



ICRA2024
YOKOHAMA | JAPAN



RoboDrive

RoboDrive Challenge

ICRA 2024 Competition

May 15th, 2024

Yokohama, Japan



Agenda

1. Competition Overview
2. Spotlight Talk
3. Track Presentation
4. Award Ceremony
5. Concluding Remark



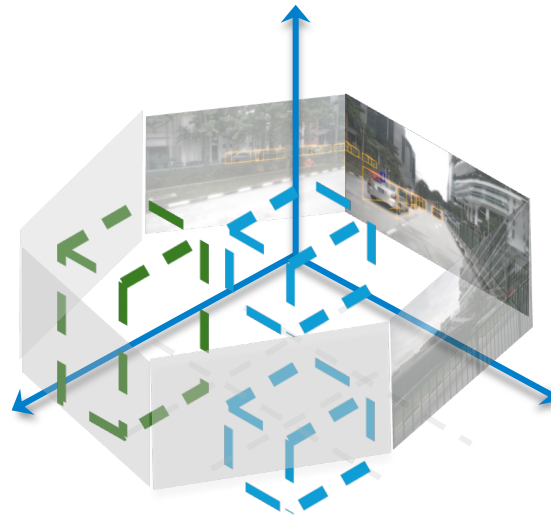
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Competition Overview

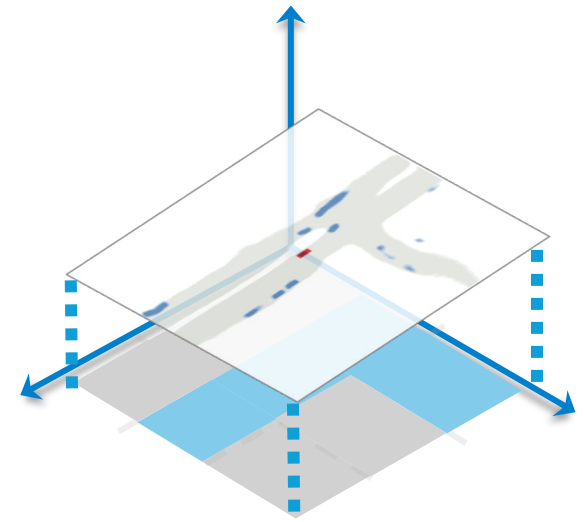


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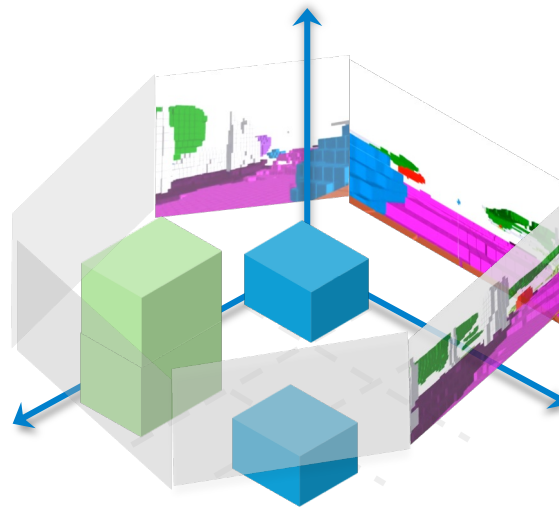
Perception Task



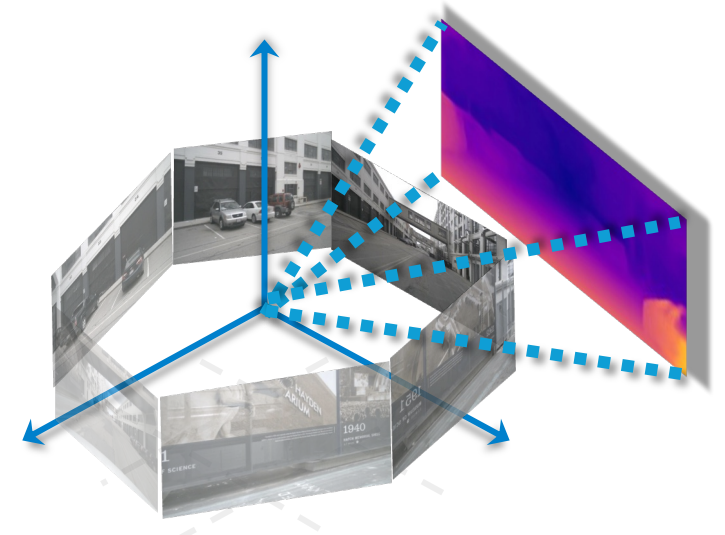
Detection



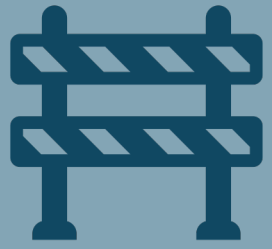
Segmentation



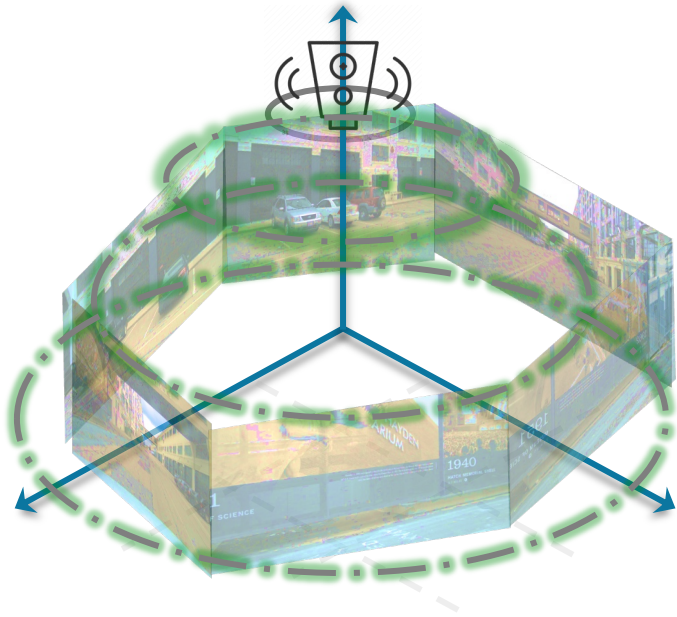
Occupancy



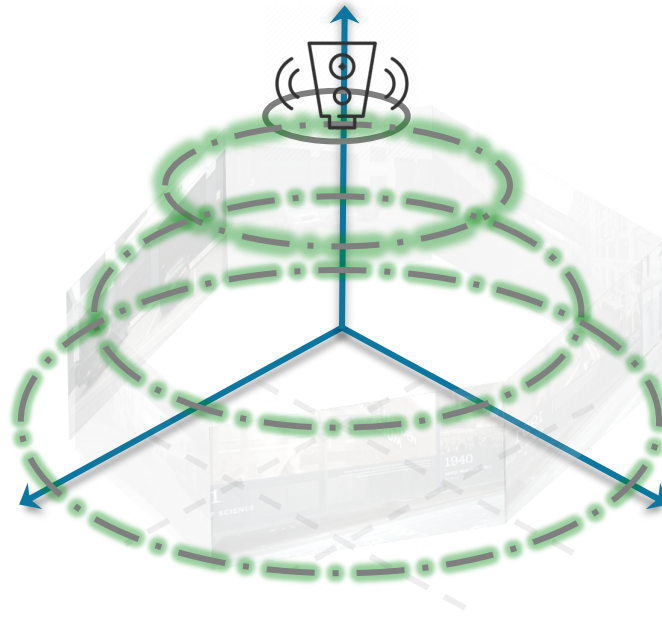
Depth



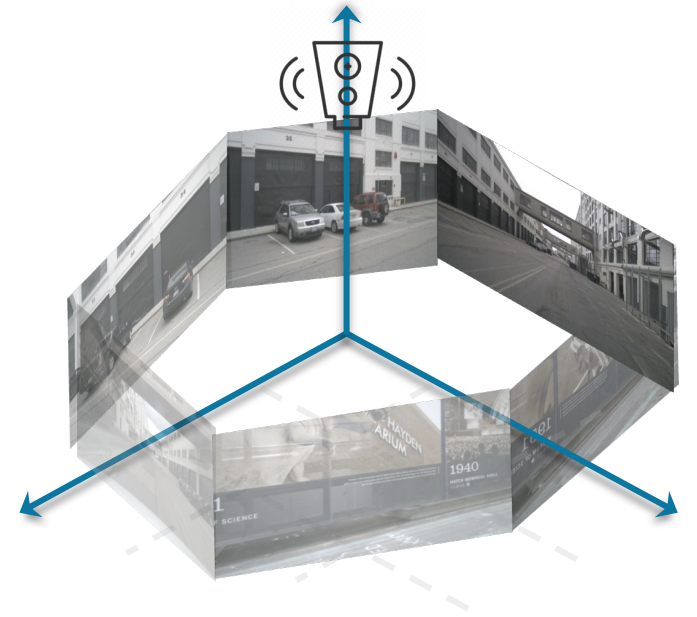
Challenging Conditions



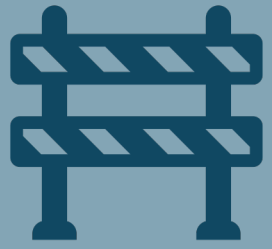
Camera
Corruption



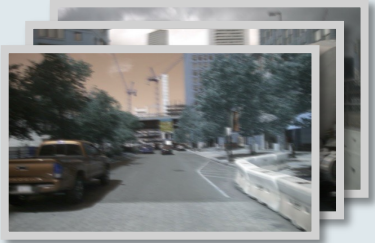
Camera
Failure



LiDAR
Failure



Common Corruption



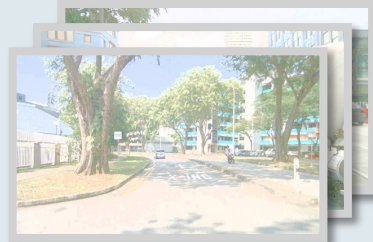
 Motion



 Quant



 Dark



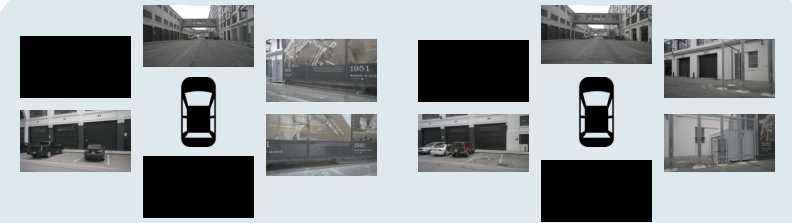
 Bright



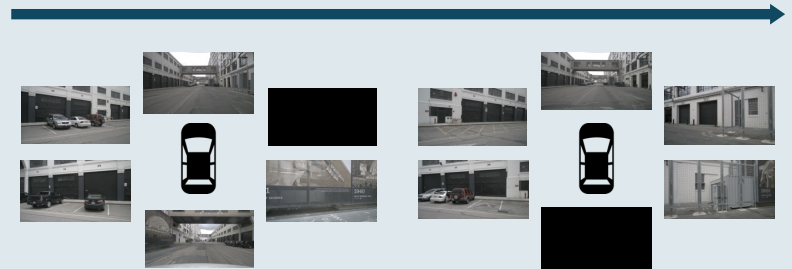
 Snow



 Fog



Camera Crash



Frame Lost

Competition Organizers



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Lingdong Kong



Shaoyuan Xie



Hanjiang Hu



Yaru Niu



Wei Tsang Ooi



Benoit R Cottureau



Lai Xing Ng



Yuexin Ma



Wenwei Zhang



Liang Pan



Kai Chen



Ziwei Liu

RoboBEV & Robo3D

The RoboBEV and Robo3D benchmarks are pioneering efforts in evaluating the out-of-distribution robustness of 3D perception models.

These two codebase lay the foundation for the RoboDrive Challenge @ ICRA 2024.

More information:

- RoboBEV:
<https://github.com/Daniel-xsy/RoboBEV>
- Robo3D:
<https://github.com/ldkong1205/Robo3D>



Codebase



RoboDrive

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MMDetection3D

MMDetection3D is an open-source toolbox based on PyTorch, towards the next-generation platform for general 3D perception.

More information: <https://github.com/open-mmlab/mmdetection3d>



– Shanghai Artificial Intelligence Laboratory –



Codebase



MMDetection3D

OpenMMLab



Affiliated Project



DesCartes
CNRS@CREATE

Program DesCartes

The program DesCartes aims to develop disruptive hybrid AI to serve the smart city and enable optimized decision-making in complex situations for critical urban systems.

More information:

<https://descartes.cnrsatcreate.cnrs.fr>



Sponsor & Tech Committee



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2024 RoboDrive Challenge Technical Committee



Weichao Qiu

HUAWEI Noah's
Ark Lab



Wei Zhang

HUAWEI Noah's
Ark Lab

HUAWEI Noah's Ark Lab

The Noah's Ark Lab is the AI research center for Huawei Technologies.

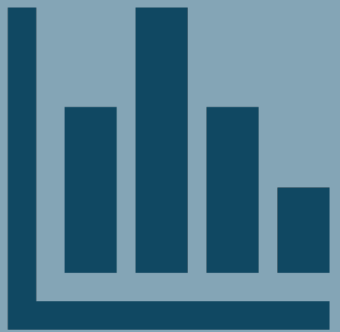
Founded in 2012, the lab has now grown to be a research organization with many significant achievements in both academia and industry.

More information:

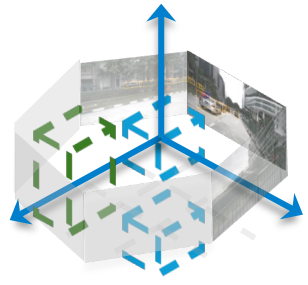
<https://www.noahlab.com.hk>



Competition Statistics

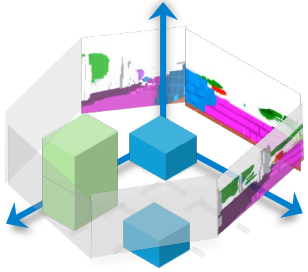


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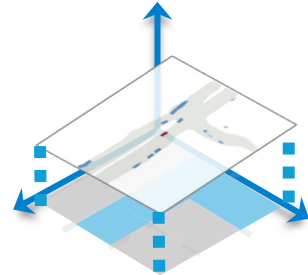
Track 1

Robust BEV Detection



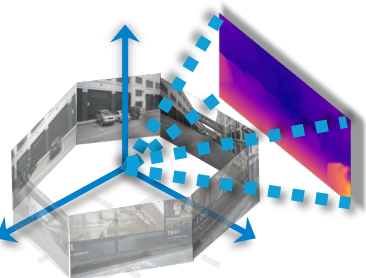
Track 2

Robust Map Segmentation



Track 3

Robust Occupancy Prediction



Track 4

Robust Depth Estimation

Track 5

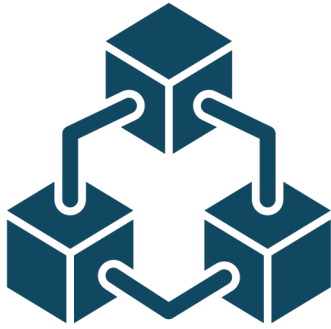
Robust Multi-Modal BEV Detection



Challenge Tracks



Two Phases



Phase #1

Jan - Mar

Preliminary Exploration



Phase #2

Mar - Apr

Final Design & Solution



140

Registered Teams



93

Institutes (Universities, Companies)



11

Countries



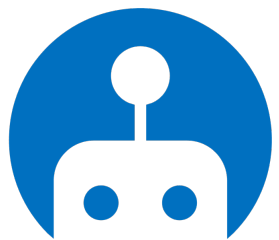
International Participants





Top-Performing Teams

Candidates

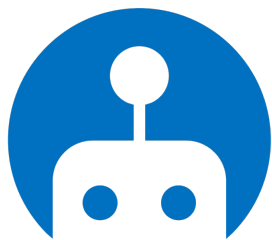


Track1

Ponyville

DeepVision

CyberBEV

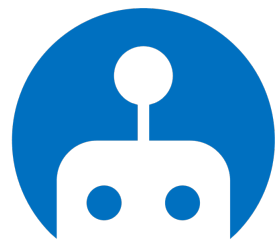


Track2

Samsung

SafeDrive-SSR

CrazyFriday

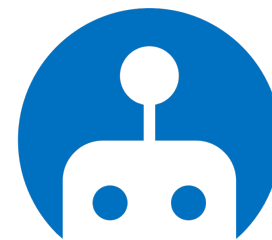


Track3

hm.unilab

APEC Blue

ViewFormer

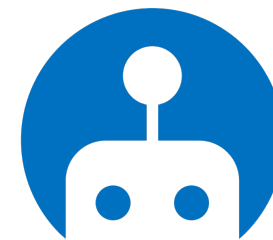


Track4

HIT-AIIA

BUAA-Trans

CUSTZS



Track5

safedrive

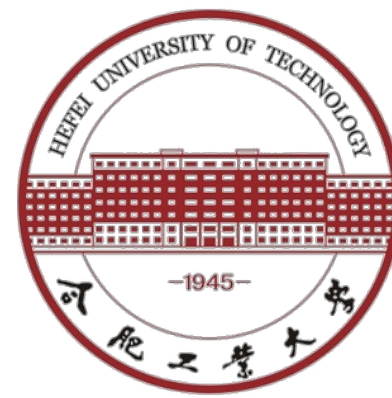
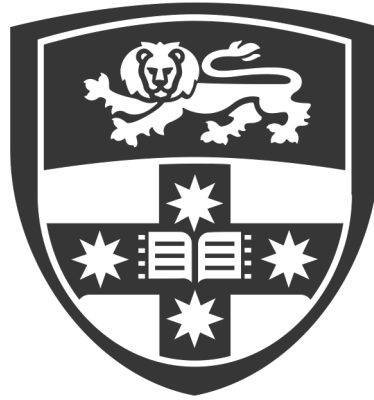
Ponyville

