The 2nd Workshop on UAVs in Multimedia: Capturing the World from a New Perspective

Zhedong Zheng
University of Macua
China
zhedongzheng@um.edu.mo

Yujiao Shi
ShanghaiTech University
China
shiyj2@shanghaitech.edu.cn

Tingyu Wang
Hangzhou Dianzi University
China
tingyu.wang@hdu.edu.cn

Chen Chen
University of Central Florida
USA
chen.chen@crcv.ucf.edu

Pengfei Zhu
Tianjing University
China
zhupengfei@tju.edu.cn

Richard Hartley
Australian National University
Australia
Richard.Hartley@anu.edu.au

ABSTRACT

Unmanned Aerial Vehicles (UAVs), also known as drones, have become increasingly popular in recent years due to their ability to capture high-quality multimedia data from the sky. With the rise of multimedia applications, such as aerial photography, cinematography, and mapping, UAVs have emerged as a powerful tool for gathering rich and diverse multimedia content. This workshop aims to bring together researchers, practitioners, and enthusiasts interested in UAV multimedia to explore the latest advancements, challenges, and opportunities in this exciting field. The workshop will cover various topics related to UAV multimedia, including aerial image and video processing, machine learning for UAV data analysis, UAV swarm technology, and UAV-based multimedia applications. In the context of the ACM Multimedia conference, this workshop is highly relevant as multimedia data from UAVs is becoming an increasingly important source of content for many multimedia applications. The workshop will provide a platform for researchers to share their work and discuss potential collaborations, as well as an opportunity for practitioners to learn about the latest developments in UAV multimedia technology. Overall, this workshop will provide a unique opportunity to explore the exciting and rapidly evolving field of UAV multimedia and its potential impact on the wider multimedia community.

CCS CONCEPTS

• **Computing methodologies** → **Vision for robotics**.

KEYWORDS

UVA Multimedia Understanding, Drone-based Video Analysis

ACM Reference Format:
Zhedong Zheng, Yujiao Shi, Tingyu Wang, Chen Chen, Pengfei Zhu, and Richard Hartley. 2024. The 2nd Workshop on UAVs in Multimedia: Capturing the World from a New Perspective. In *Proceedings of the 32nd ACM International Conference on Multimedia (MM '24), October 28 - November 1 2024, Melbourne, Australia.* ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3581783.3610937

MM '24, October 28-November 1, 2024, Melbourne, Australia

ACM ISBN 979-8-4007-0108-5/23/10.
https://doi.org/10.1145/3581783.3610937

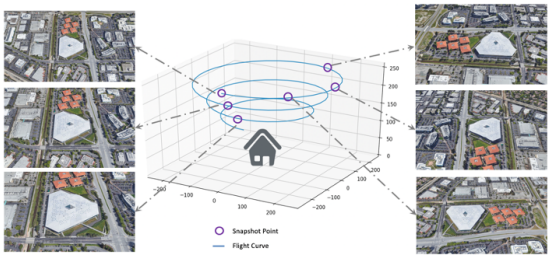

Figure 1: Different from conventional devices, UAV is a controllable aerial information capture platform, and multi-view information helps to establish a robust target model.

1 BACKGROUND AND MOTIVATION

Unmanned Aerial Vehicles (UAVs), also known as drones, have become increasingly popular in recent years due to their ability to capture high-quality multimedia data from the sky. This has opened up a wide range of possibilities for applications such as aerial photography [14, 33], cinematography [2, 12], mapping [9, 28, 36], agriculture [6, 13], geo-localization [10, 16–23] and delivery [3, 24]. UAVs have emerged as a powerful tool for gathering rich and diverse multimedia content, providing a unique vantage point with less occlusions [11, 25, 31, 32] and the ability to capture data from previously inaccessible or hard-to-reach locations (see Figure 1). The use of UAVs in multimedia applications has become even more significant in recent years with the emergence of new technologies such as machine learning, computer vision, big data analytics, and transfer learning [27, 29, 38]. These technologies have the potential to revolutionize the way UAVs are used to capture and analyze multimedia content, opening up new possibilities for applications such as automated image and video analysis [7, 8, 11, 26, 37], real-time tracking [30, 32], predictive modeling [5, 15], natural language control [1] and citywide simulation [34].

