UAVs in Multimedia: Capturing the World from a New Perspective

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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 \rightarrow Vision for robotics.

KEYWORDS

UVA Multimedia Understanding, Drone-based Video Analysis

ACM MM '23, October 29 – November 3, 2023, Ottawa, Canada © 2023 Copyright held by the owner/author(s). ACM ISBN 978-1-4503-9203-7/22/10.

https://doi.org/10.1145/3503161.3546969

ACM Reference Format: Zhedong Zheng, Yujiao Shi, Tingyu Wang, Jun Liu, Jianwu Fang, Yunchao Wei, and Tat-seng Chua. 2023. UAVs in Multimedia: Capturing the World from a New Perspective. In Proceedings of the 31st ACM International Conference on Multimedia, October 29 – November 3, 2023, Ottawa, Canada. ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3503161.3546969

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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 [26], cinematography [1, 11], mapping [8, 21, 28], agriculture [5, 12], geo-localization [9, 14-18] and delivery [2, 19]. UAVs have emerged as a powerful tool for gathering rich and diverse multimedia content, providing a unique vantage point with less occlusions [10, 24, 25] 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, and big data analytics [20, 22]. 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 [6, 7, 10, 29], real-time tracking [23, 25], predictive modeling [4, 13], and citywide simulation [27].

The ACM Multimedia conference has been at the forefront of multimedia research for over 31 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 [3, 24, 25, 28]. 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

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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.

workshop for people with different backgrounds to communicate in person.

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 UAV.

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

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Figure 2: A cross-view matching example between three platforms, *i.e.*, satellite, drone and ground. The figure is credited by LPN [21].

- 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

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 ??.

5 PAPER SUBMISSION AND REVIEWING

5.1 Challenge Dataset

We also provide a challenging cross-view geo-localization dataset, called University160k, and the workshop audience may consider to participate the competition. The motivation is to simulate the realworld geo-localization scenario that we usually face an extremely large satellite-view pool. In particular, University160k extends the current University-1652 dataset [28] with extra 167,486 satelliteview gallery distractors. We will release University160k on our website, and make a public leader board. These distractor satelliteview images have a size of 1024×1024 and are obtained by cutting orthophoto images of real urban and surrounding areas. The larger image size ensures higher image clarity, while the wider framing range allows the images to contain more diverse scenes, such as buildings, city roads, trees, fields, and more (see Figure 3). In our primary evaluation, the distractor is challenging and make the competitive baseline model, LPN [21], 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 (Please see Table 2). We hope more audiences can be involved to solve this challenge, and may also consider the efficiency problem against a large candidate pool.

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	Торіс	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 1: Schedule of workshop activities

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

	#Distractor	LPN	
Dataset		Drone \rightarrow Satellite	
		R@1	AP
University-1652 [28]	0	75.93	79.14
+ Subset1-lian1	18,155	68.09	71.18
+ Subset2-kai1	43,728	71.62	74.42
+ Subset3-lian2	37,522	69.10	72.03
+ Subset4-kai2	6,8081	69.03	71.95
University160k	167,486	64.85 (-11.08)	67.69 <mark>(-11.45)</mark>

5.2 **Submission Types**

In this workshop, we welcome four 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, in terms of effectiveness and efficiency. (2). Position or perspective 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 explainable recommender systems; (3). Featured papers (title and abstract of the paper, plus the original paper): already published papers or papers summarizing existing publications in leading conferences and highimpact journals that are relevant for the topic of the workshop; (4). Demonstration papers (up to 2 pages in length, plus unlimited pages for references): original or already published prototypes and operational evaluation approaches in the area of explainable recommender systems. 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),



Figure 3: Distractor samples in University 160k, with diverse building types. (9) Paul-Edouard Sarlin (ETH Zurich, Switzerland), (10) Zhun Zhong (University of Trento, Italy)

ORGANIZER INFORMATION 6

Zhedong Zheng (https://zdzheng.xyz) is a research fellow at NExT++, 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 has published 33 papers in highly selective venues such as CVPR, ICCV, ACM MM, TMM, IJCV and TPAMI with a citation of 7,000+ times in Google Scholar. He has served as the reviewer and program committee (PC) member for multiple conferences and journals, including TPAMI, TMM, IJCV, CVPR, ICCV, ECCV, IJCAI, AAAI and ACM Multimedia, and organized a special session on reliable retrieval at ICME 2022. Besides, he is also invited as a keynote speaker at CVPR 2020, and 2021, and a tutorial speaker at ACM Multimedia 2022.