HITSZ



Top-Performing Teams

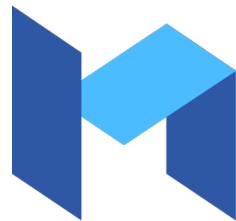
Academia



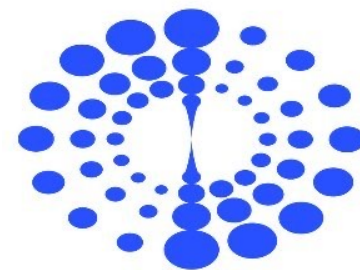


Top-Performing Teams

Industry



HAOMO.AI



ORBEC



里工
Li-Gong



松果出行



极越

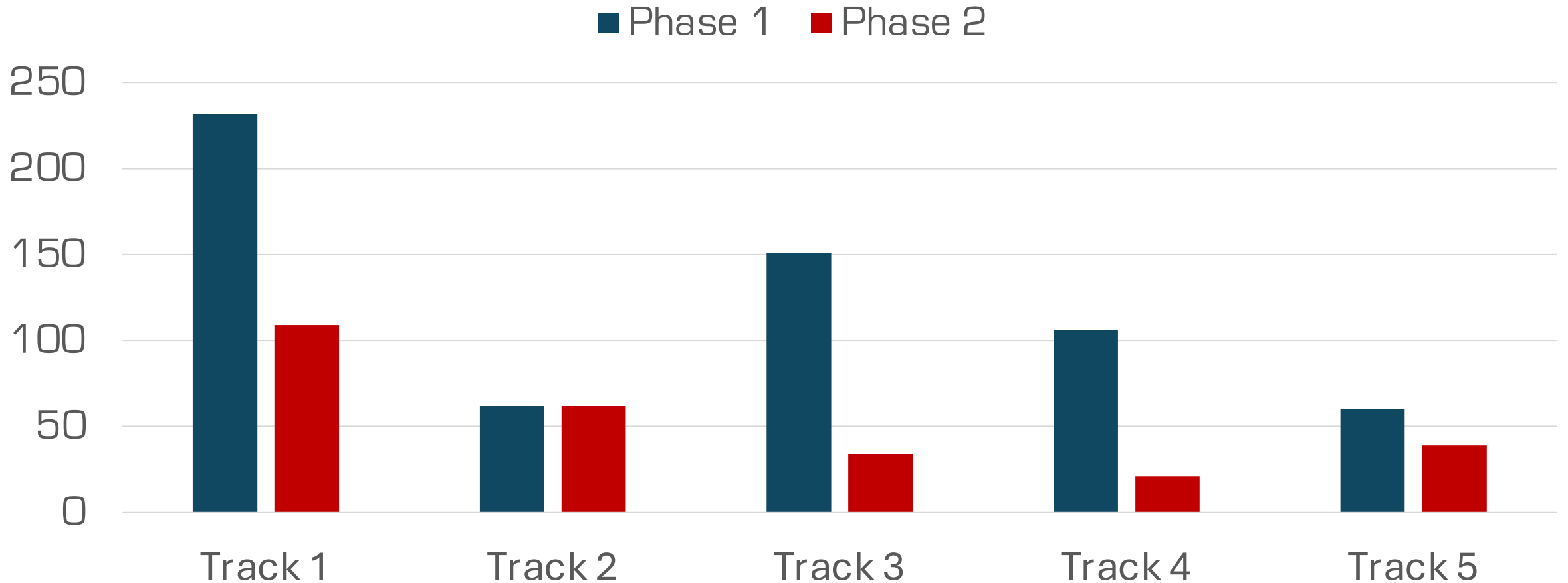


UISEE 驭势

SAMSUNG



Submission Records

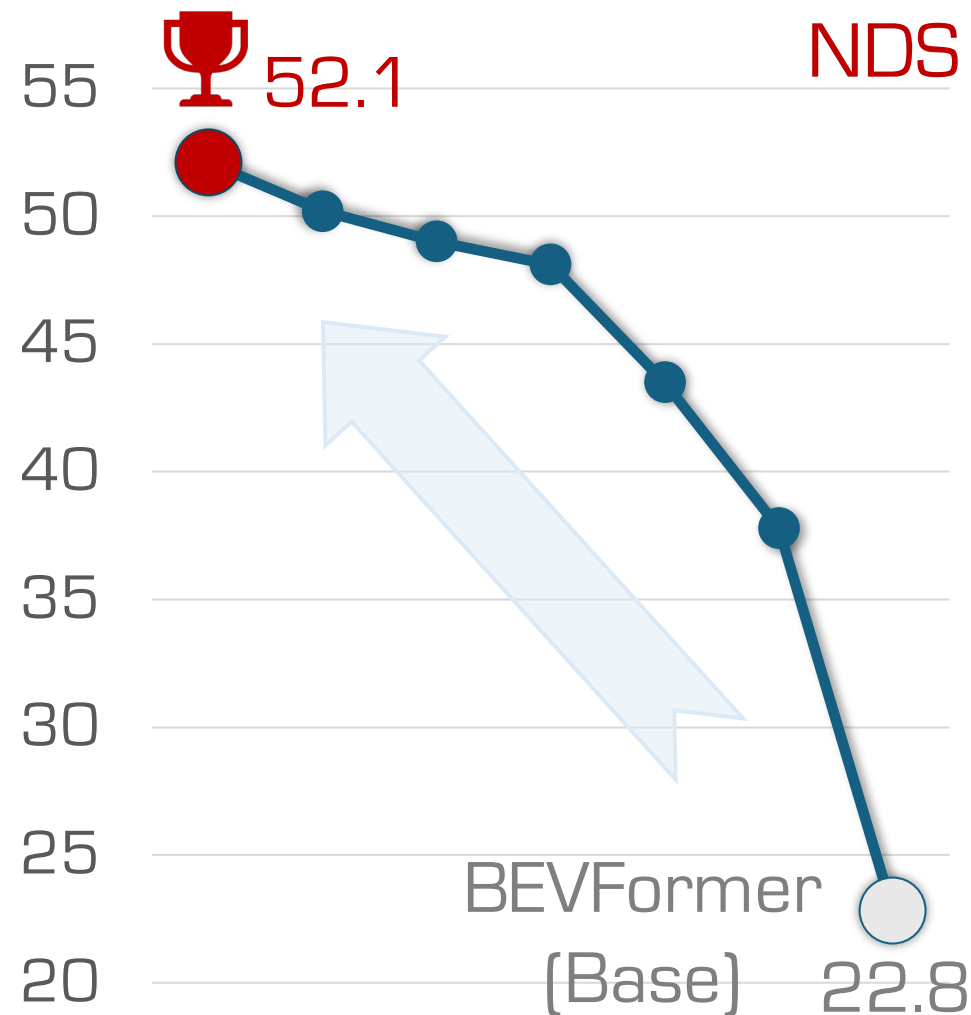
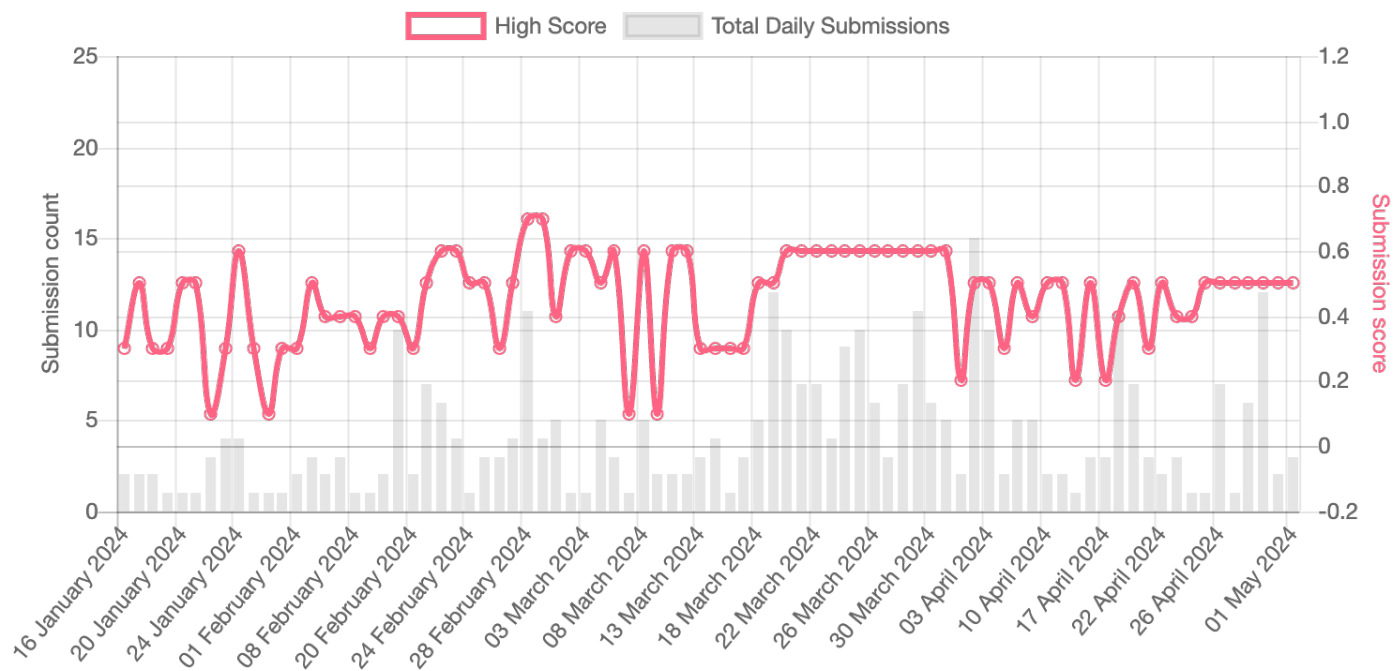




Performance Improvements



Challenge Results (Phase 2)

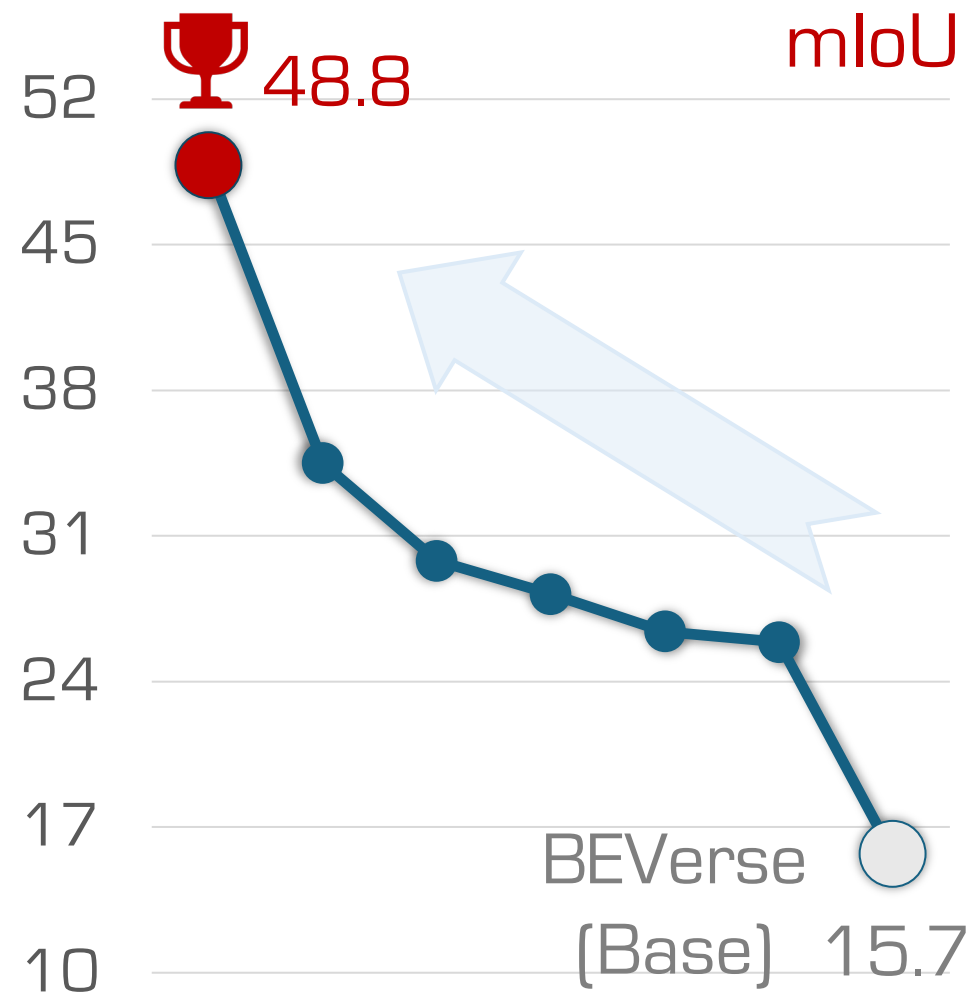
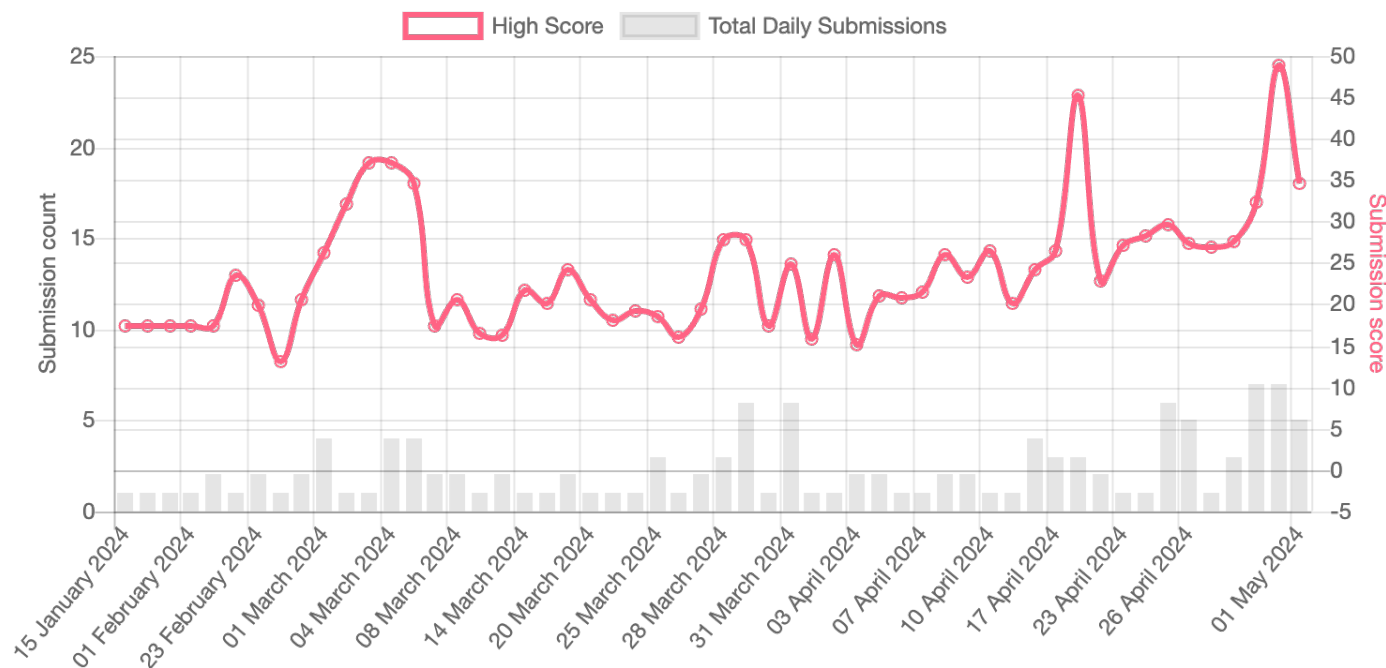




Performance Improvements



Challenge Results (Phase 2)

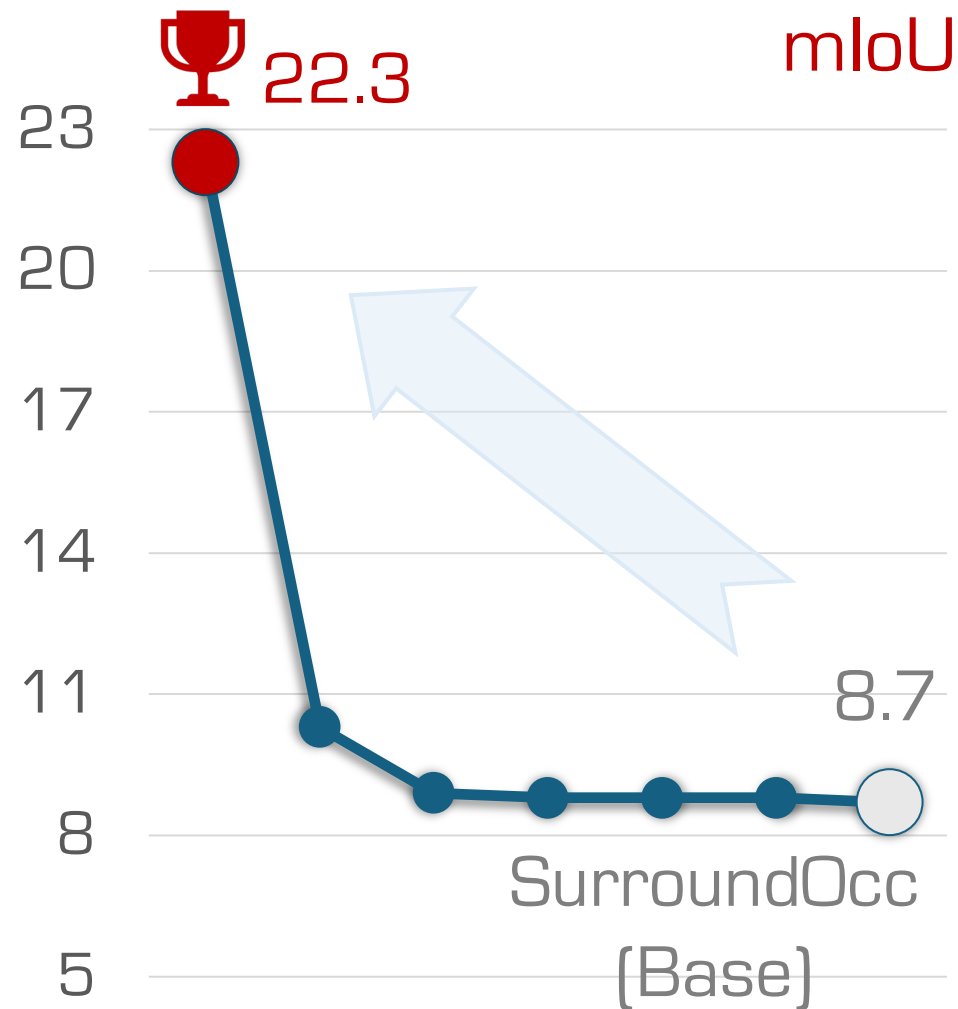
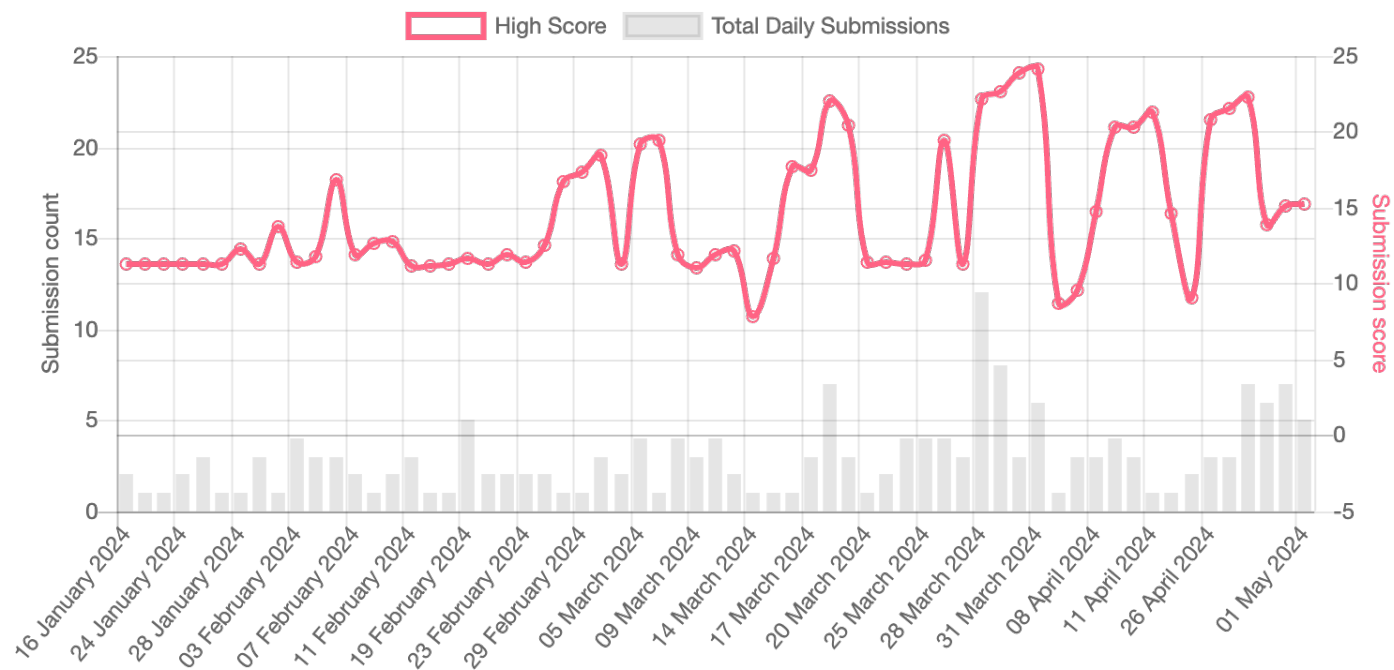




Performance Improvements



Challenge Results (Phase 2)

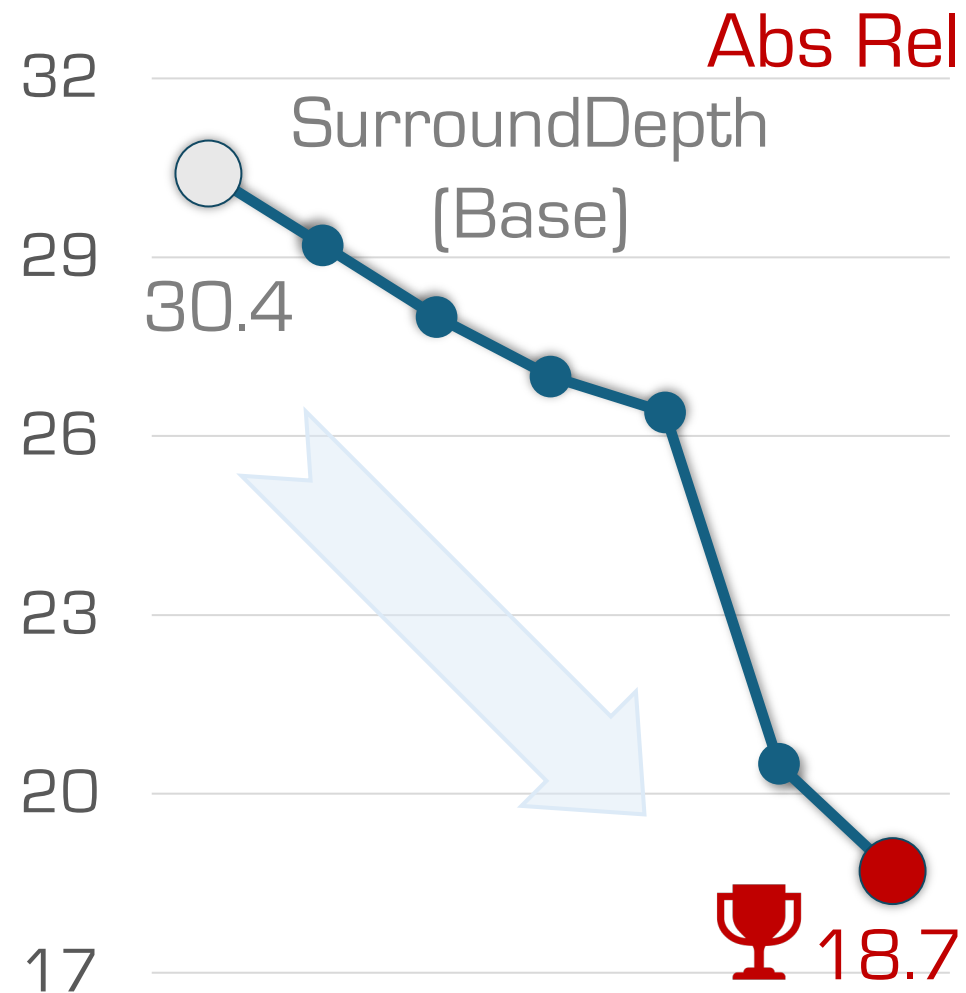
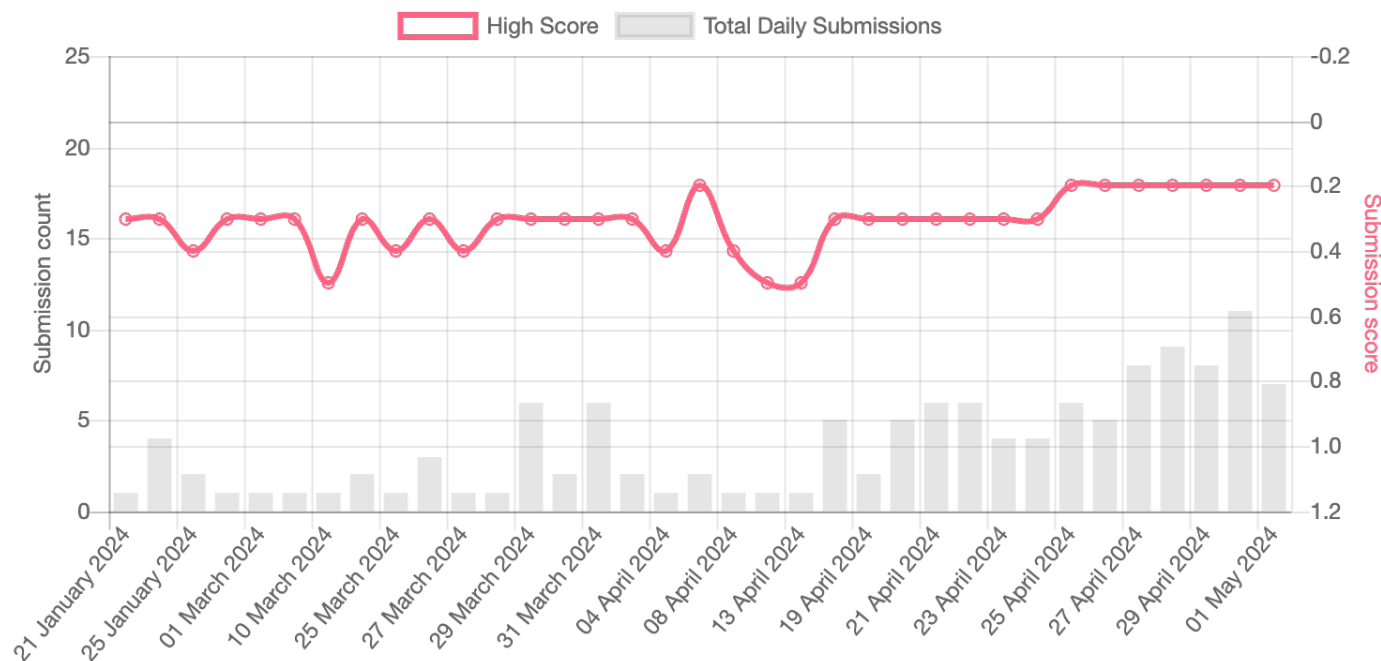