The ACM Multimedia conference has been at the forefront of multimedia research for over 32 years, providing a forum for researchers and practitioners to exchange ideas, explore the latest advancements, and discuss the challenges facing the field. In recent years, the conference has also started to cover the topic of UAV multimedia, recognizing the growing importance of this area of

research [4, 31, 32, 36]. The use of UAVs to capture multimedia data is becoming increasingly common, and the data captured by UAVs is becoming an important source of content for many multimedia applications. Therefore, we think it is good timing to hold a workshop for people with different backgrounds to communicate.

This workshop is the 2nd workshop on UAVs in Multimedia (UAVM) since 2023 [35]. In 2023, the first UAVM'23 attracted 55 registered participants, 22 teams from various countries provided results in the challenge, and accepted 13 high-quality papers. The motivation behind this workshop is to contribute to this ongoing conversation and provide a platform for experts in the field of UAV multimedia to discuss the latest research and developments. The workshop will cover a wide range of topics related to UAV multimedia, including image and video processing, machine learning, swarm technology, and applications such as aerial photography, cinematography, and mapping. For instance, the cross-view matching is also included, as shown in Figure 2. Through this workshop, we hope to bring together experts from academia and industry to share their insights and expertise on UAV multimedia, explore the latest advancements and challenges in the field, and encourage new collaborations and research initiatives. By doing so, we believe that this workshop will contribute to the ongoing dialogue on UAV multimedia and its role in the wider multimedia community.

2 TARGET AUDIENCE & PROMOTION

We plan to promote the UAV workshop in order to increase audience awareness and interest, targeting researchers, academics, industry data scientists and engineers, as well as other parties interested in the latest developments and advances in the field. To achieve this, we will take several measures: **1).** Use social media platforms, such as Twitter and Facebook, to promote the workshop topic and event. We will create an event page on Facebook and invite people to attend, as well as share updates about the workshop on Twitter. **2).** Create a website for the UAV workshop that provides detailed information about the agenda, speakers, and registration. We will share the website link on our social media platforms to make it accessible to a wider audience. By utilizing social media and creating a website, we aim to increase the visibility of our UAV workshop and attract a diverse range of attendees from various fields who are interested in learning about the latest research and opportunities in UAVs.

3 TOPICS AND THEMES

Topics covered in this workshop (but not limited to) is as follows:

- Video-based UAV Navigation
  - Satellite-guided & Ground-guided Navigation
  - Path Planning and Obstacle Avoidance
  - Visual SLAM (Simultaneous Localization and Mapping)
  - Sensor Fusion and Reinforcement Learning for Navigation
- UAV Swarm Coordination
  - Multiple Platform Collaboration
  - Multi-agent Cooperation and Communication
  - Decentralized Control and Optimization
  - Distributed Perception and Mapping
- UAV-based Object Detection and Tracking
  - Aerial-view Object Detection, Tracking and Re-identification
  - Aerial-view Action Recognition
- UAV-based Sensing and Mapping
  - 3D Mapping and Reconstruction
  - Remote Sensing and Image Analysis
  - Disaster Response and Relief
- UAV-based Delivery and Transportation
  - Package Delivery and Logistics
  - Safety and Regulations for UAV-based Transportation

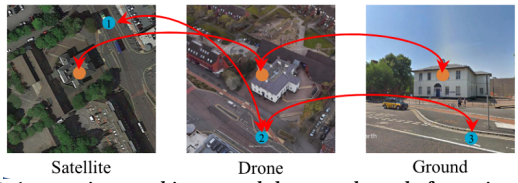

Figure 2: A cross-view matching example between three platforms, *i.e.*, satellite, drone and ground. The figure is credited by LPN [28].

4 ACTIVITIES AND INVITED KEYNOTES

We plan to hold a hybrid format of workshop, *i.e.*, both onsite and online. For the onsite one at least two organizers will attend in person to host the workshop. The workshop will include two major activities, the invited keynotes, and the paper presentations. We will invite keynote presentations for a half-day workshop, following by accepted workshop presentations. The speakers are the experts on the relevant community from different organizations globally. The schedule of the workshop activities are listed in Table 1.

