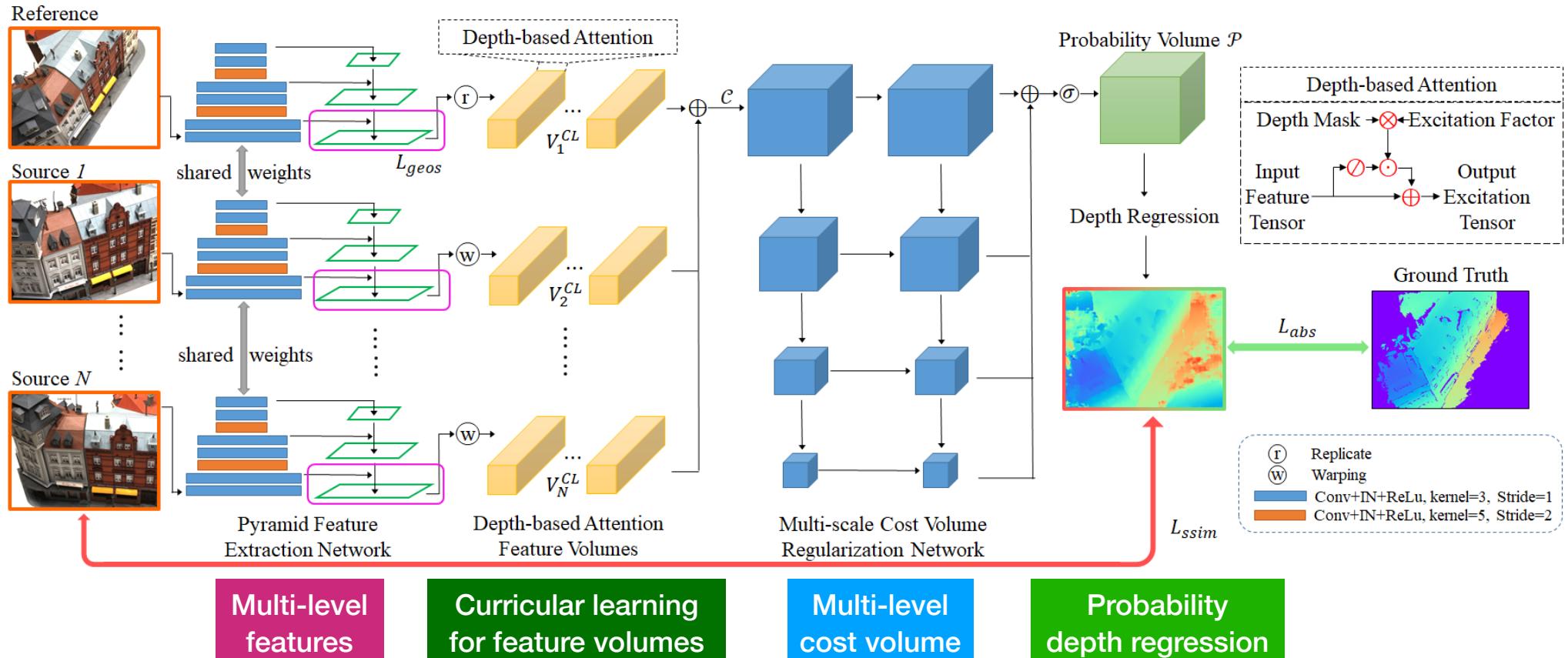
影像特徵比對 Feature Matching

場景模型重建 Scene Modeling

SCENE MODELING



MVSNet++

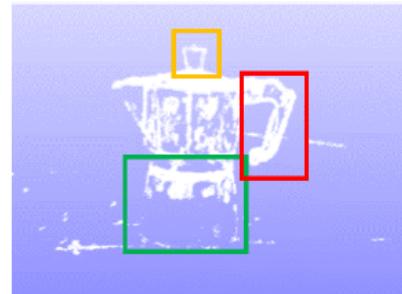


MVSNet++: Learning Depth-based Attention Pyramid Features for Multi-View Stereo
 P.-H. Chen, H.-C. Yang, K.-W. Chen, Y.-S. Chen
IEEE Transactions on Image Processing, June 2020