Performance Improvements



Challenge Results (Phase 2)

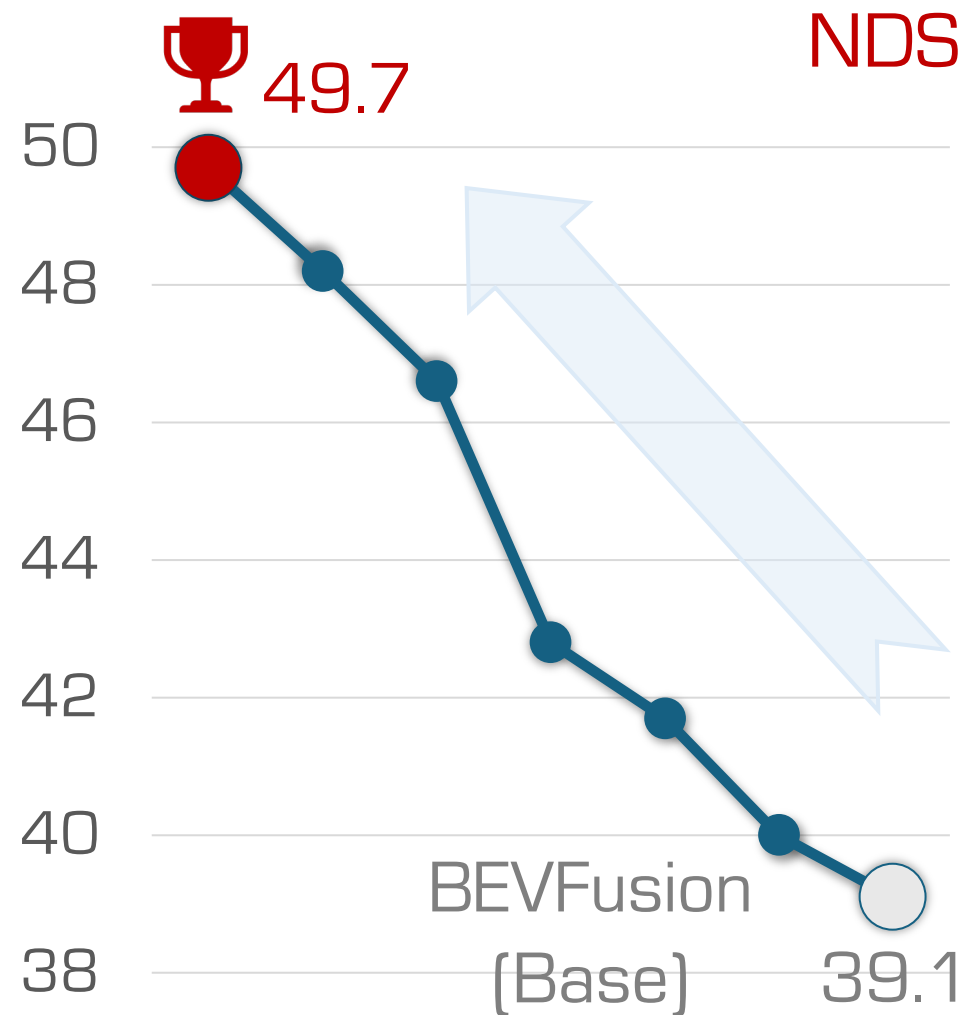
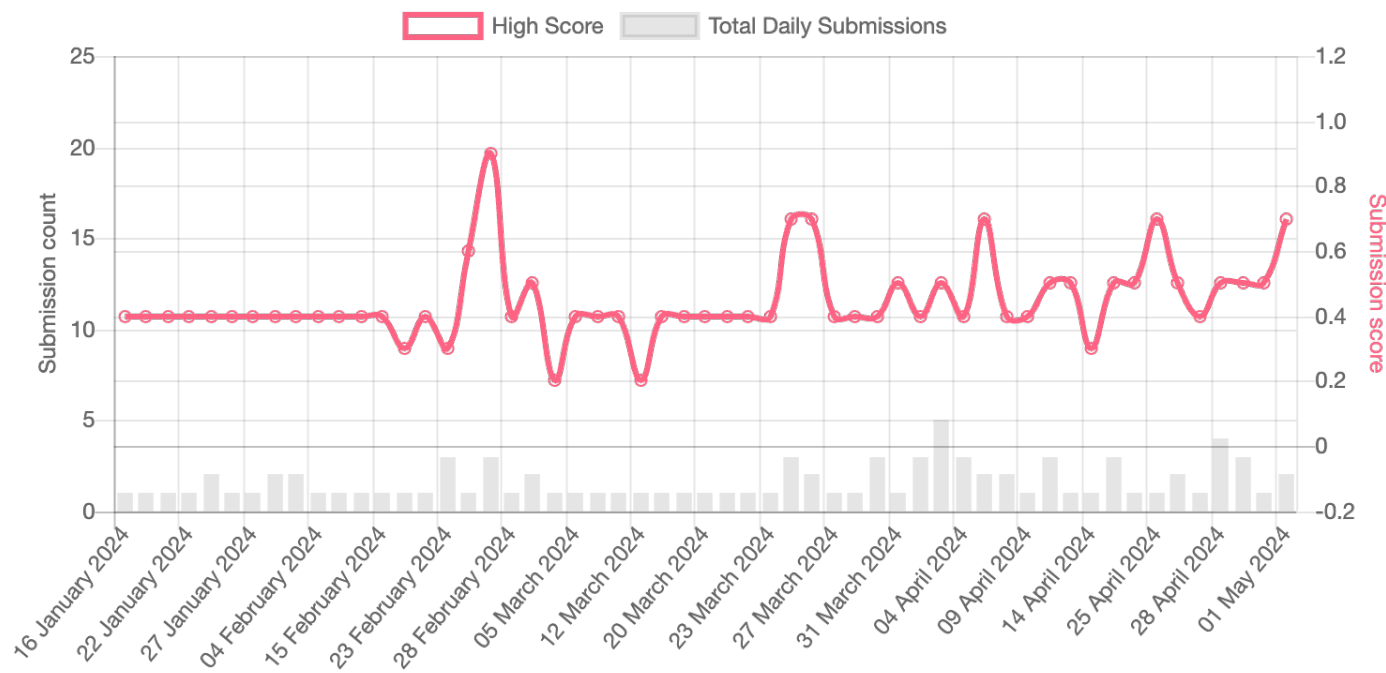




Performance Improvements

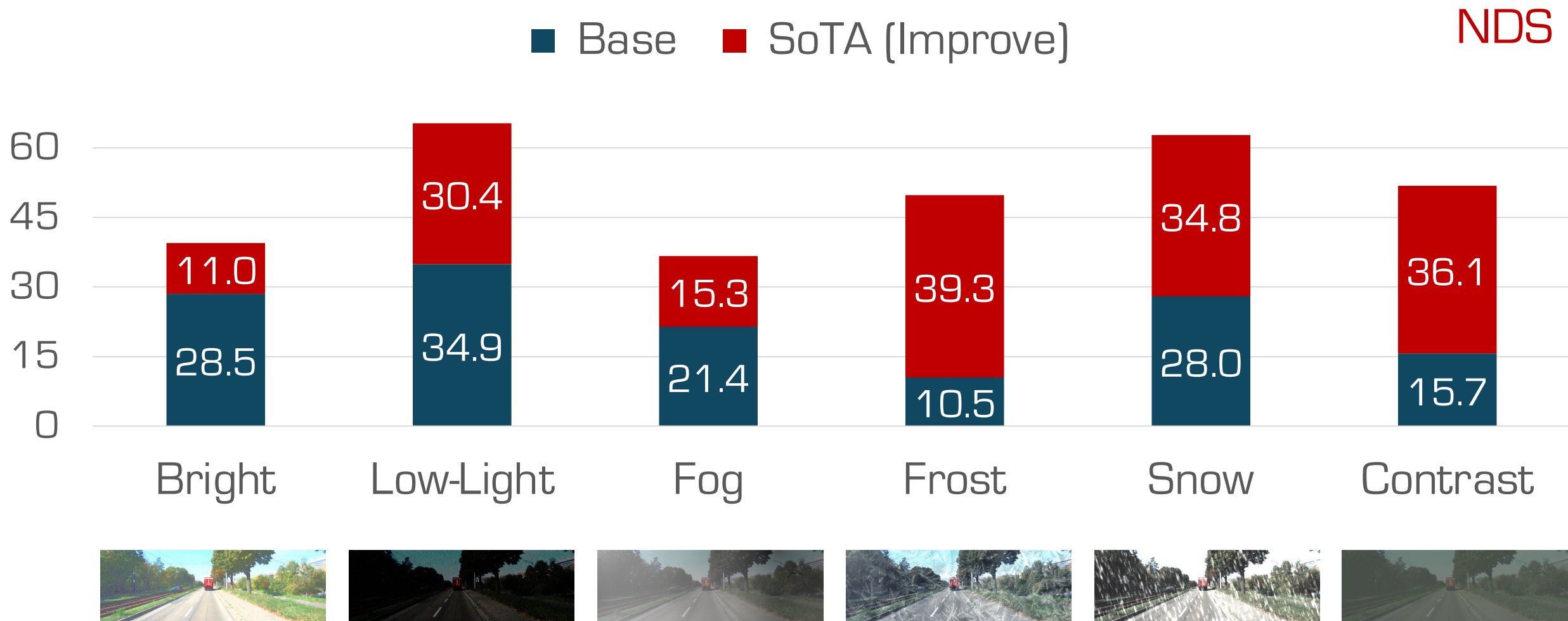


Challenge Results (Phase 2)





Weather & Lighting



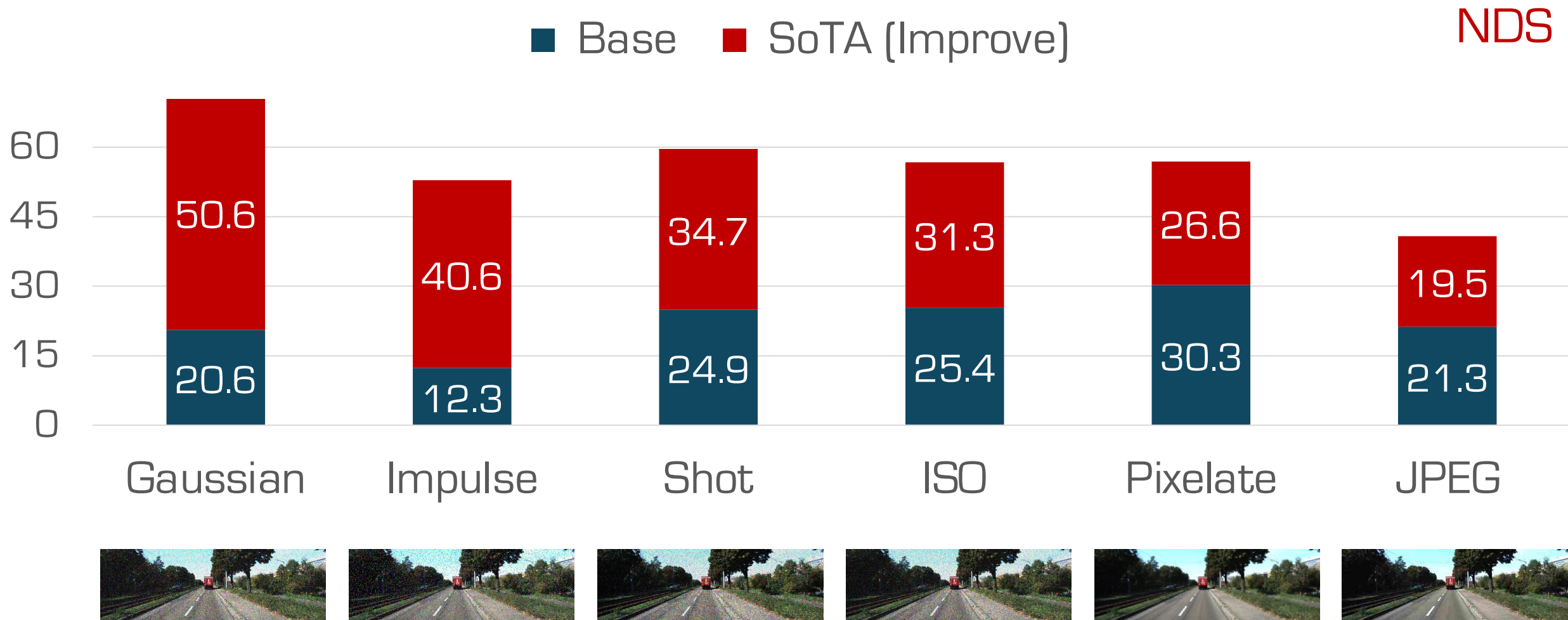


Sensor & Movement





Noise & Processing



Spotlight Talk

Wenhao Ding

NVIDIA - Autonomous Vehicle



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NVIDIA

Spotlight Talk

Challenges and Future Directions in Safe Autonomous Driving



Wenhao Ding

NVIDIA Autonomous
Vehicle Research

Track Presentation Top-Performing Solution



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Track 1

Robust BEV Detection



DeepVision



Ponyville Autonauts Ltd



CyberBEV



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Team Members:

- X. Cao, H. Lu, and Y.-C. Chen

Affiliations:

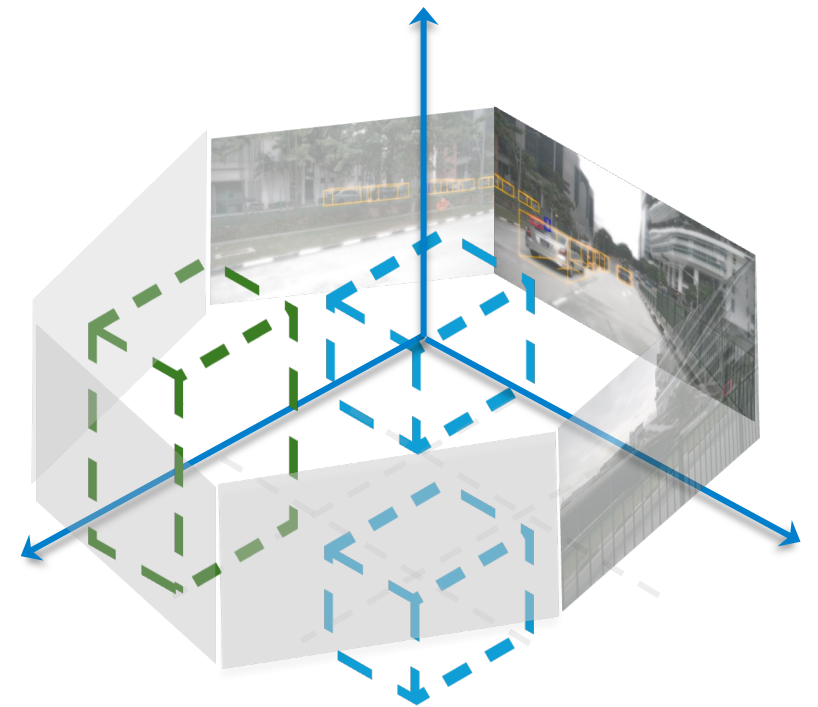
- Hong Kong University of Science and Technology (Guangzhou)
- Hong Kong University of Science and Technology



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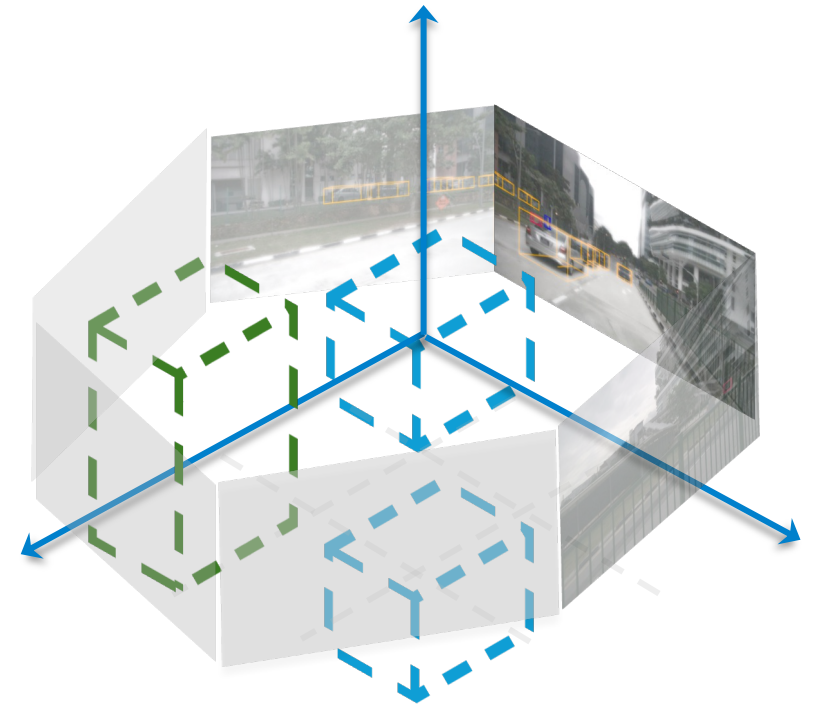
Team DeepVision



Q & A



Team
DeepVision



Team Members:

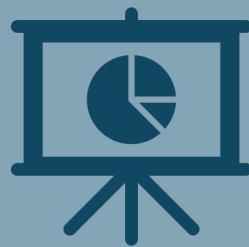
- C. Kang, X. Zhou, C. Ying,
W. Shang, X. Wei, and Y. Dong

Affiliations:

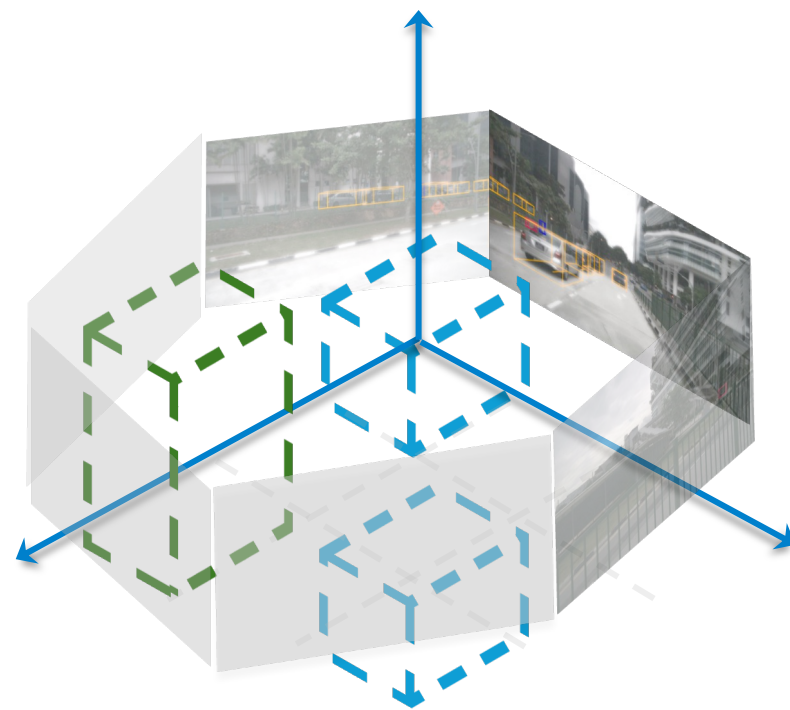
- Beihang University
- Tsinghua University
- Hefei University of Technology