5 PAPER SUBMISSION AND REVIEWING

5.1 Challenge Dataset

We also provide a multi-weather cross-view geo-localization dataset, called University160k-WX, and the workshop audience may consider to participate in the competition. The motivation is to simulate the real-world geo-localization scenario. In particular, University160k extends the current University-1652 dataset [36] with extra 167,486 satellite-view gallery distractors. University160k-WX further introduces weather variants on University160k, including fog, rain, snow and multiple weather compositions. We will release University160k-WX on our website, and make a public leader board. These distractor satellite-view images have a size of 1024×1024 and are obtained by cutting orthophoto images of real urban and surrounding areas. Multiple weathers are randomly sampled to increase the difficulty of representation learning (see Figure 3). In our primary evaluation, the distractor is challenging and makes the competitive baseline model, LPN [28], decrease the Recall@1 accuracy from 75.93% to 64.85% and the value of AP from 79.14% to 67.69% in the Drone $\rightarrow$ Satellite task. If we further introduce extreme weather, the performance further drops from 64.85% to 7.94% (see Table 2). We hope more audiences can be involved to solve this challenge, and consider the robustness problem against extreme weather.

Table 1: Schedule of workshop activities.

Topic	Duration	Speaker	Organization
• **Morning Schedule**			
An opening of the workshop	5 min	Tat-seng Chua	National University of Singapore
Where We Are and What We're Looking At	30 min	Mubarak Shah	University of Central Florida
From Coarse Global to Fine Structure from Motion	30 min	Gim Hee Lee	National University of Singapore
Coffee Break	10 min		
Round Table Discussion	30 min	Workshop Host	
Geometry-guided street-view panorama synthesis	30 min	Hongdong Li	Australian National University
Revisiting Near/Remote Sensing with Geospatial Attention	30 min	Nathan Jacobs	Washington University in St. Louis
• **Afternoon Schedule**			
Paper1 Presentation	20 min	TBD	
Paper2 Presentation	20 min	TBD	
Paper3 Presentation	20 min	TBD	
...			

Table 2: Here, we show the result on different subsets. The competitive baseline model's performance drops significantly with diverse weather variants added. Therefore, we call for the audience to design a robust algorithm against our challenging large-scale satellite pool to minimize such performance gaps.

Dataset	#Distractor	LPN	
		Drone → Satellite	
		R@1	AP
University-1652 [36]	0	**75.93**	**79.14**
University160k	167,486	64.85 (-11.08)	67.69 (-11.45)
University160k-WX	167,486	7.94 (-67.99)	8.49 (-70.65)

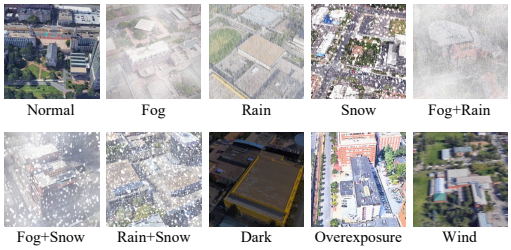

Figure 3: Multiple weather samples in University160k-WX, with diverse building types.

5.2 Submission Types

In this workshop, we welcome two types of submissions, all of which should relate to the topics and themes as listed in Section 3: **(1).** Challenge papers (up to 4 pages in length, plus unlimited pages for references): original solution to the Challenge data, University160k-WX, in terms of effectiveness and efficiency. **(2).** Original papers (up to 4 pages in length, plus unlimited pages for references): original ideas, perspectives, research vision, and open challenges in the area of evaluation approaches for UAVs in Multimedia; Page limits include diagrams and appendices. Submissions should be single-blind, written in English, and formatted according to the current ACM two-column conference format. Suitable LaTeX, Word, and Overleaf templates are available from the ACM Website (use "sigconf" proceedings template for LaTeX and the Interim Template for Word).

5.3 Potential Program Committee Members

We will invite the following experts as the (senior) potential program committee (PC) members to organize the reviewing process. (1) Dylan Campbell (Australian National University, Australia), (2) Tawfiq Salem (Purdue University, USA), (3) Julian F.P.Kooij (Delft University of Technology, Netherlands), [4] Long Chen (Hong Kong University of Science and Technology, China), (5) Yawei Luo (Zhejiang University, China), (6) Torsten Sattler (Czech Technical University in Prague, Czech Republic), (7) Laurent Kneip (ShanghaiTech University, China), (8) Yan Yan (Washington State University, USA), (9) Paul-Edouard Sarlin (ETH Zurich, Switzerland), (10) Zhun Zhong (University of Trento, Italy)

6 ORGANIZER INFORMATION

Zhedong Zheng (https://zdzheng.xyz) is an assistant professor with the University of Macau. He was a research fellow at School of Computing, National University of Singapore. He received the Ph.D. degree from the University of Technology Sydney, Australia, in 2021 and the B.S. degree from Fudan University, China, in 2016. He received the IEEE Circuits and Systems Society Outstanding Young Author Award of 2021. He has organized a special session on reliable retrieval at ICME'22, two workshops at ACM MM'23 and one workshop at ACM ICMR'24. Besides, he is invited as a keynote speaker at CVPR'20, CVPR'21, a tutorial speaker at ACM MM'22. He also serves as an area chair at ACM MM'24.