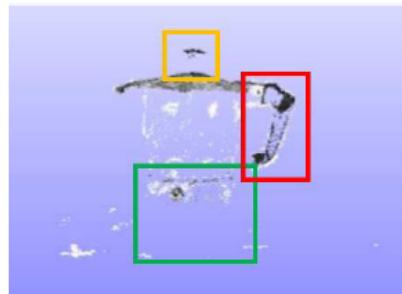
SCENE MODELING

MVSNet++

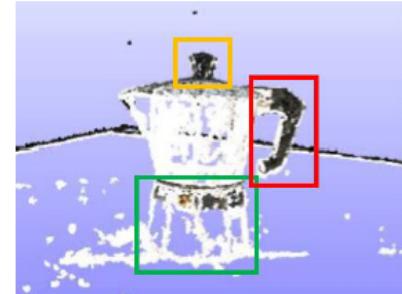
DTU dataset



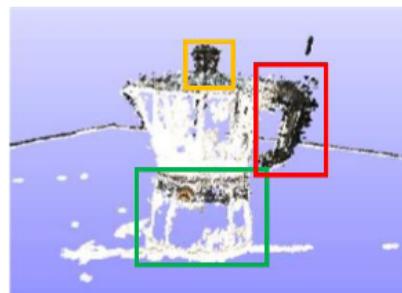
(b) tola [44]



(c) Gipuma [14]



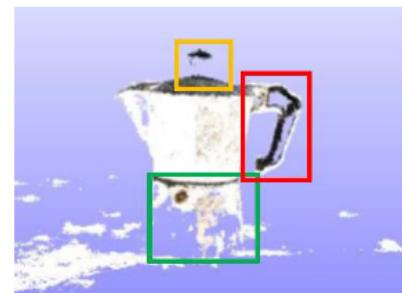
(d) furu [12]



(e) camp [4]



(f) SurfaceNet [21]



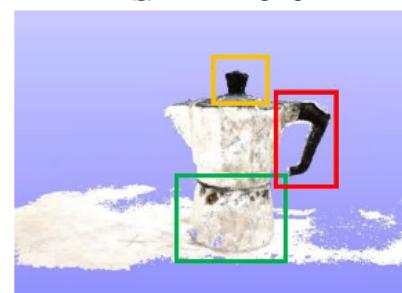
(g) MVSNet [48]



(h) R-MVSNet [49]



(i) P-MVSNet [32]



(j) Ours

Left to right:

- MVA, 2012
- ICCV, 2015
- TPAMI, 2009

Left to right:

- ECCV, 2008
- ICCV, 2015
- ECCV, 2018

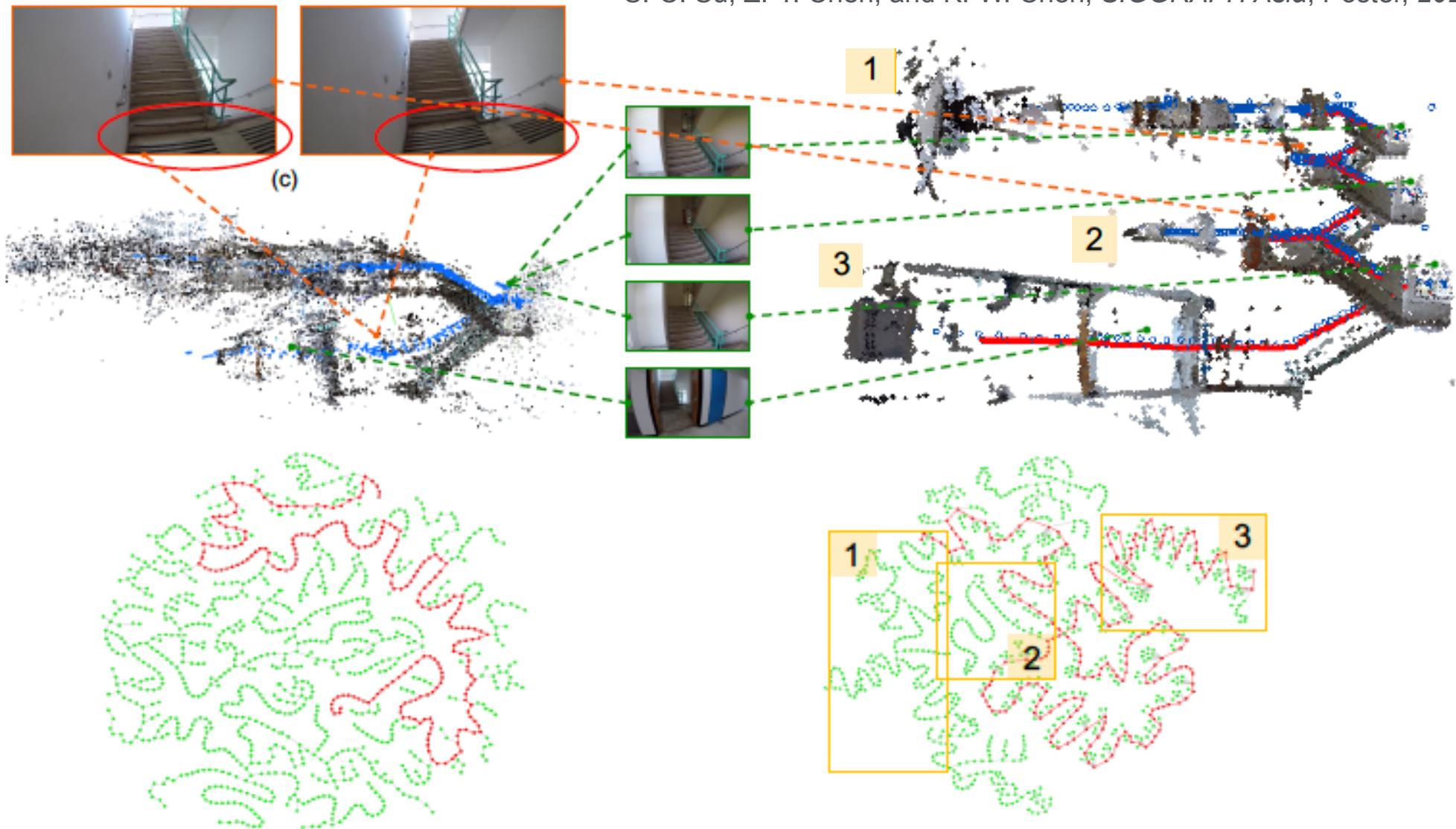
Left to right:

- CVPR, 2019
- ICCV, 2019
- Ours

SCENE MODELING

Spatial and Photometric Consistent Matching for Structure-from-Motion in Highly Ambiguous Scenes

S.-C. Su, Z.-Y. Chen, and K.-W. Chen, SIGGRAPH Asia, Poster, 2020



SCENE MODELING



Spatial and Photometric Consistent Matching for Structure-from-Motion in Highly Ambiguous Scenes

S.-C. Su, Z.-Y. Chen, and K.-W. Chen, SIGGRAPH Asia, Poster, 2022



SCENE MODELING



Spatial and Photometric Consistent Matching for Structure-from-Motion in Highly Ambiguous Scenes

S.-C. Su, Z.-Y. Chen, and K.-W. Chen, *SIGGRAPH Asia*, Poster, 2022



SCENE MODELING

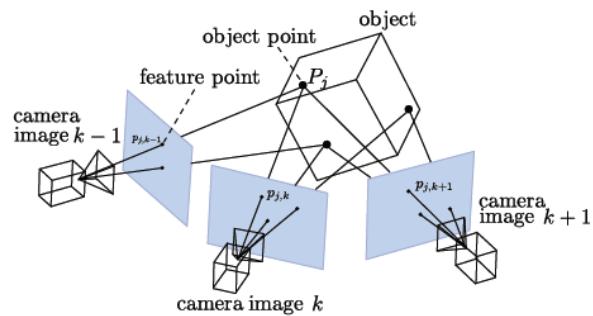


Spatial and Photometric Consistent Matching for Structure-from-Motion in Highly Ambiguous Scenes