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Team Ponyville Autonauts Ltd



Team Members:

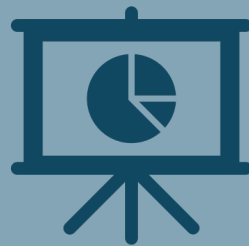
- B. Yang, S. Jiang, and Z. Ma

Affiliations:

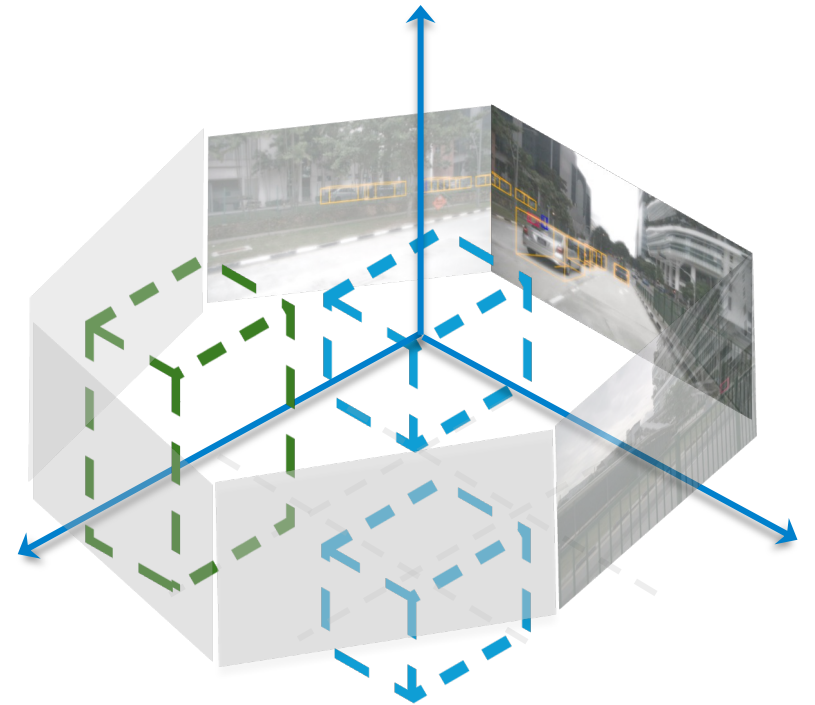
- Beijing University of Posts and Telecommunications



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Team CyberBEV



Track 2

Robust Map Segmentation



SafeDrive-SSR



CrazyFriday



Samsung



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Team Members:

- X. Huang and Y. Tian

Affiliations:

- University of Chinese Academy of Sciences
- Tsinghua University

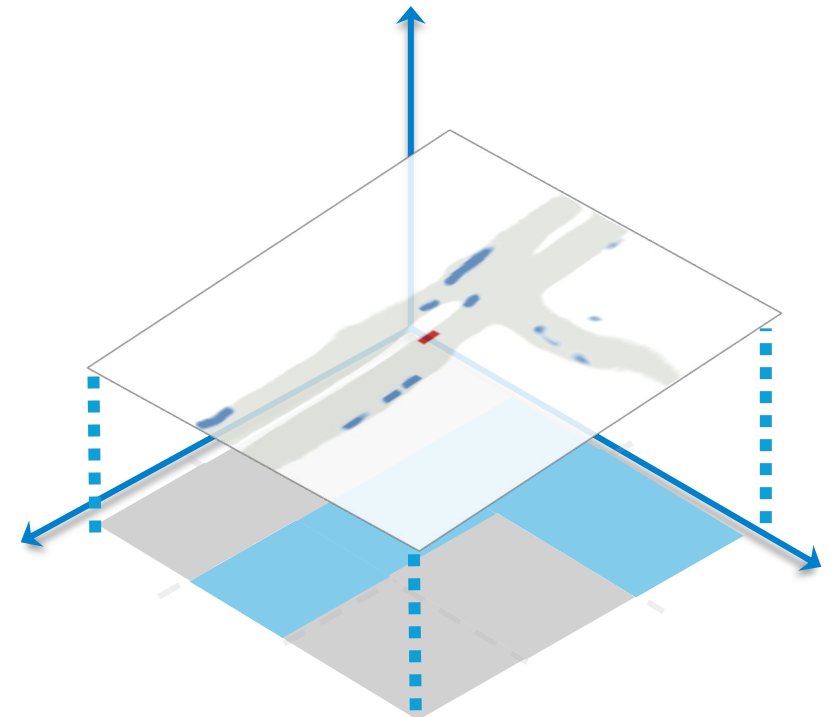


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Team

SafeDrive-SSR

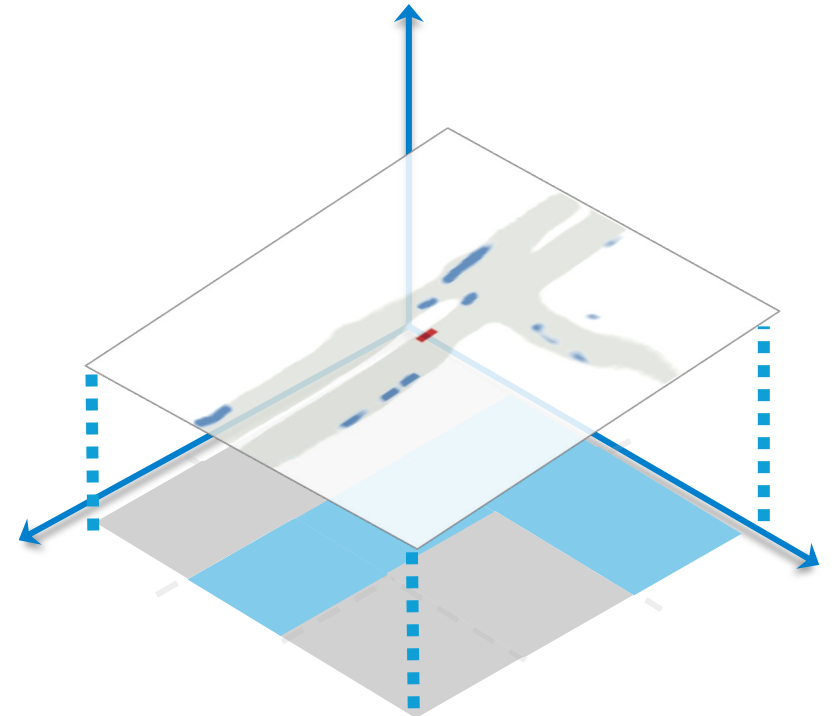


Q & A



Team

SafeDrive-SSR



Team Members:

- G. Kou, F. Jia, Y. Liu, T. Wang, and Y. Li

Affiliations:

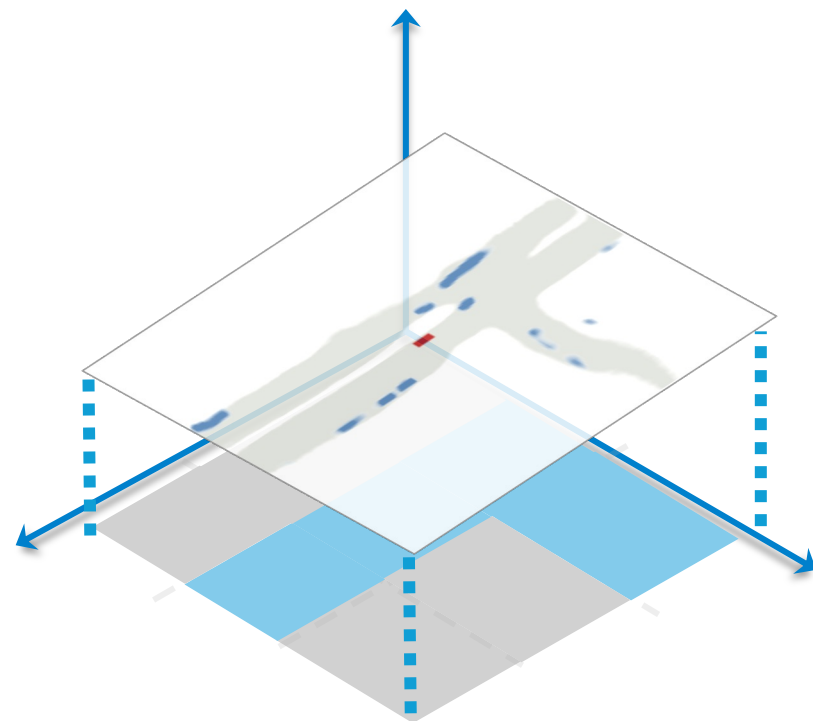
- Beijing Institute of Technology
- Megvii Technology



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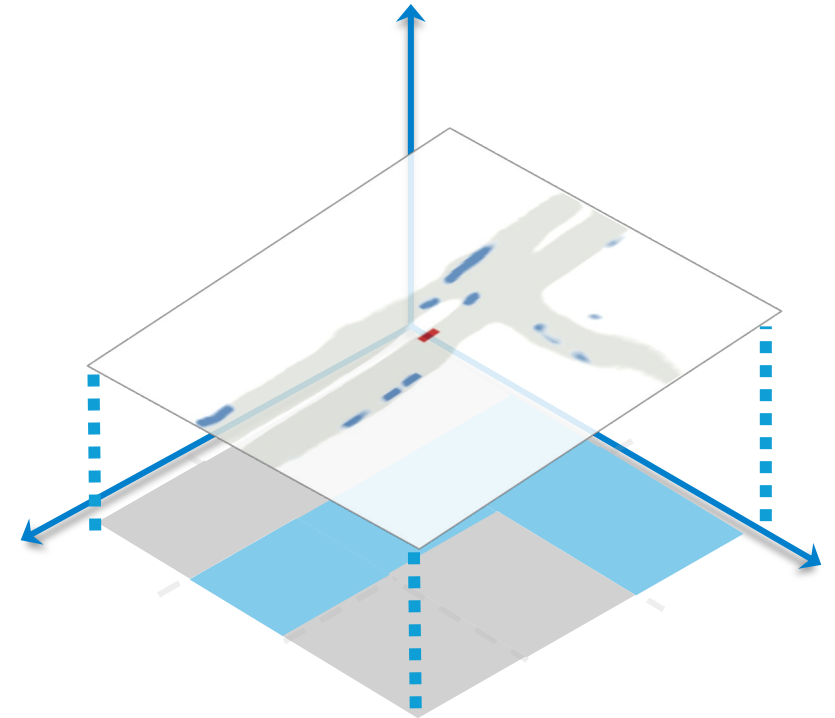
Team CrazyFriday



Q & A



Team CrazyFriday



Team Members:

- X. Hao, Y. Yang, H. Zhang, M. Wei, Y. Zhou, H. Zhao, and J. Zhang

Affiliations:

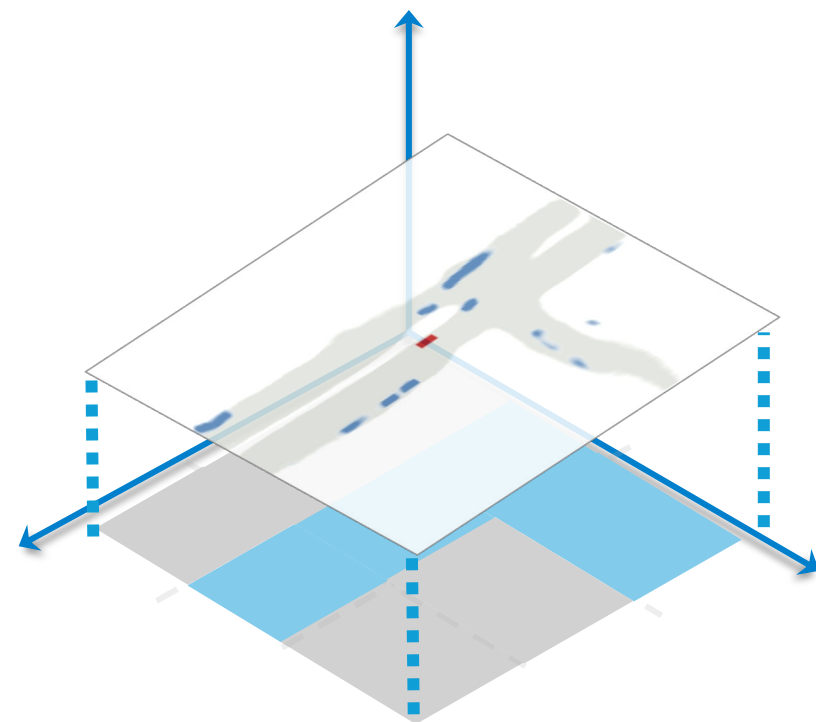
- Samsung R&D Institute China - Beijing
- The University of Sydney



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Team Samsung



Track 3

Robust Occupancy Prediction



APEC Blue



hm.unilab



ViewFormer



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Team Members:

- B. Zhang, L. Zhao, D. Ding, F. Liu, Y. Yan, and H. Wang

Affiliations:

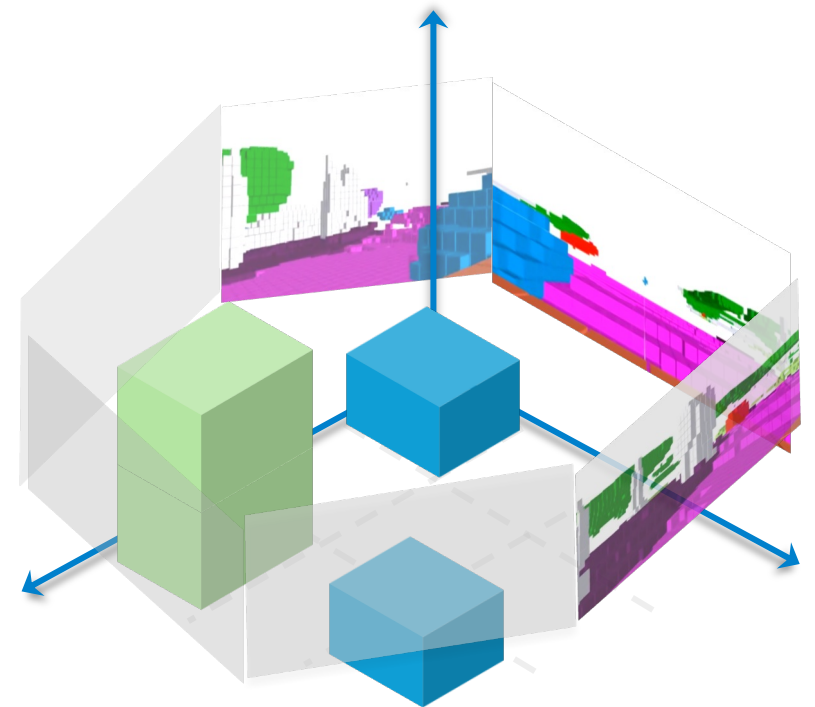
- Beijing APEC Blue Technology Co., Ltd
- Beihang University



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Team APEC Blue

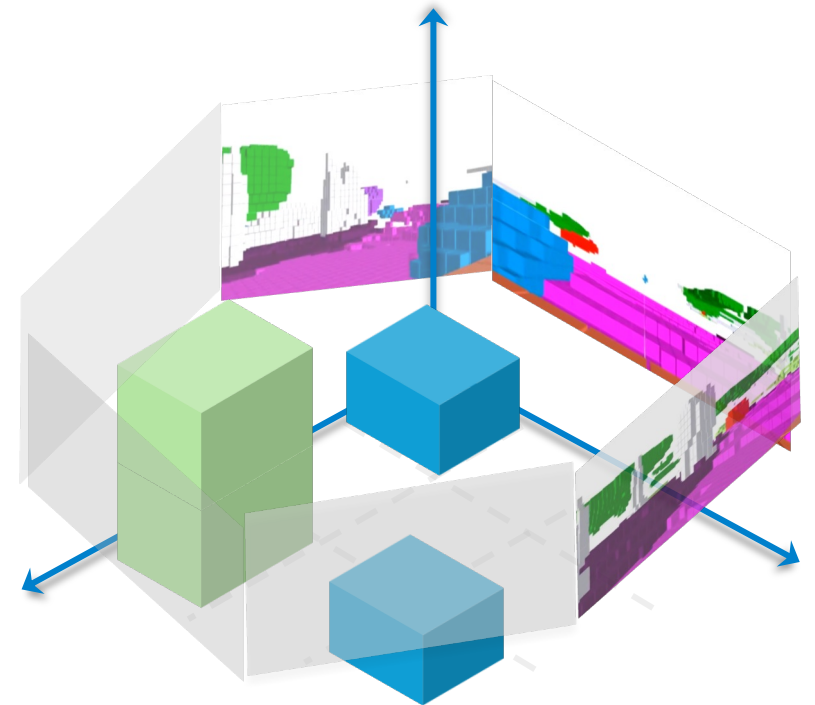


Q & A



Team

APEC Blue



Team Members:

- N. Ye, L. Luo, Y. Tian, Y. Zuo, Z. Cao, Y. Ren, Y. Li, W. Liu, and X. Wu

Affiliations:

- Haomo.ai

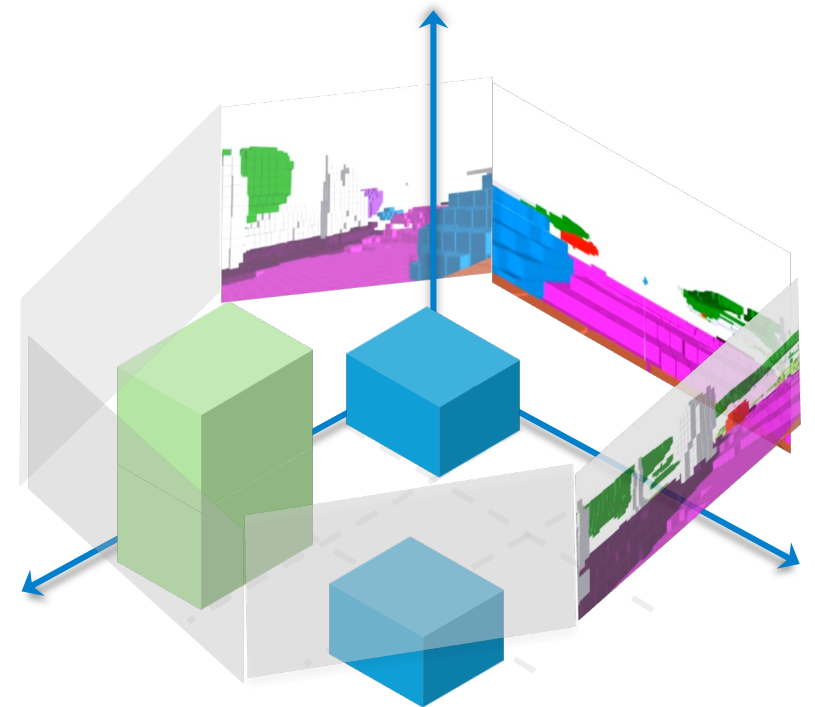


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Team

hm.unilab



Team Members:

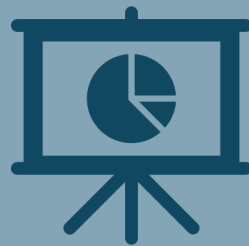
- J. Li, X. He, and X. Cheng

Affiliations:

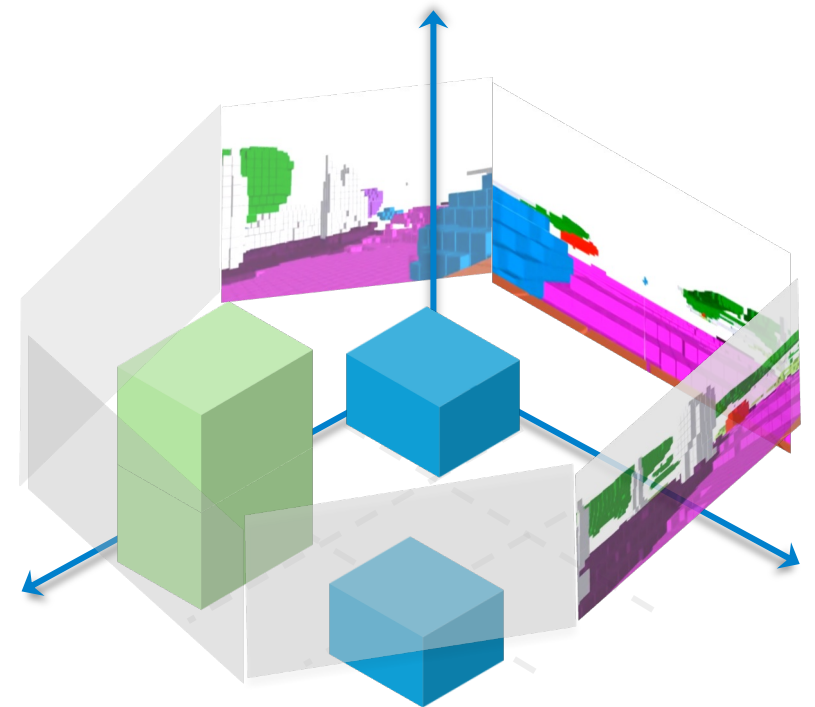
- UISEE



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Team ViewFormer



Coffee Break

We are back at 3:00 PM



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Track Presentation Top-Performing Solution