Yujiao Shi (https://yujiaoshi.github.io/) is an Assistant Professor at ShanghaiTech University. She was previously a research fellow and PhD student at the Australian National University, supervised by Prof. Hongdong Li. Her research interests include multi-modal retrieval, registration and translation, 3D vision, and self-supervised learning. She was a tutorial speaker on aerial image-based localization at CVPR 2023.

Tingyu Wang (https://scholar.google.com/citations?user=wv3H-F4AAAAJ) is an assistant professor at the School of Information and Communication Engineering, Hangzhou Dianzi University, Hangzhou, China. He received his Ph.D. degree from the Lab of Intelligent Information Processing, Hangzhou Dianzi University, in 2023, supervised by Prof. Chenggang Yan. His research interests include deep learning, image retrieval and remote sensing.

Chen Chen (https://www.crcv.ucf.edu/chenchen/) is an Assistant Professor at the Center for Research in Computer Vision, University of Central Florida. He received the Ph.D. degree from the Department of Electrical Engineering, University of Texas at Dallas in 2016, where he received the David Daniel Fellowship (Best Doctoral Dissertation Award). His research interests include computer vision, efficient deep learning, and federated learning. Dr. Chen was an Area Chair for CVPR 2022, ECCV 2022, ACM Multimedia 2019-2022, ICME 2021-2023, and WACV 2019. His paper entitled "Local Learning Matters: Rethinking Data Heterogeneity in Federated Learning" was one of the finalists for the CVPR 2022 Best Paper. He organized CVPR 2021 and 2023 tutorials on "Cross-view

and cross-modal visual geo-localization". He was the lead organizer of the Workshop on Federated Learning for Computer Vision (FedVision) in conjunction with CVPR 2022, 2023, and 2024.

Pengfei Zhu (https://cic.tju.edu.cn/faculty/zhupengfei/index.html) is an associate professor at College of Intelligence and Computing of Tianjin University. He has successfully organized six VisDrone Challenges since 2018 at conferences such as ECCV and ICCV as the primary organizer of VisDrone.

Richard Hartley (http://users.cecs.anu.edu.au/~hartley/) (Fellow, IEEE) is an Emeritus Professor with the ANU College of Engineering, Computing and Cybernetics. Richard is renowned as one of the founders of the field of multi-view geometry in computer vision – his text has received over 34,000 citations. Richard has been at ANU since January 2001. He was also the Program Leader for the Autonomous Systems and Sensor Technology Program of NICTA. Richard worked at the General Electric Research and Development Center from 1985 to 2001, where he became involved with Image Understanding and Scene Reconstruction, working with GE's Simulation and Control Systems Division. This division built large-scale flight simulators. Professor Hartley's projects in this area were in the construction of terrain models and texture mosaics from aerial and satellite imagery. From 1995, he was GE project leader for a shared-vision project with Lockheed-Martin involving the design and implementation of algorithms for an AFIS (fingerprint analysis) system being developed under a Lockheed-Martin contract with the FBI. This involved work in feature extraction, interactive fingerprint editing, and fingerprint database matching. In 2000, he co-authored (with Andrew Zisserman) a book for Cambridge University Press, summarizing the previous decade's research in this area. (Over 70,000 citations and an h-index of 85).

Acknowledgments. We really appreciate Dinnovate Technology (https://www.dinnovate.cn/) providing us the real satellite data that they collected in urban scenes during different weather.