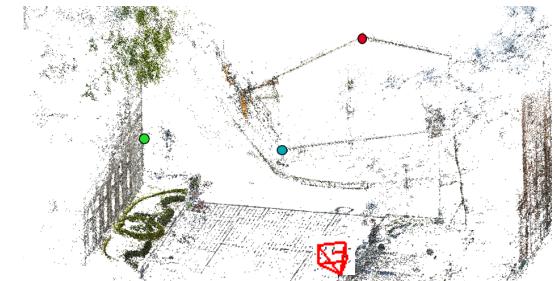
S.-C. Su, Z.-Y. Chen, and K.-W. Chen, *SIGGRAPH Asia*, Poster, 2022



多視野影像協同 Multi-View Collaboration



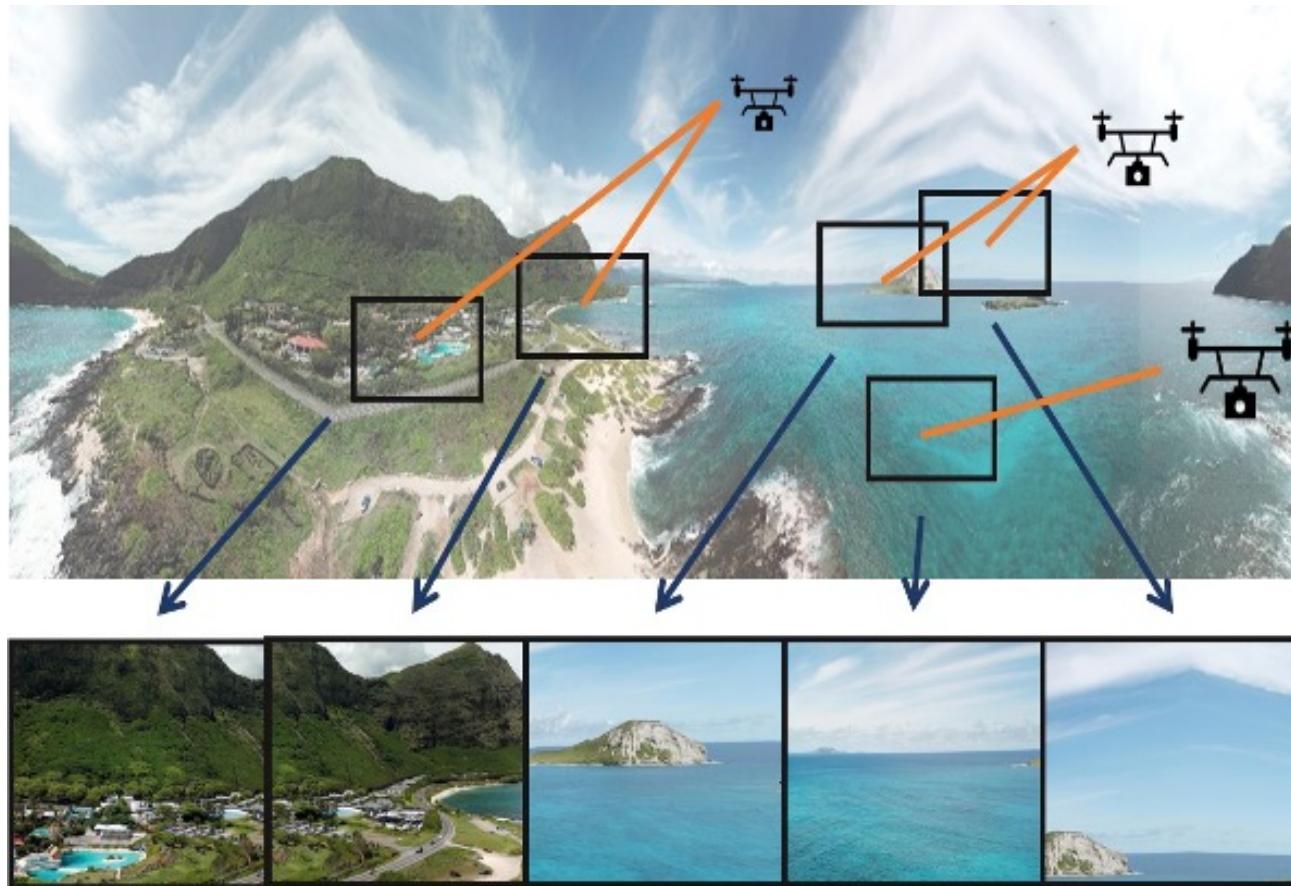
視覺定位 Visual Localization



影像特徵比對 Feature Matching

場景模型重建 Scene Modeling

Drone Exploration



MULTI-VIEW COLLABORATION

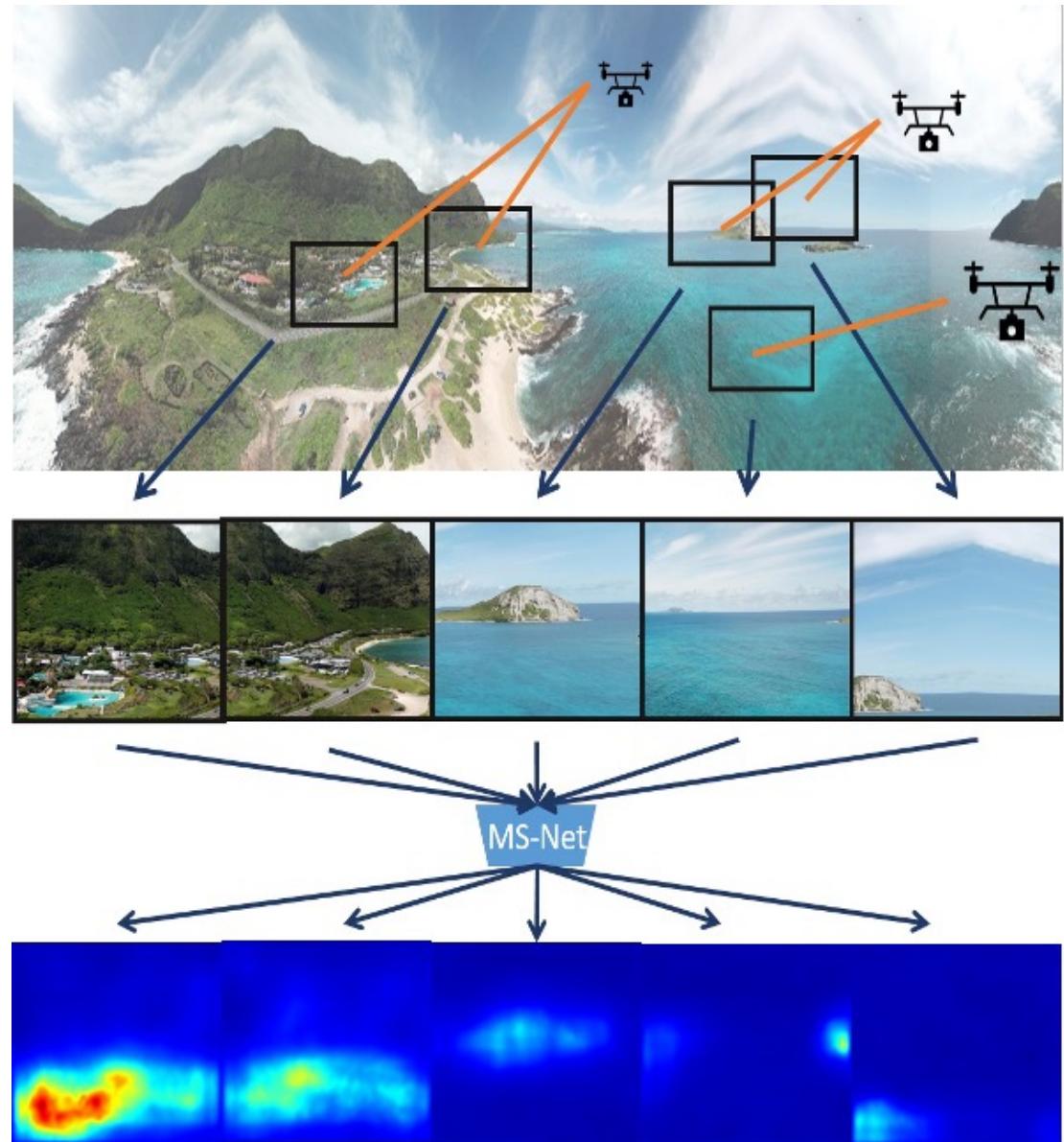


**Collaborative Learning of Multiple-
Discontinuous-Image Saliency Prediction