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Track 4

Robust Depth Estimation



BUAA-Trans



HIT-AIHA



CUSTZS



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Team Members:

- P. Chen, Z. Wang, C. Li, S. Li, C. Yuan, S. Yang, W. Liu, and B. Zhou

Affiliations:

- Beihang University

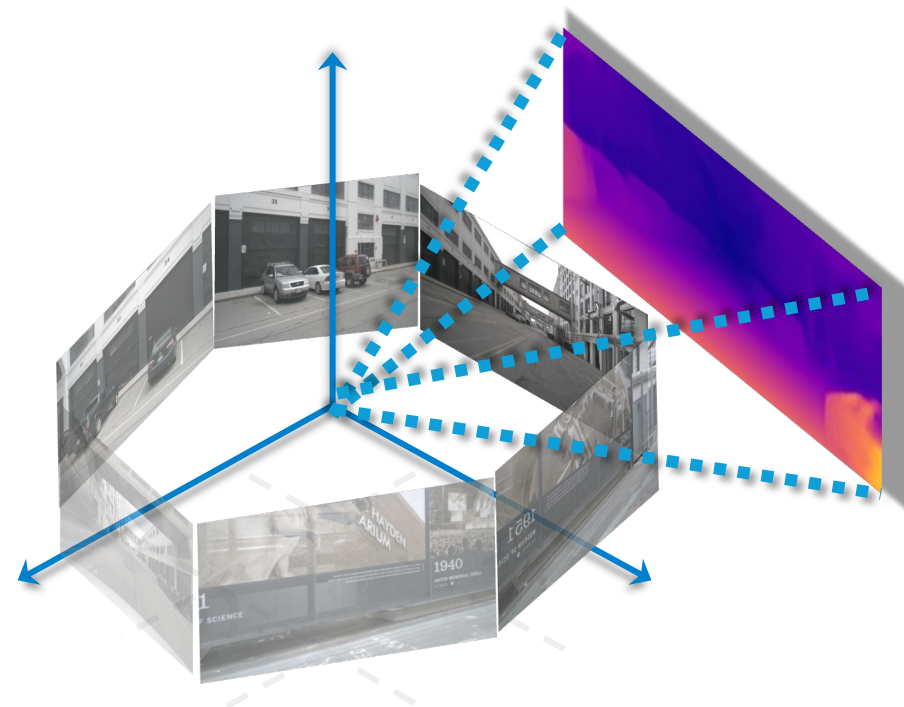


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Team

BUAA-Trans

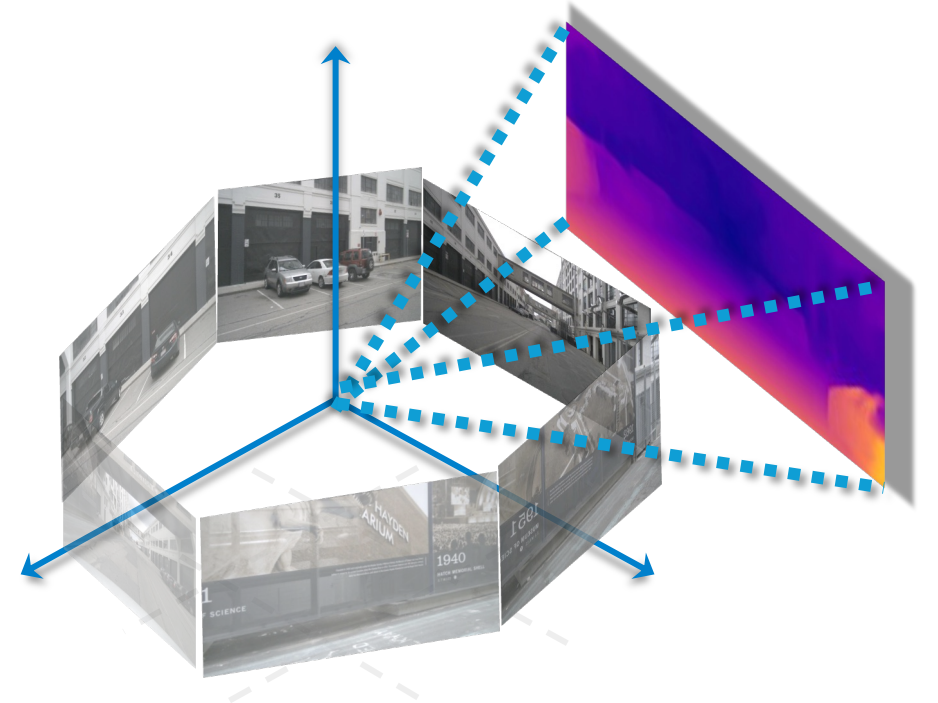


Q & A



Team

BUAA-Trans



Team Members:

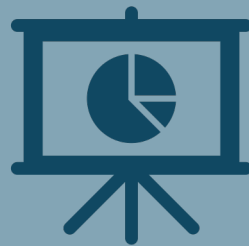
- Y. Mao, M. Li, J. Liu, J. Liu, Z. Qin, C. Chu, J. Xu, W. Zhao, J. Jiang, and X. Liu

Affiliations:

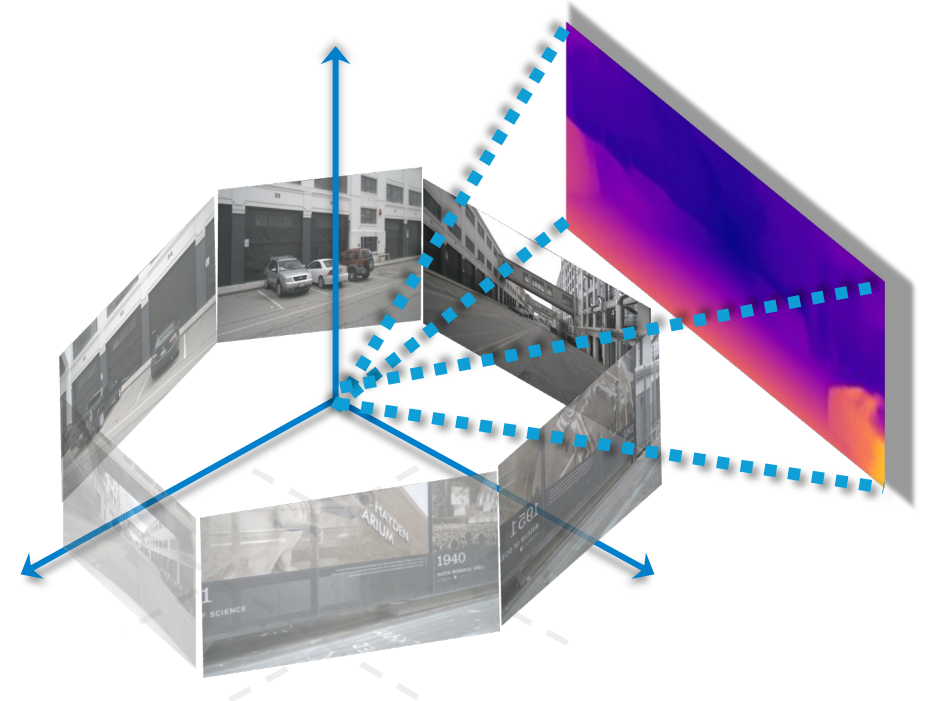
- Harbin Institute of Technology



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Team HIT-AIIA



Team Members:

- Y. Wang, C. Zhang, and J. Sun

Affiliations:

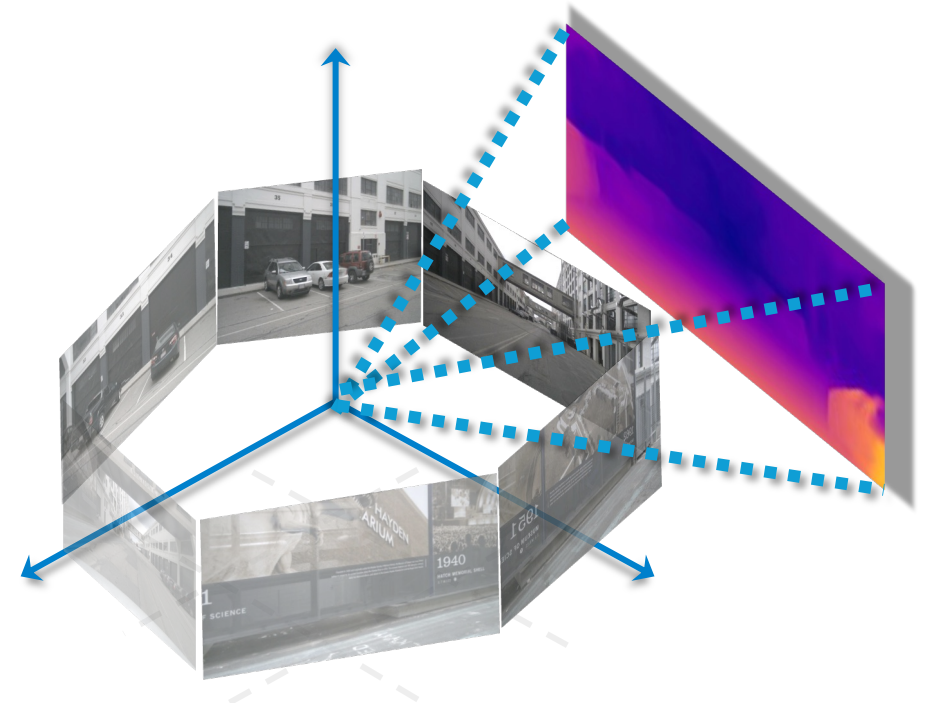
- Zhongshan Institute, Changchun University of Science and Technology



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Team CUSTZS



Track 5

Robust Multi-Modal BEV Detection



HITSZrobodrive



Ponyville Autonauts Ltd



SafeDrive-ProMax



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Team Members:

- D. Fu, Y. Lin, H. Yang, H. Li, Y. Luo, X. Cheng, and Y. Xu

Affiliations:

- Harbin Institute of Technology
- Guangdong U. of Technology
- HKUST (Guangzhou)
- University of Queensland

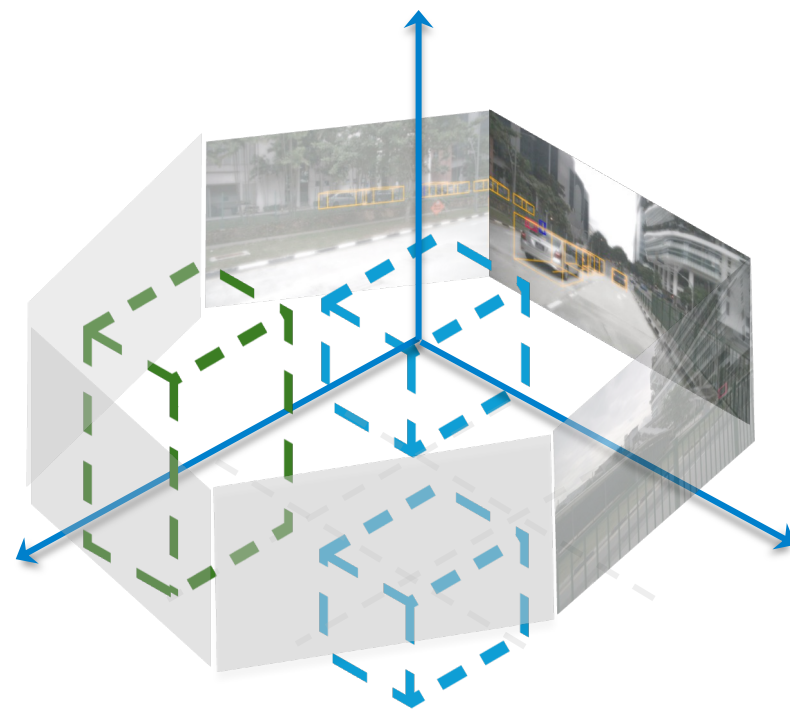


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Team

HITSZrobodrive

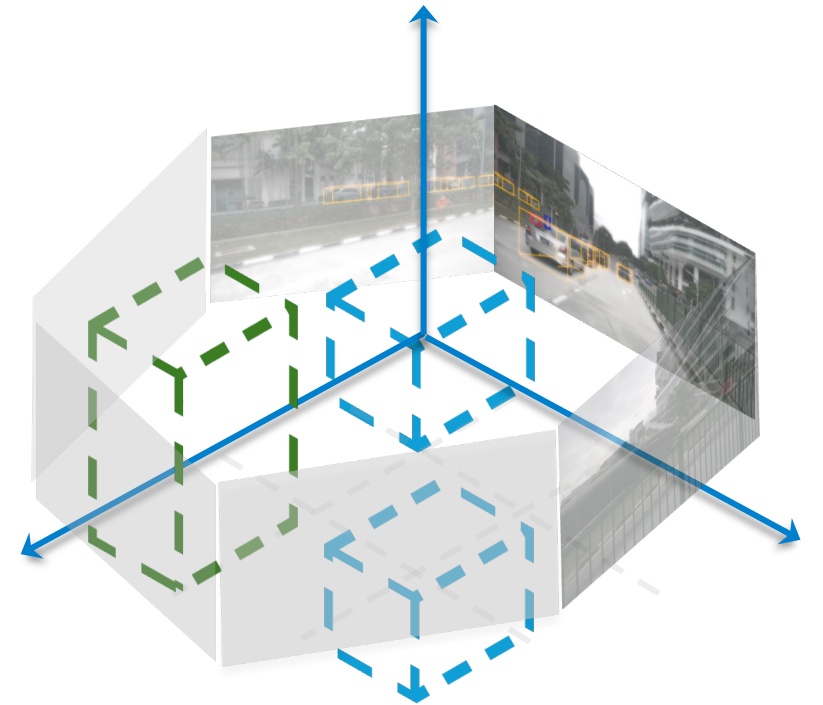


Q & A



Team

HITSZrobodrive



Team Members:

- C. Kang, X. Zhou, C. Ying,
W. Shang, X. Wei, and Y. Dong

Affiliations:

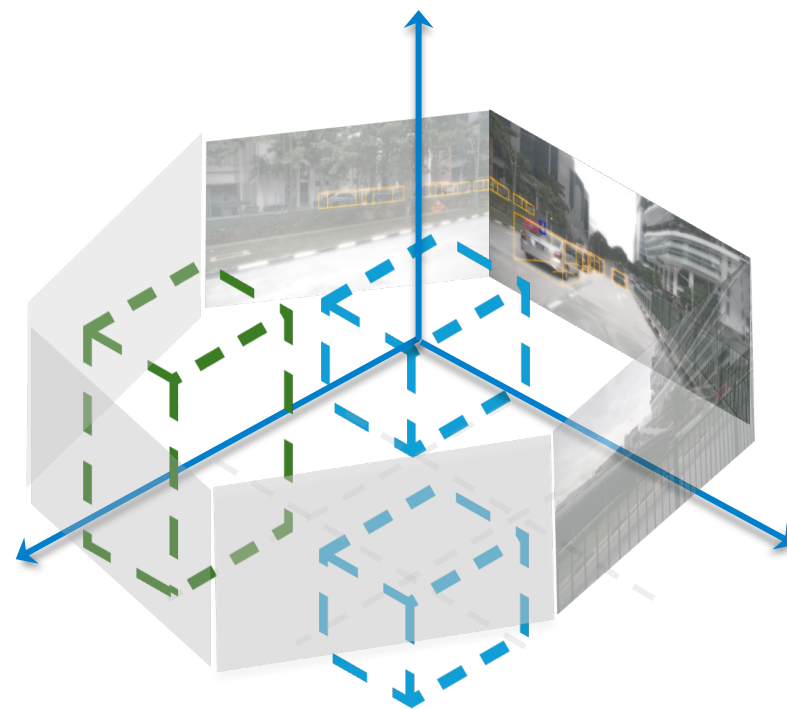
- Beihang University
- Tsinghua University
- Hefei University of Technology



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Team Ponyville Autonauts Ltd



Team Members:

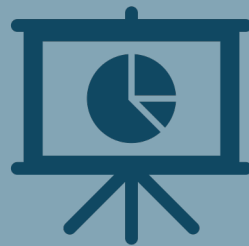
- X. Yang, H. Chen, and L. Wang

Affiliations:

- Tsinghua University

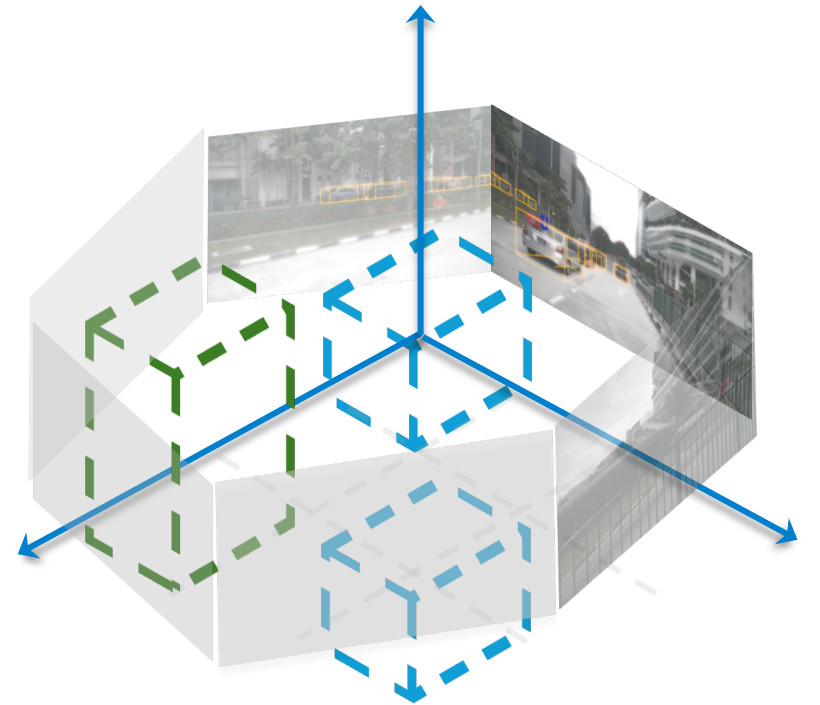


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Team

SafeDrive-ProMax



Spotlight Presentation

Lingdong Kong

National University of Singapore



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Invited Presentation

Towards Robust 3D Perception in Challenging Conditions



Lingdong Kong

National University of
Singapore

Spotlight Presentation

Ye Li

University of Michigan, Ann Arbor



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Invited Presentation

Optimizing Sensor Placements for Robust Driving Perception



Ye Li

University of
Michigan, Ann Arbor

Coffee Break

We are back at 4:30 PM



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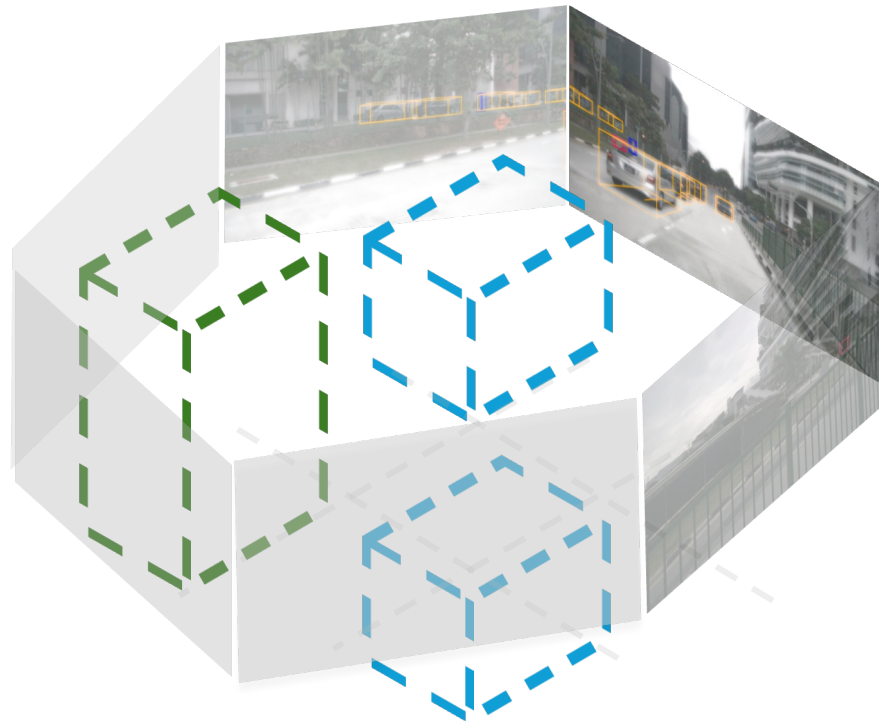
Award Ceremony