REFERENCES

[1] Meng Chu, Zhedong Zheng, Wei Ji, Tingyu Wang, and Tat-Seng Chua. 2023. Towards Natural Language-Guided Drones: GeoText-1652 Benchmark with Spatially Relation Matching. *arXiv preprint arXiv:2311.12751* (2023).
[2] Yuanjie Dang, Chong Huang, Peng Chen, Ronghua Liang, Xin Yang, and Kwang-Ting Cheng. 2022. Path-Analysis-Based Reinforcement Learning Algorithm for Imitation Filming. *TMM* (2022).
[3] Didula Dissanayaka, Thumeera R Wanasinghe, Oscar De Silva, Awantha Jayasiri, and George KI Mann. 2023. Review of Navigation Methods for UAV-Based Parcel Delivery. *TASE* (2023).
[4] Tzu-Yi Fan, Fangqi Liu, Jia-Wei Fang, Nalini Venkatasubramanian, and Cheng-Hsin Hsu. 2022. Enhancing situational awareness with adaptive firefighting drones: leveraging diverse media types and classifiers. In *ACM Multimedia*.
[5] Jianwu Fang, Lei-Lei Li, Kuan Yang, Zhedong Zheng, Jianru Xue, and Tat-Seng Chua. 2022. Cognitive Accident Prediction in Driving Scenes: A Multimodality Benchmark. *arXiv:2212.09381* (2022).
[6] Payton Goodrich, Omar Betancourt, Ana Claudia Arias, and Tarek Zohdi. 2023. Placement and drone flight path mapping of agricultural soil sensors using machine learning. *Computers and Electronics in Agriculture* (2023).
[7] Pu Jin, Lichao Mou, Gui-Song Xia, and Xiao Xiang Zhu. 2022. Anomaly Detection in Aerial Videos With Transformers. *TGRS* (2022).
[8] Tianjiao Li, Jun Liu, Wei Zhang, Yun Ni, Wenqian Wang, and Zhiheng Li. 2021. Uav-human: A large benchmark for human behavior understanding with unmanned aerial vehicles. In *CVPR*.
[9] Jinliang Lin, Zhedong Zheng, Zhun Zhong, Zhiming Luo, Shaozi Li, Yi Yang, and Nicu Sebe. 2022. Joint Representation Learning and Keypoint Detection for Cross-view Geo-localization. *TIP* (2022).
[10] Liu Liu and Hongdong Li. 2019. Lending orientation to neural networks for cross-view geo-localization. In *CVPR*.
[11] Zhihao Liu, Yuanyuan Shang, Timing Li, Guanlin Chen, Yu Wang, Qinghua Hu, and Pengfei Zhu. 2023. Robust Multi-Drone Multi-Target Tracking to Resolve Target Occlusion: A Benchmark. *TMM* (2023).
[12] Ioannis Pitas and Ioannis Mademlis. 2022. Autonomous UAV Cinematography. In *ACM Multimedia*.
[13] Redmond Ramin Shamshiri, Ibrahim A Hameed, Siva K Balasundram, Desa Ahmad, Cornelia Weltzien, and Muhammad Yamin. 2018. Fundamental research on unmanned aerial vehicles to support precision agriculture in oil palm plantations. *Agricultural Robots-Fundamentals and Application* (2018).
[14] Mingwen Shao, Chao Wang, Wangmeng Zuo, and Deyu Meng. 2022. Efficient pyramidal GAN for versatile missing data reconstruction in remote sensing images. *IEEE Transactions on Geoscience and Remote Sensing* 60 (2022), 1–14.
[15] Yujiao Shi, Dylan John Campbell, Xin Yu, and Hongdong Li. 2022. Geometry-guided street-view panorama synthesis from satellite imagery. *TPAMI* (2022).
[16] Yujiao Shi and Hongdong Li. 2022. Beyond Cross-view Image Retrieval: Highly Accurate Vehicle Localization Using Satellite Image. In *CVPR*.
[17] Yujiao Shi, Liu Liu, Xin Yu, and Hongdong Li. 2019. Spatial-Aware Feature Aggregation for Image based Cross-View Geo-Localization. In *NeurIPS*.
[18] Yujiao Shi, Fei Wu, Akhil Perincherry, Ankit Vora, and Hongdong Li. 2023. Boosting 3-DoF Ground-to-Satellite Camera Localization Accuracy via Geometry-Guided Cross-View Transformer. In *ICCV*.
[19] Yujiao Shi, Xin Yu, Dylan Campbell, and Hongdong Li. 2020. Where am I looking at? joint location and orientation estimation by cross-view matching. In *CVPR*.