for Drone Exploration,**

T.-T. Chu, P.-H. Chen, P.-J. Huang, K.-W. Chen,
ICRA 2021

**Temporally-Aggregating Multiple-
Discontinuous-Image Saliency Prediction
with Transformer-Based Attention,**

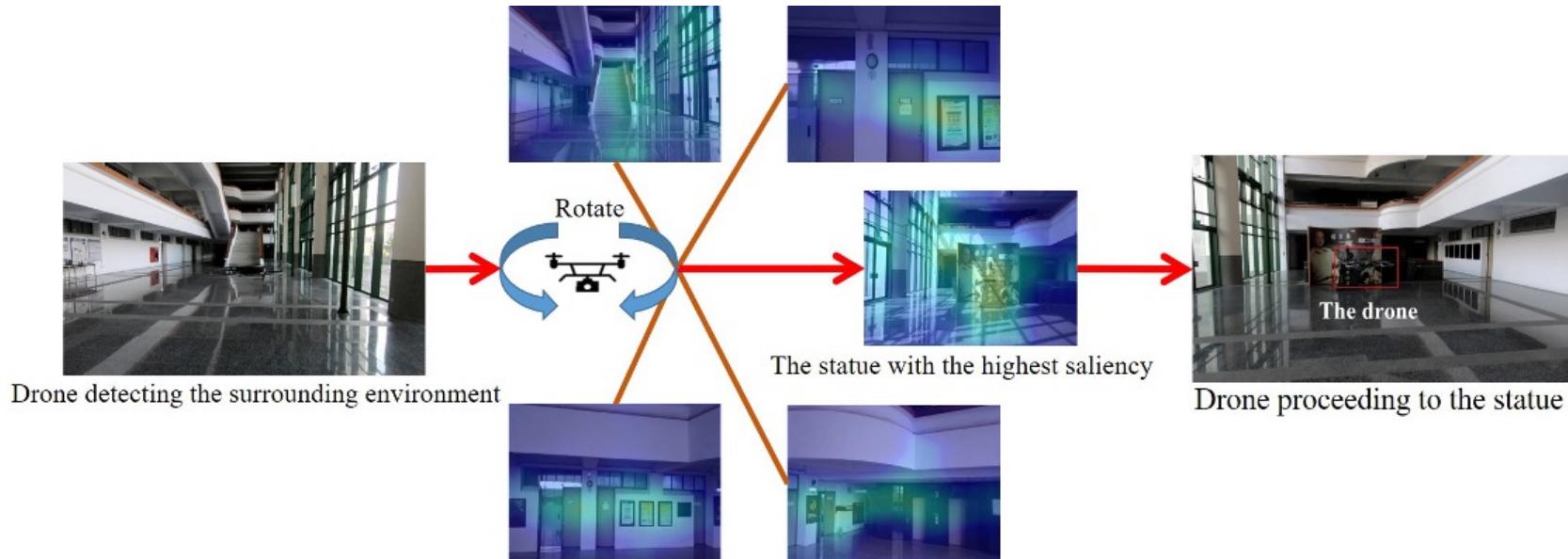
P.-J. Huang, C.-A. Lu, K.-W. Chen, *ICRA 2022*



DRONE AUTOPILOT - DRONE EXPLORATION



Efficient Drone Exploration in Real Unknown Environments ,
M.-R. Xie, S.-Y. Jung, K.-W. Chen, SIGGRAPH ASIA 2022 Poster



	Proposed	TA-MSNet
CPU Inference Time (s)	6.0	6.4
Number of Parameters (million)	57.48	108.07
CC ↑	0.1997	0.2075
SIM ↑	0.2483	0.2538
KL ↓	1.2218	1.2296

DRONE AUTOPILOT - DRONE EXPLORATION



Efficient Drone Exploration in Real Unknown Environments ,
M.-R. Xie, S.-Y. Jung, K.-W. Chen, *SIGGRAPH ASIA 2022 Poster*

Efficient Drone Exploration in Real Unknown Environments