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Track 1

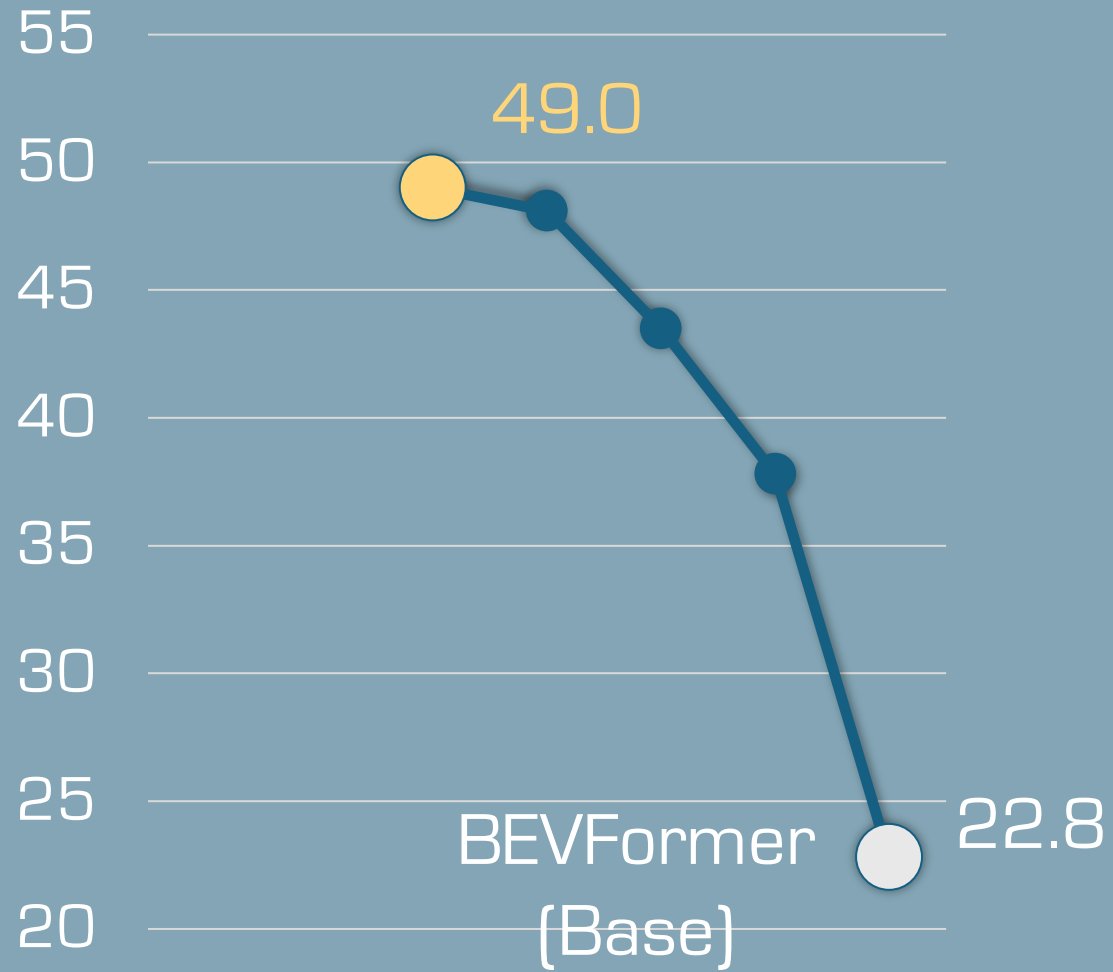
Robust BEV Detection



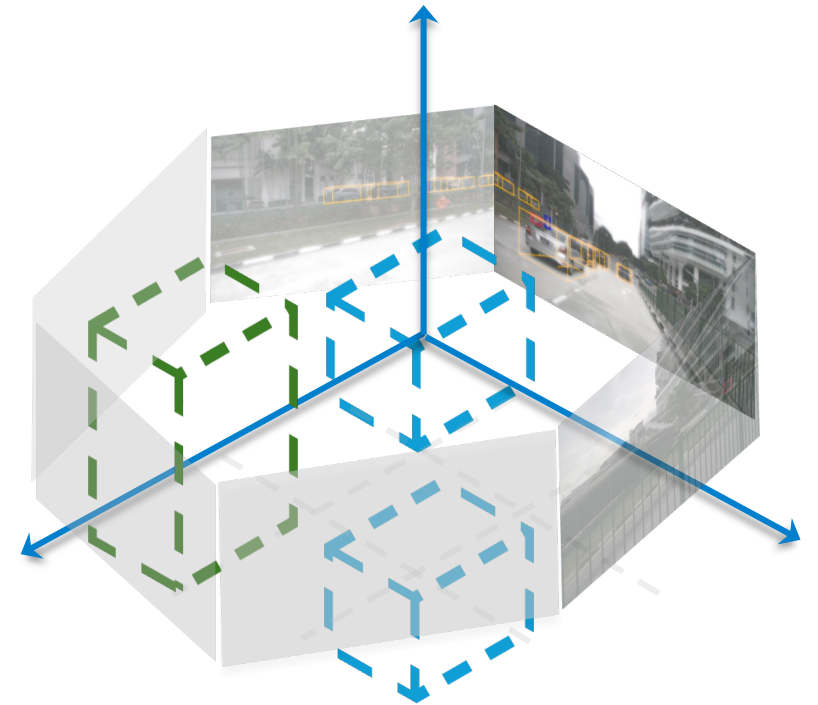
Winning Solution



NDS



Team CyberBEV



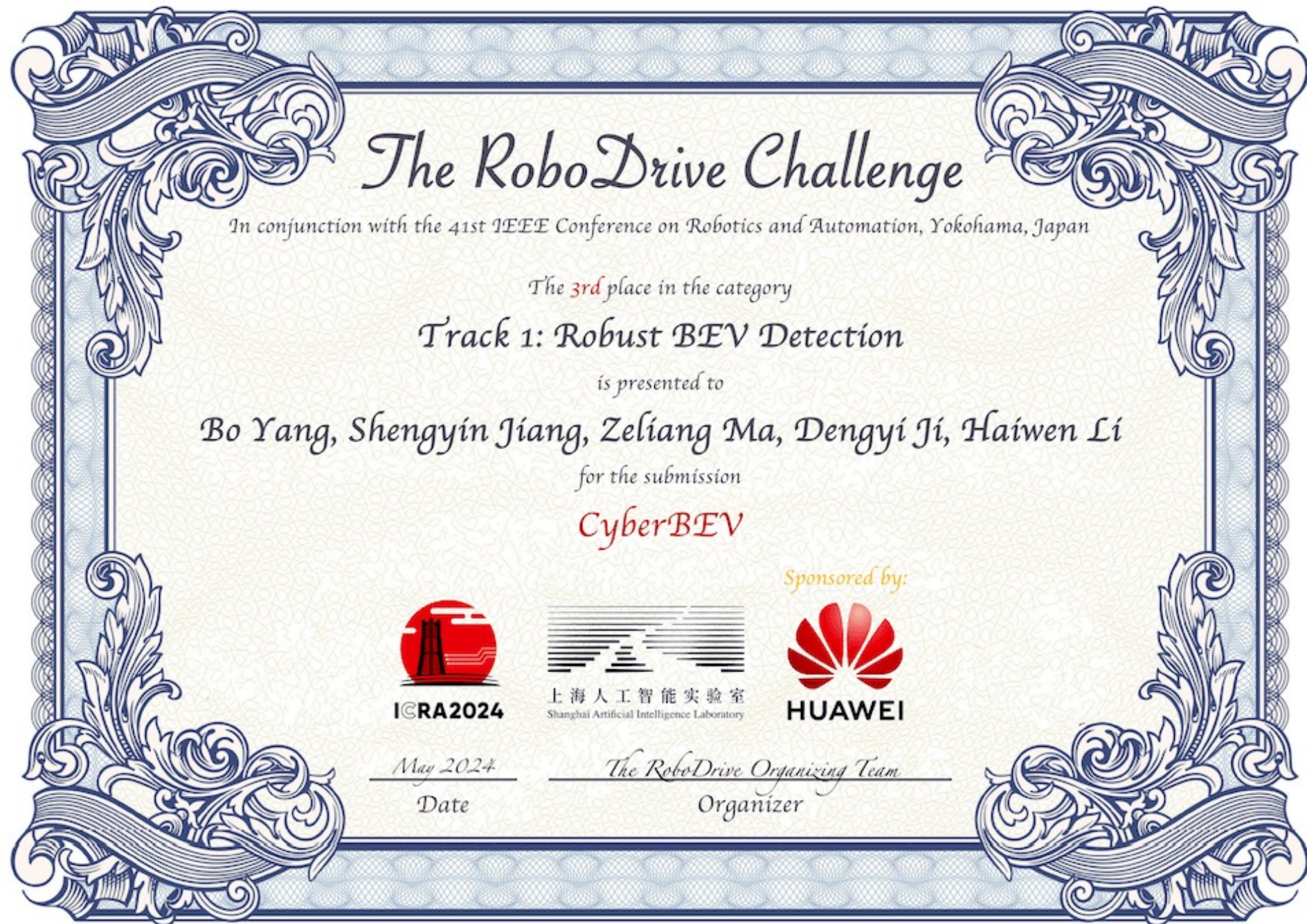
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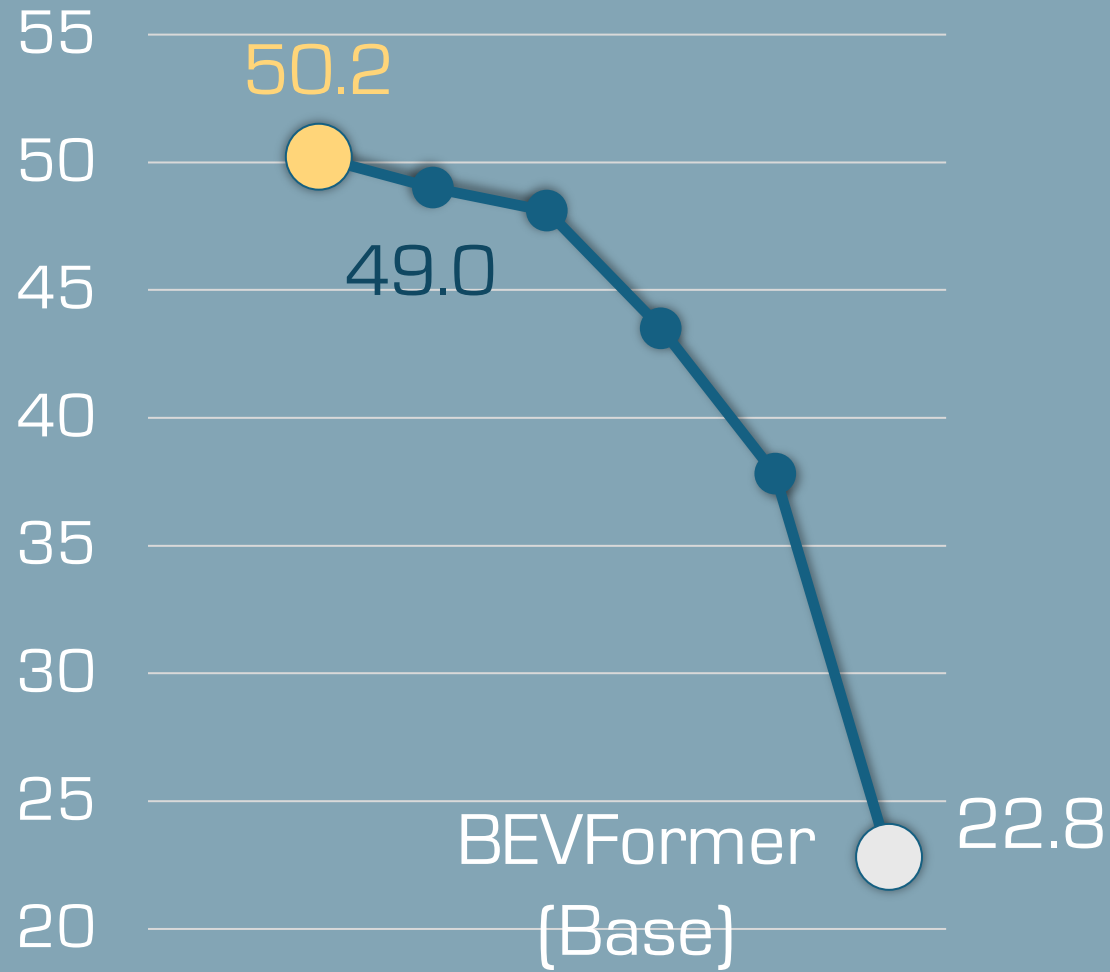


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3rd Place



NDS



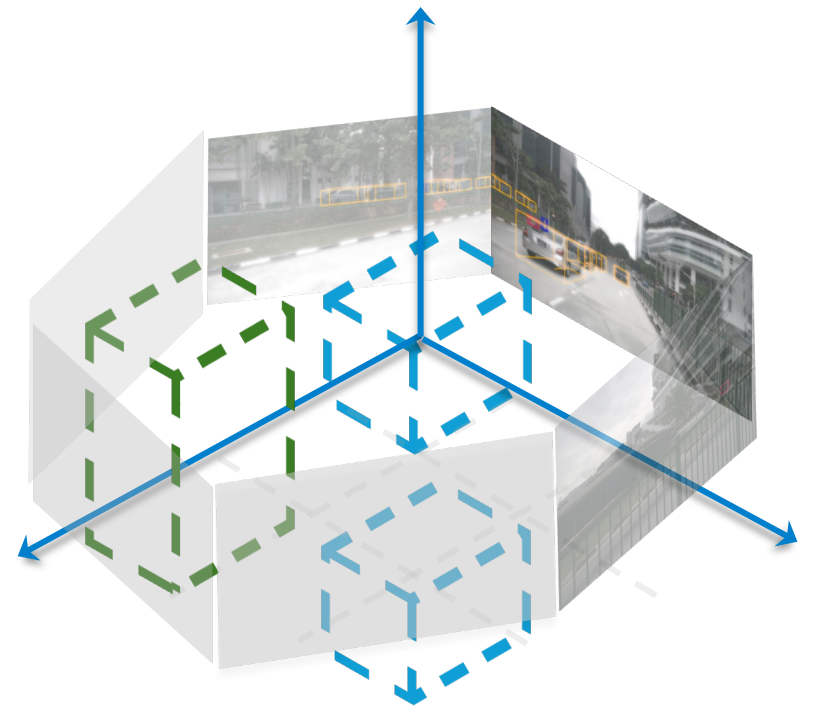
BEVFormer
[Base]



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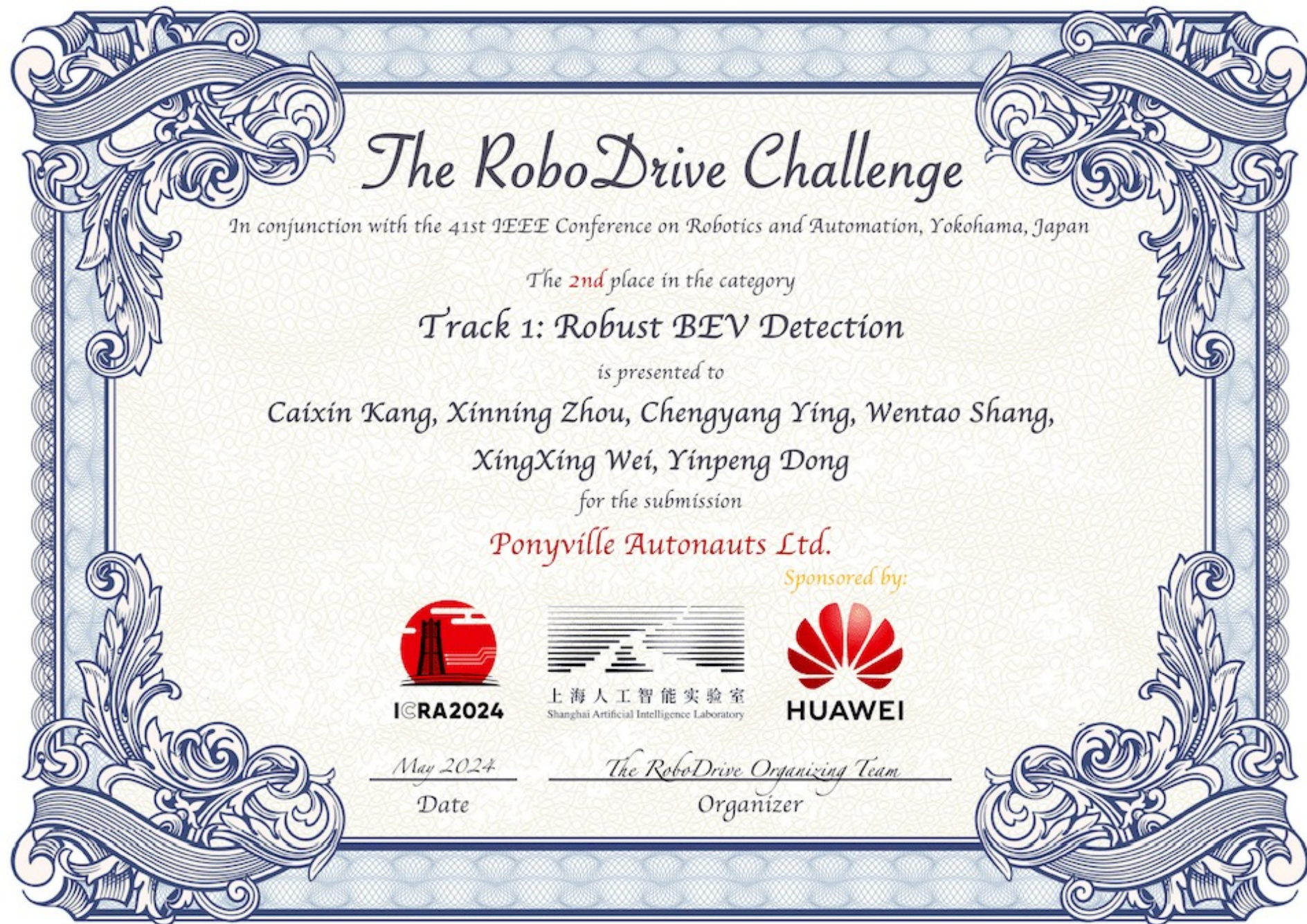
Team
Ponyville
Autonauts Ltd

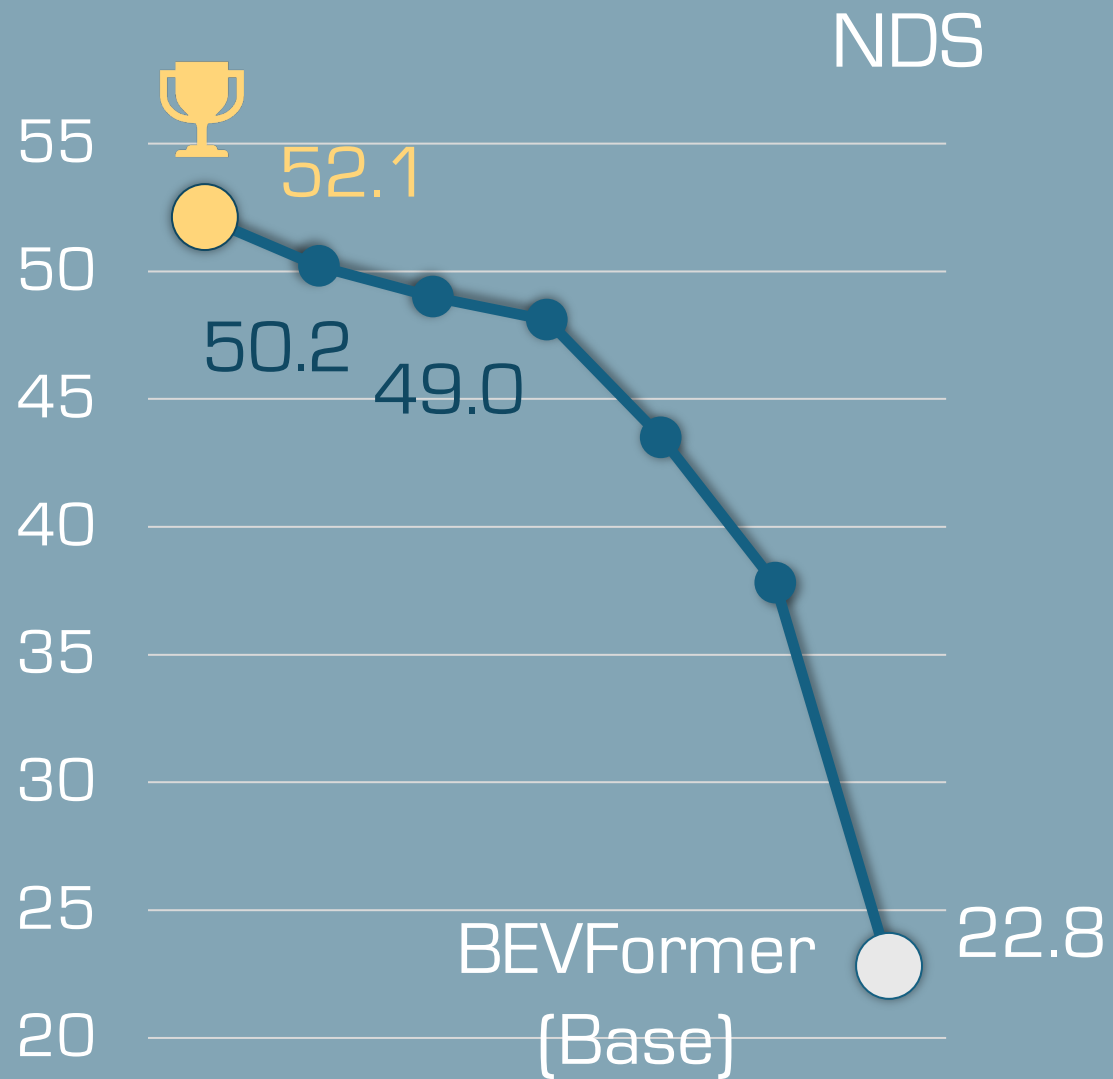




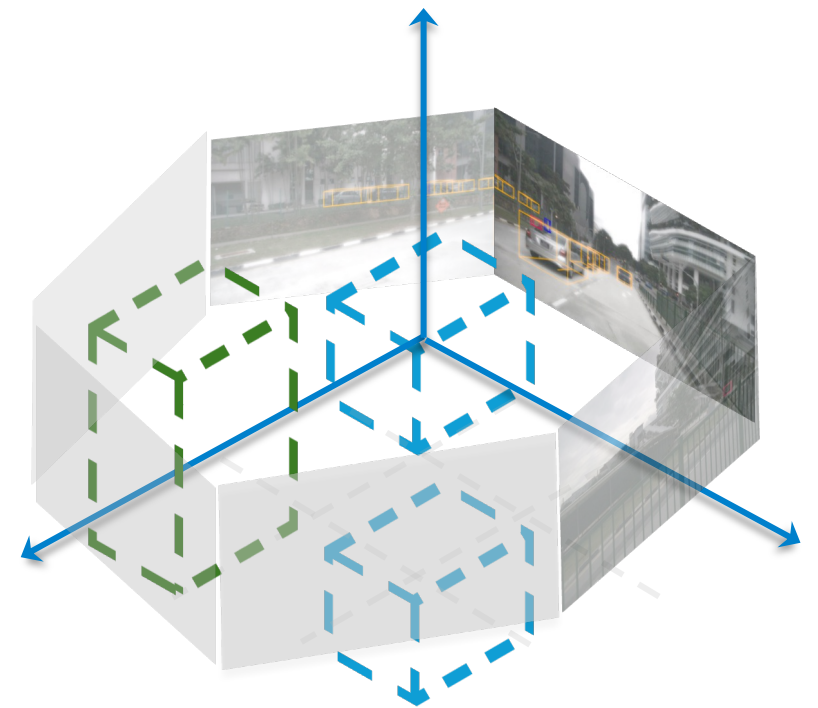
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YOKOHAMA | JAPAN