[20] Yujiao Shi, Xin Yu, Liu Liu, Dylan Campbell, Piotr Koniusz, and Hongdong Li. 2022. Accurate 3-DoF Camera Geo-Localization via Ground-to-Satellite Image Matching. *TPAMI* (2022).
[21] Yujiao Shi, Xin Yu, Liu Liu, Tong Zhang, and Hongdong Li. 2020. Optimal feature transport for cross-view image geo-localization. In *AAAI*.
[22] Yujiao Shi, Xin Yu, Shan Wang, and Hongdong Li. 2022. CVLNet: Cross-View Feature Correspondence Learning for Video-based Camera Localization. In *ACCV*.
[23] Zhenbo Song, Xianghui Ze, Jianfeng Lu, and Yujiao Shi. 2023. Learning Dense Flow Field for Highly-accurate Cross-view Camera Localization. *arXiv:2309.15556* (2023).
[24] Francesco Betti Sorbelli, Federico Corò, Lorenzo Palazzetti, Cristina M Pinotti, and Giulio Rigoni. 2023. How the Wind Can Be Leveraged for Saving Energy in a Truck-Drone Delivery System. *TITS* (2023).
[25] Chao Wang, Mingwen Shao, Deyu Meng, and Wangmeng Zuo. 2022. Dual-pyramidal image inpainting with dynamic normalization. *IEEE Transactions on Circuits and Systems for Video Technology* 32, 9 (2022), 5975–5988.
[26] Chao Wang, Zhedong Zheng, Ruijie Quan, Yifan Sun, and Yi Yang. 2023. Context-Aware Pretraining for Efficient Blind Image Decomposition. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 18186–18195.
[27] Tingyu Wang, Zhedong Zheng, Yaoqi Sun, Tat-Seng Chua, Yi Yang, and Chenggang Yan. 2024. Multiple-environment Self-adaptive Network for Aerial-view Geo-localization. *Pattern Recognition* (2024).
[28] Tingyu Wang, Zhedong Zheng, Chenggang Yan, Jiyong Zhang, Yaoqi Sun, Bolun Zheng, and Yi Yang. 2021. Each part matters: Local patterns facilitate cross-view geo-localization. *TCSVT* (2021).
[29] Tingyu Wang, Zhedong Zheng, Zunjie Zhu, Yuhan Gao, Yi Yang, and Chenggang Yan. 2022. Learning Cross-view Geo-localization Embeddings via Dynamic Weighted Decorrelation Regularization. *arXiv:2211.05296* (2022).
[30] Longyin Wen, Dawei Du, Pengfei Zhu, Qinghua Hu, Qilong Wang, Liefeng Bo, and Siwei Lyu. 2021. Detection, tracking, and counting meets drones in crowds: A benchmark. In *CVPR*.
[31] Cai YuanQiang, Dawei Du, Libo Zhang, Longyin Wen, Weiqiang Wang, Yanjun Wu, and Siwei Lyu. 2020. Guided attention network for object detection and counting on drones. In *ACM Multimedia*.
[32] Haotian Zhang, Gaoang Wang, Zhichao Lei, and Jenq-Neng Hwang. 2019. Eye in the sky: Drone-based object tracking and 3d localization. In *ACM Multimedia*.
[33] LiangLiang Zhao and MinLing Zhu. 2023. MS-YOLOv7: YOLOv7 Based on Multi-Scale for Object Detection on UAV Aerial Photography. *Drones* (2023).
[34] Ou Zheng, Mohamed Abdel-Aty, Lishengsa Yue, Amr Abdelraouf, Zijin Wang, and Nada Mahmoud. 2022. CitySim: A Drone-Based Vehicle Trajectory Dataset for Safety Oriented Research and Digital Twins. *arXiv:2208.11036* (2022).
[35] Zhedong Zheng, Yujiao Shi, Tingyu Wang, Jun Liu, Jianwu Fang, Yunchao Wei, and Tat-seng Chua. 2023. UAVM'23: 2023 Workshop on UAVs in Multimedia: Capturing the World from a New Perspective. In *Proceedings of the 31st ACM International Conference on Multimedia*. 9715–9717.
[36] Zhedong Zheng, Yunchao Wei, and Yi Yang. 2020. University-1652: A multi-view multi-source benchmark for drone-based geo-localization. In *ACM Multimedia*.
[37] Zhedong Zheng and Yi Yang. 2019. Unsupervised scene adaptation with memory regularization in vivo. *IJCAI* (2019).
[38] Zhedong Zheng and Yi Yang. 2022. Adaptive boosting for domain adaptation: Toward robust predictions in scene segmentation. *IEEE Transactions on Image Processing* 31 (2022), 5371–5382.