Yujiao Shi (https://shiyujiao.github.io/) is a research fellow at the Australian National University where she did her Ph.D. degree. She received the M.S and B.S degree from Nanjing University of Posts and Telecommunications, China, in 2014 and 2017, respectively. Her research interests include multi-modal retrieval, registration and translation, 3D vision, and self-supervised learning. She has published seven first-author papers in aerial image-related tasks in top-tier conferences, including CVPR, NeurIPS, TPAMI et al.. She is also invited as a tutorial speaker on aerial image-based localization at CVPR 2023.

Tingyu Wang (https://scholar.google.com/citations?user=wv3H-F4AAAAJ) received the B.S. degree in automation from Yantai University, Shandong, China, in 2015, and the M.S. degree in automation from Hangzhou Dianzi University, Hangzhou, China, in 2018. He will be awarded the Ph.D. degree in April with the department of automation of Hangzhou Dianzi University, Hangzhou, China and serve as a lecturer at Hangzhou Dianzi University. His research interests include deep learning, image retrieval and remote sensing. ACM MM '23, October 29 - November 3, 2023, Ottawa, Canada

Jun Liu (https://istd.sutd.edu.sg/people/faculty/liu-jun) is currently an assistant professor at Singapore University of Technology and Design. He received the PhD degree from Nanyang Technological University, the MSC degree from Fudan University, and the BEng degree from Central South University. His research interests include computer vision and artificial intelligence. He is an Associate Editor of IEEE Transactions on Image Processing and IEEE Transactions on Biometrics, Behavior, and Identity Science, and Area Chair of ICML, NeurIPS, ICLR, and WACV in 2022 and 2023.

Jianwu Fang (www.lotvs.net) received the Ph.D. degree in signal and information processing (SIP) from the University of Chinese Academy of Sciences, China, in 2015. He is currently the Director and an Associate Professor with the Laboratory of Traffic Vision Safety (LOTVS) and the Department of Big Data Management and Application, College of Transportation Engineering, Chang'an University, Xi'an, China. He has been the reviewer and program committee (PC) member for many top conferences and journals, including CVPR, ICCV, ACM MM, ICRA, AAAI, IJCAI, IROS, TIP, TITS, TCSVT, TCYB, TIV *et al.*. His research interests include computer vision and pattern recognition and their applications intelligent transportation.

Yunchao Wei (https://weiyc.github.io) received the Ph.D. degree from Beijing Jiaotong University in 2016. He is currently an Assistant Professor with Beijing Jiaotong University. Before joining BJTU, he was an Assistant Professor at the University of Technology Sydney. His main research interests include deep learning and its applications in computer vision, e.g., image classification, video/image object detection/segmentation, and learning with imperfect data. He received the Excellent Doctoral Dissertation Award of CIE in 2016, the ARC Discovery Early Career Researcher Award in 2019, and the First Prize in Science and Technology awarded by China Society of Image and Graphics in 2019.

Tat-seng Chua (https://www.chuatatseng.com/) received the Ph.D. degree from the University of Leeds, U.K. He is the KITHCT Chair Professor with the School of Computing, National University of Singapore, where he was the Acting and Founding Dean of the School from 1998 to 2000. His main research interests include multimedia information retrieval and social media analytics. He is the Co-Director of NExT, a joint center between NUS and Tsinghua University, to develop technologies for live social media search. He is the 2015 winner of the prestigious ACM SIGMM Award for Outstanding Technical Contributions to Multimedia Computing, Communications, and Applications. He is the Chair of Steering Committee of the ACM International Conference on Multimedia Retrieval (ICMR) and Multimedia Modeling (MMM) conference series. He is also the General Co-Chair of ACM Multimedia 2005, ACM CIVR (now ACM ICMR) 2005, ACM SIGIR 2008, and ACM Web Science 2015. He serves on the editorial boards of four international journals. He is the Co-Founder of two technology startup companies in Singapore.

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.

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