2nd Place





Team DeepVision



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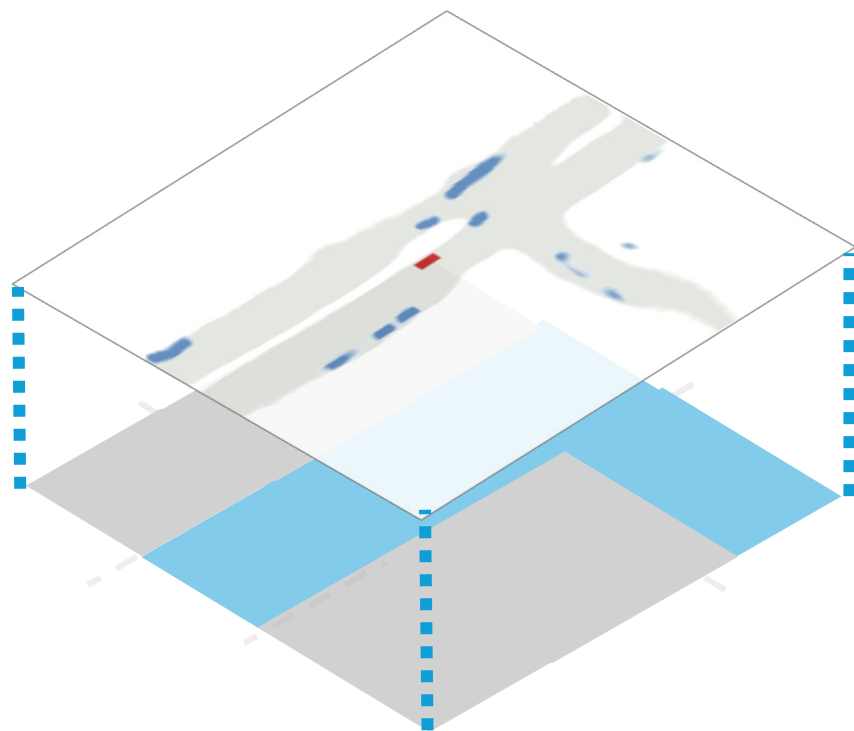
ICRA2024
YOKOHAMA | JAPAN

1st Place



Track 2

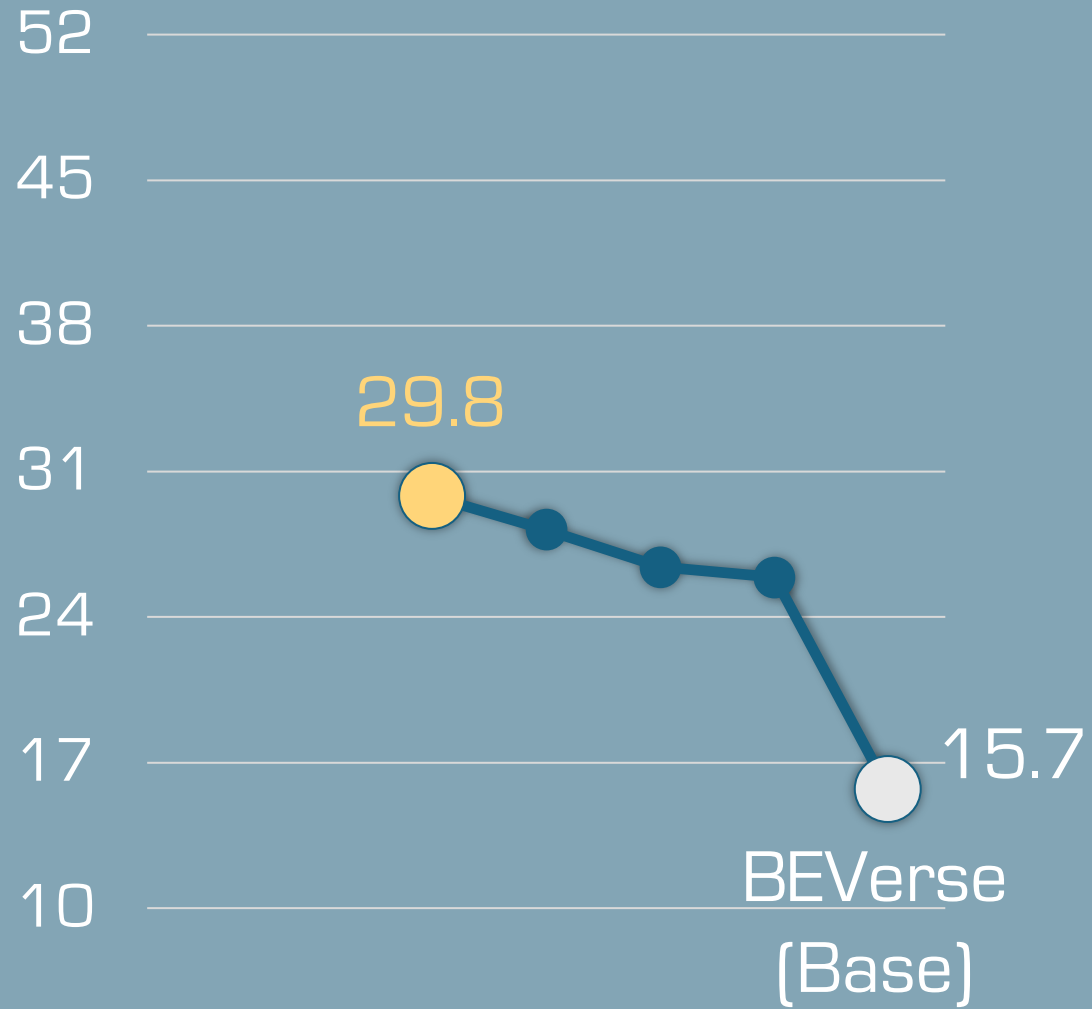
Robust Map Segmentation



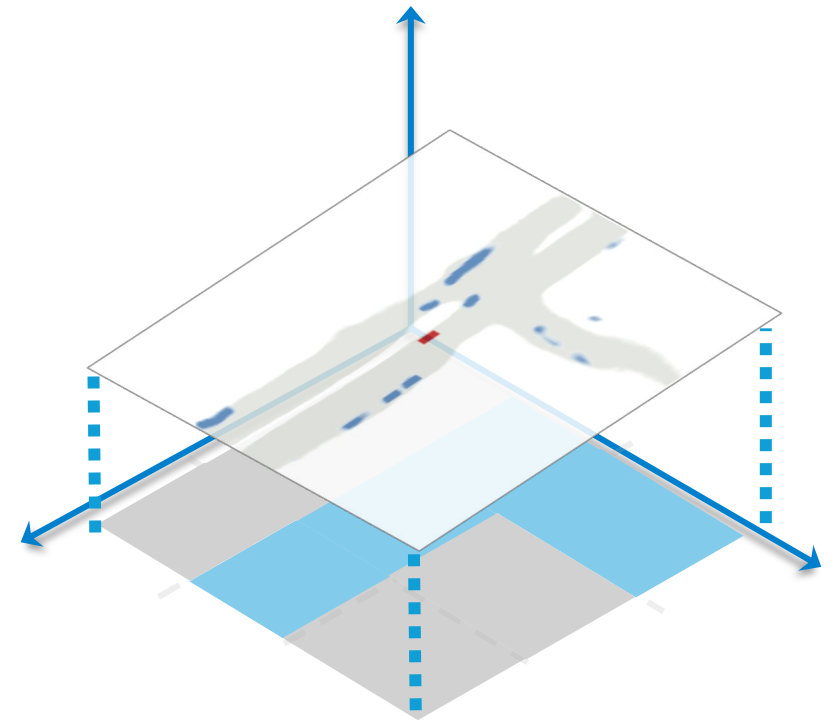
Winning Solution



mIoU



Team
Samsung



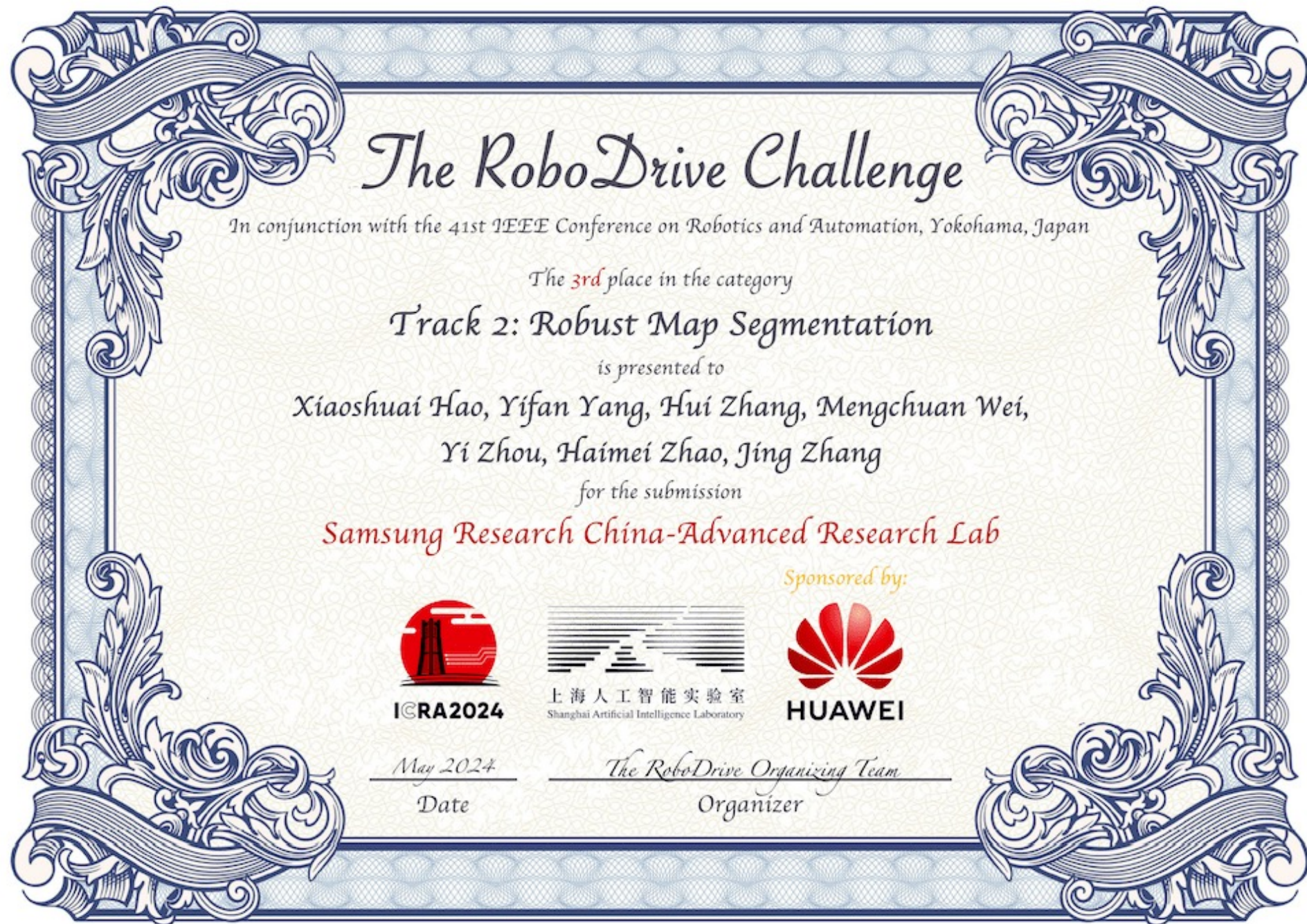
ICRA2024
YOKOHAMA | JAPAN



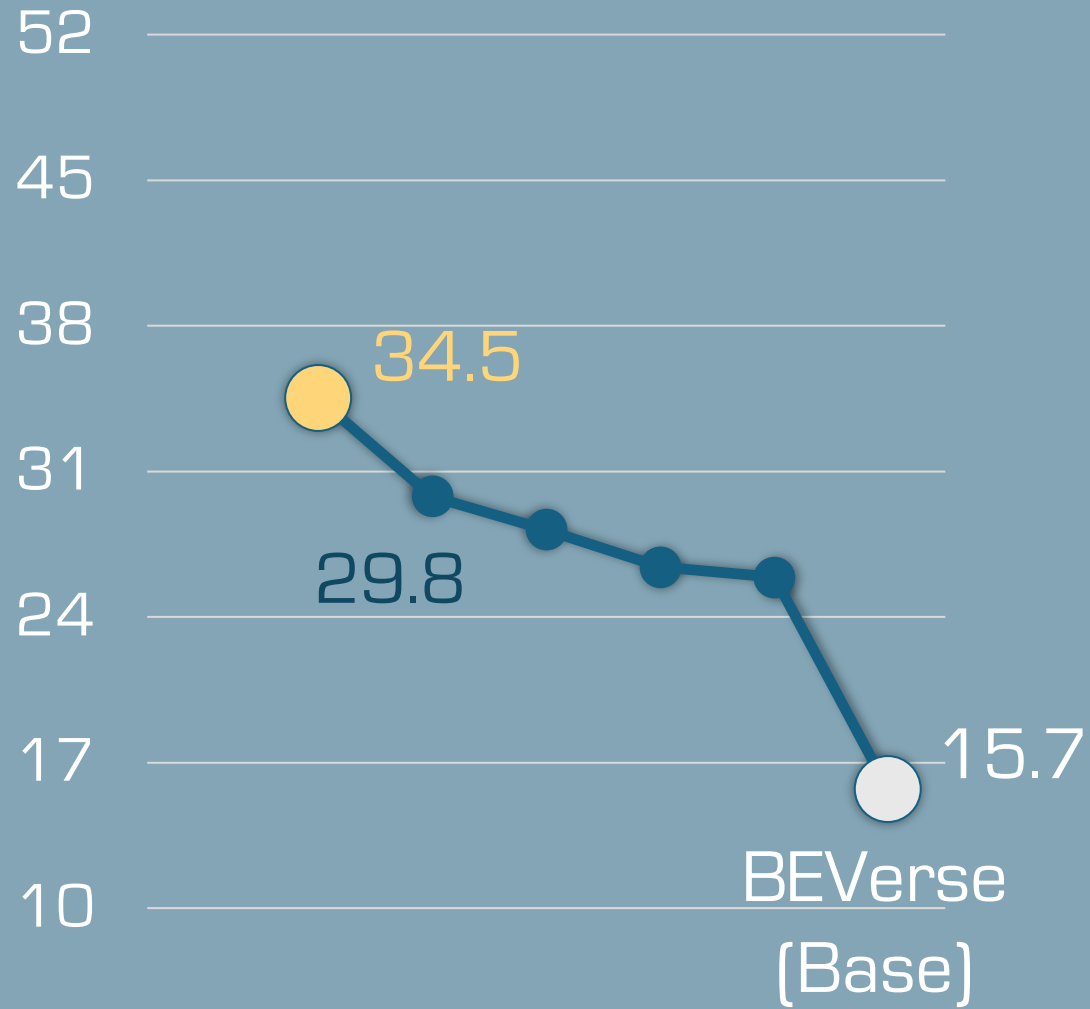


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3rd Place



mIoU

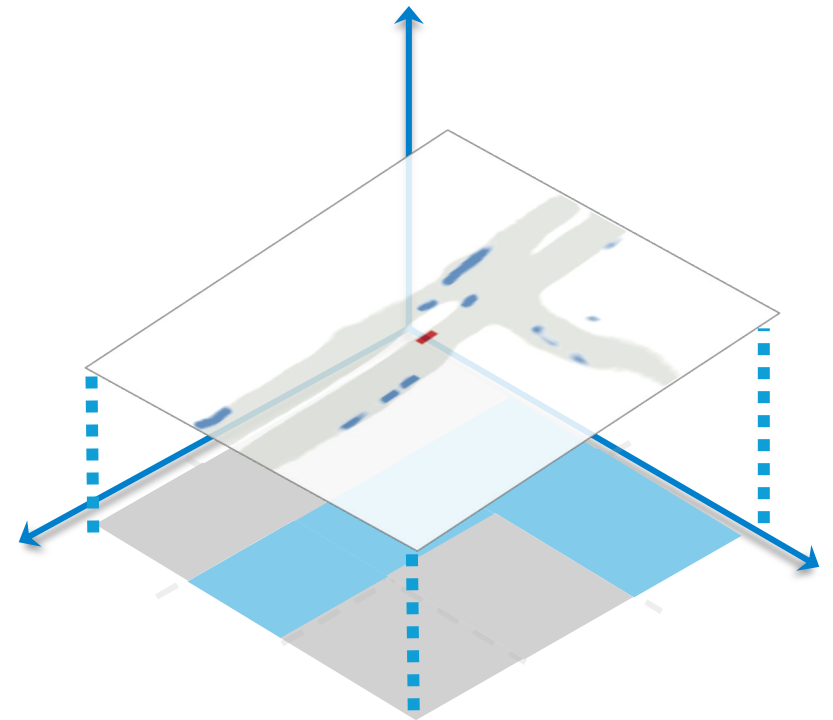


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Team

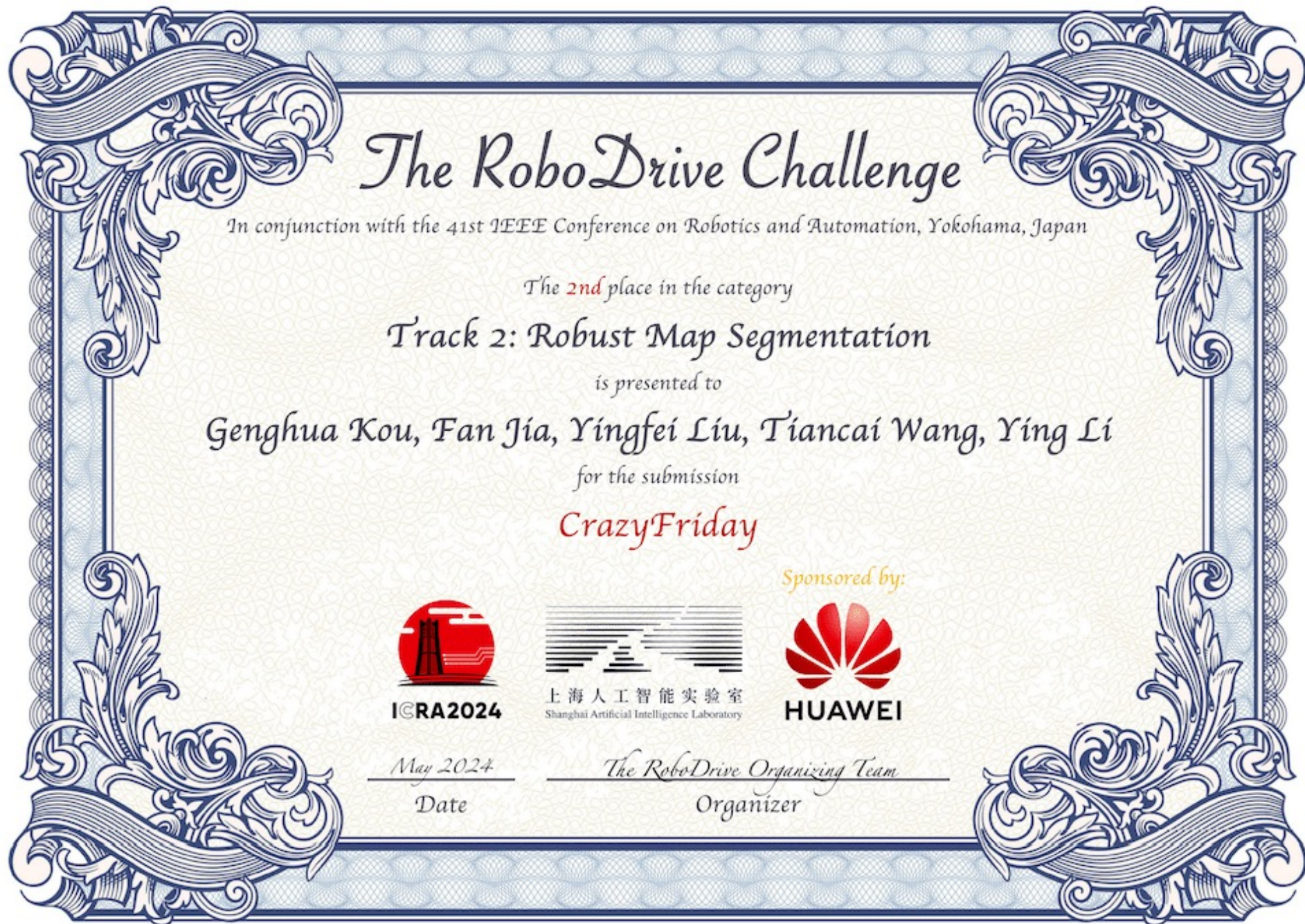
CrazyFriday



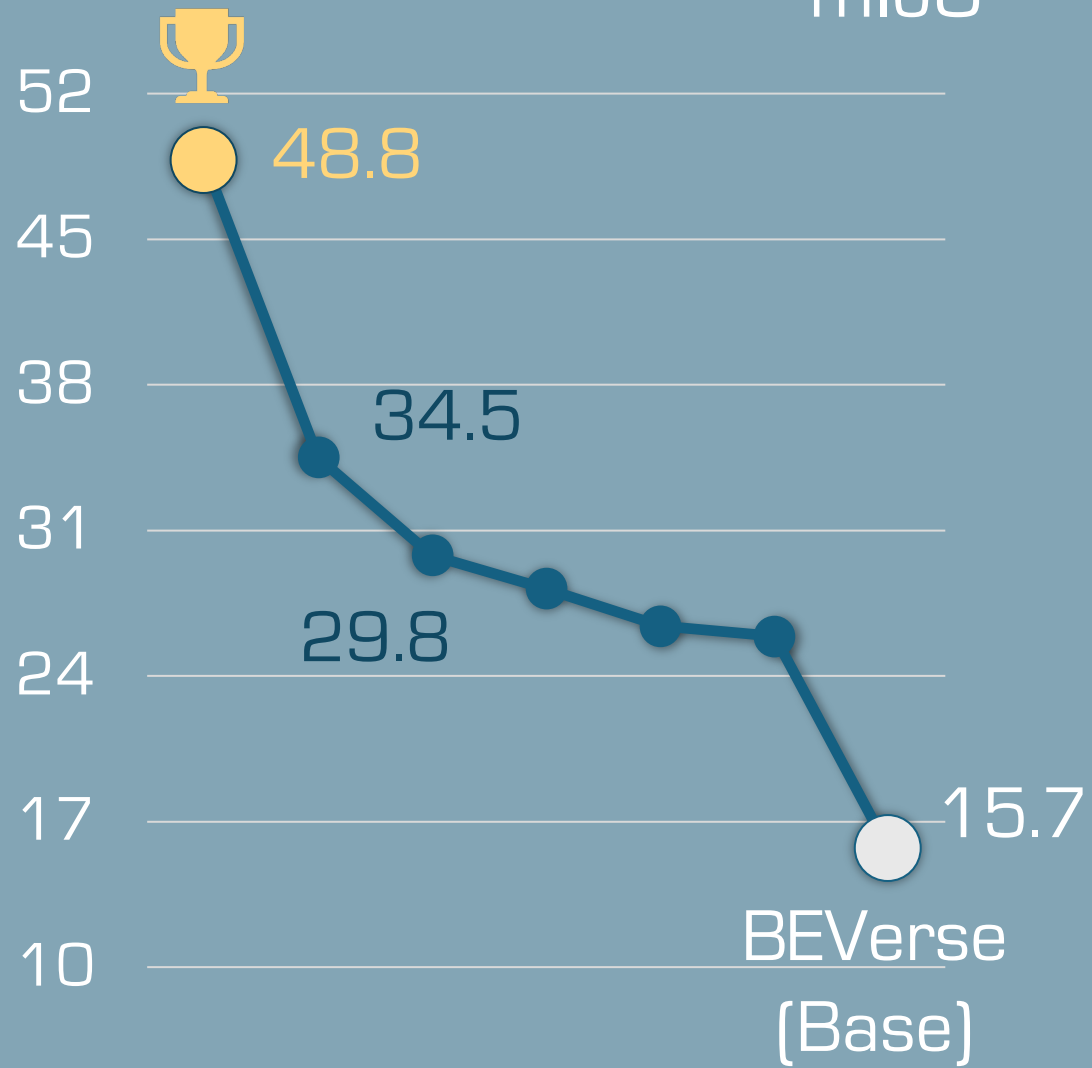


ICRA2024
YOKOHAMA | JAPAN

2nd Place

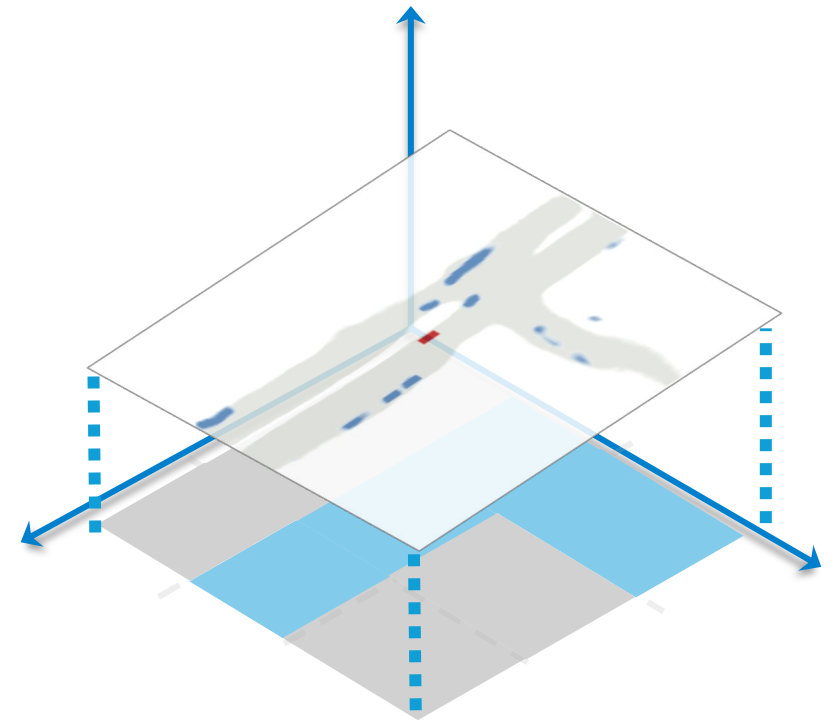


mIoU



Team

SafeDrive-SSR



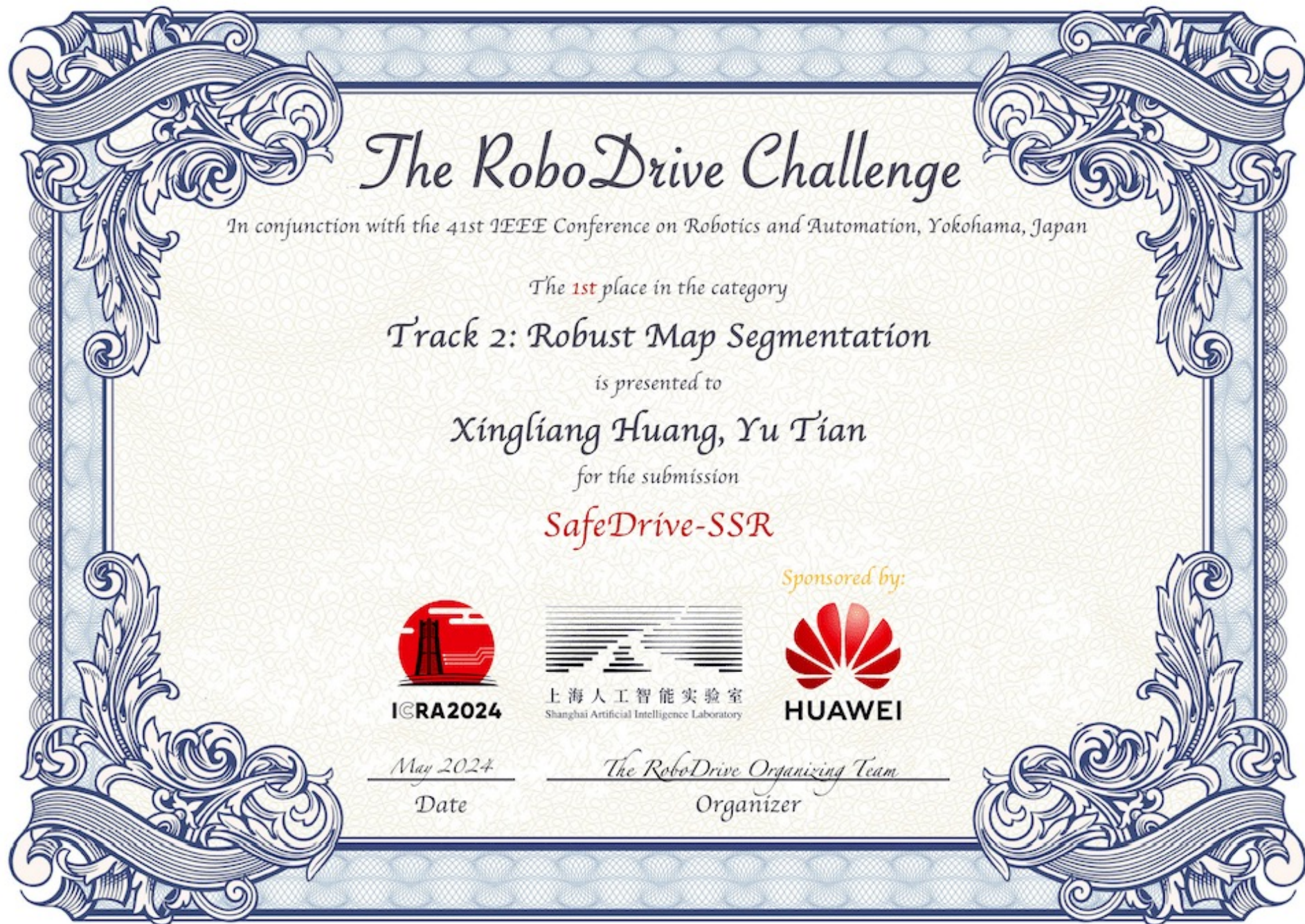
ICRA2024
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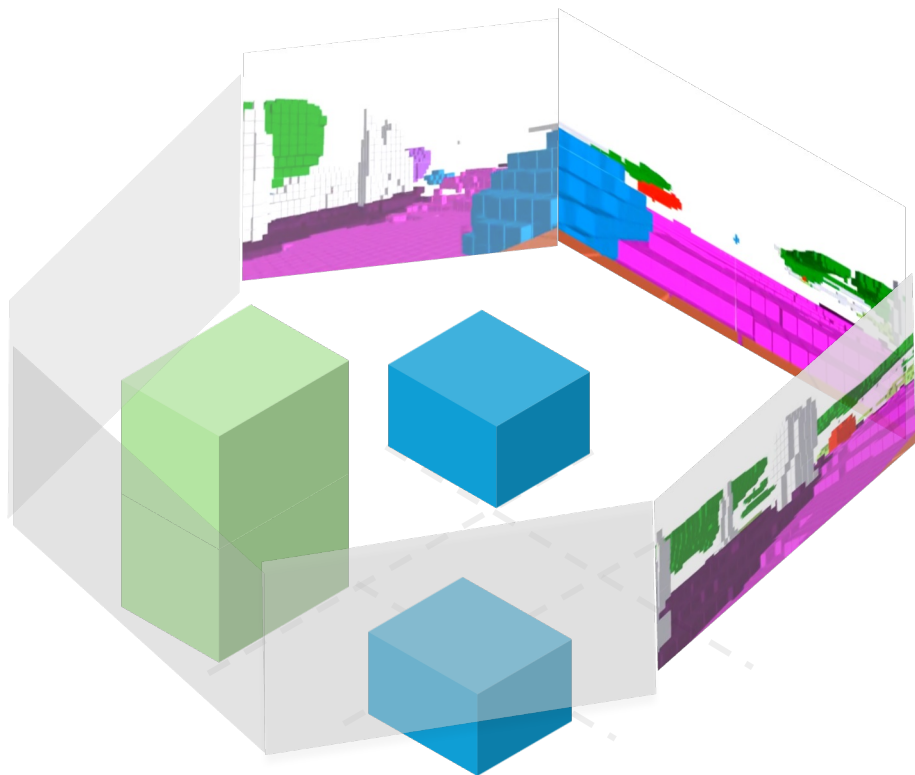
ICRA2024
YOKOHAMA | JAPAN

1st Place



Track 3

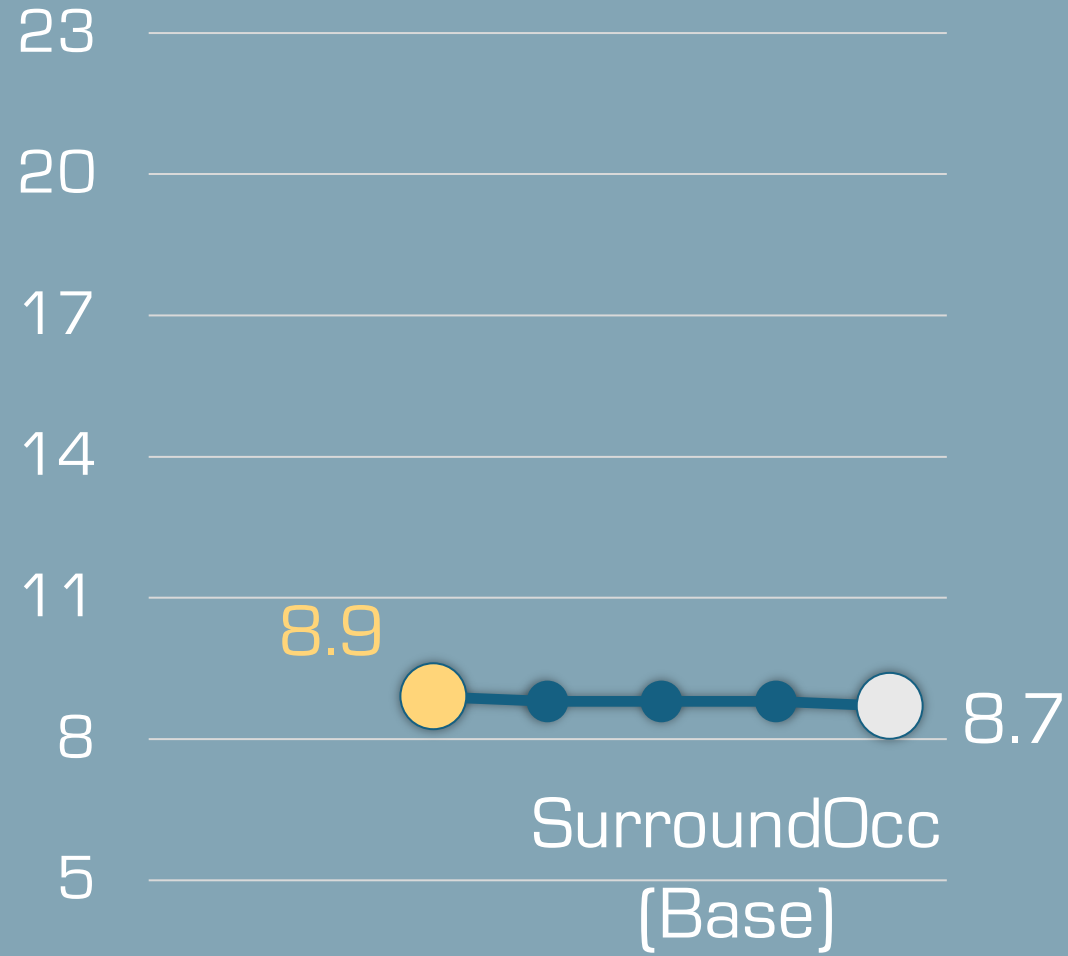
Robust Occupancy Prediction



Winning Solution



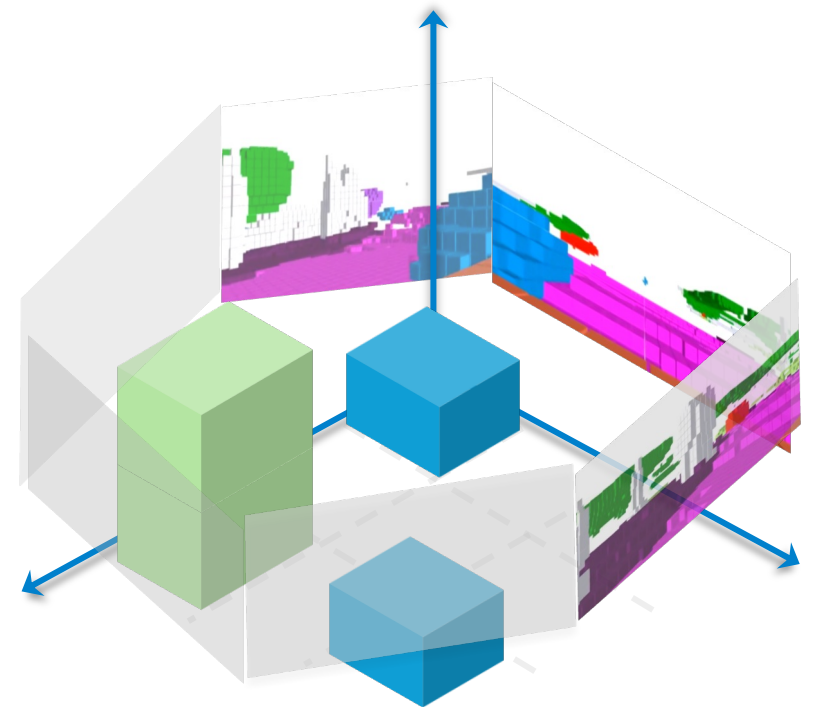
mIoU



ICRA2024
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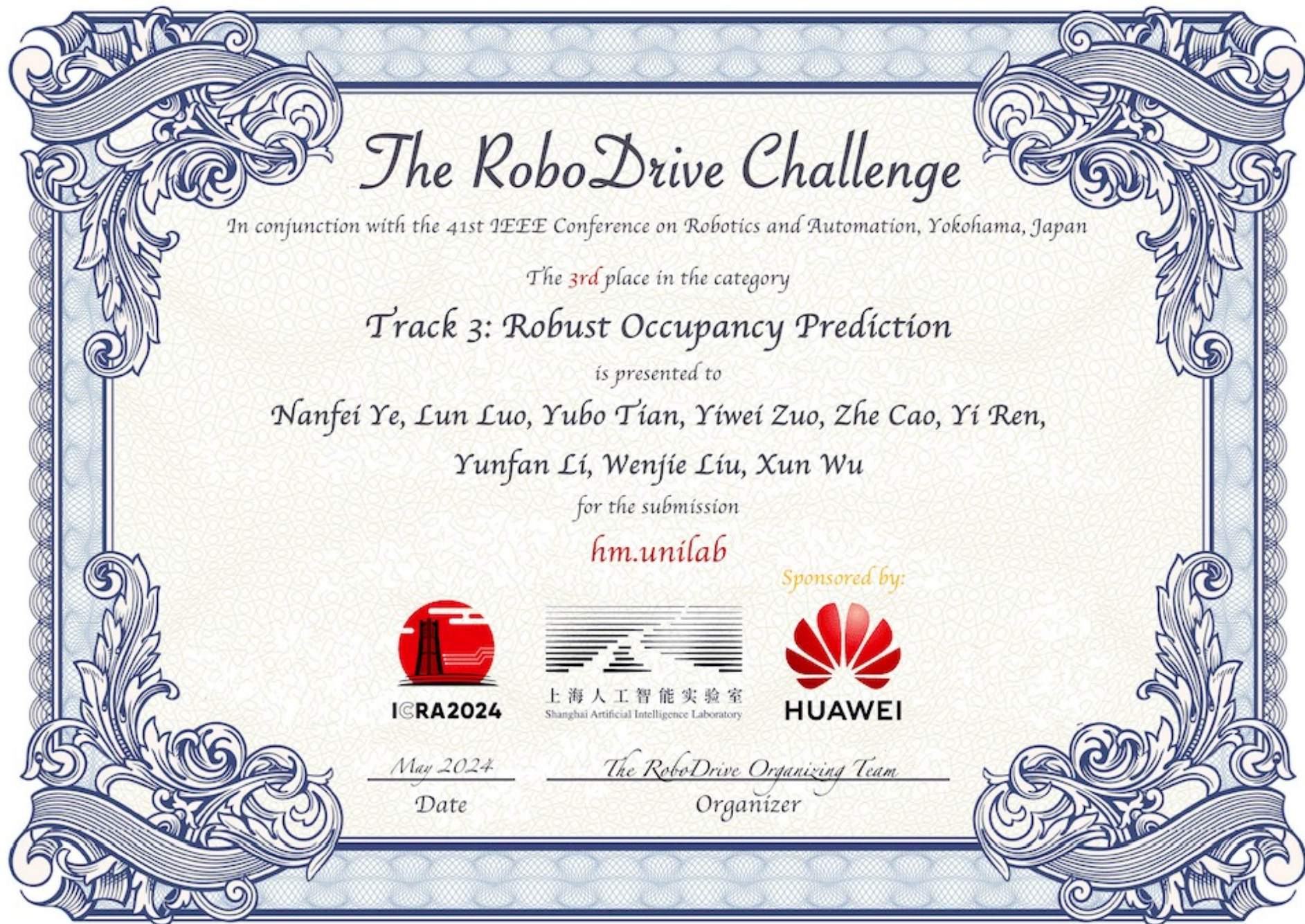
Team
hm.unilab



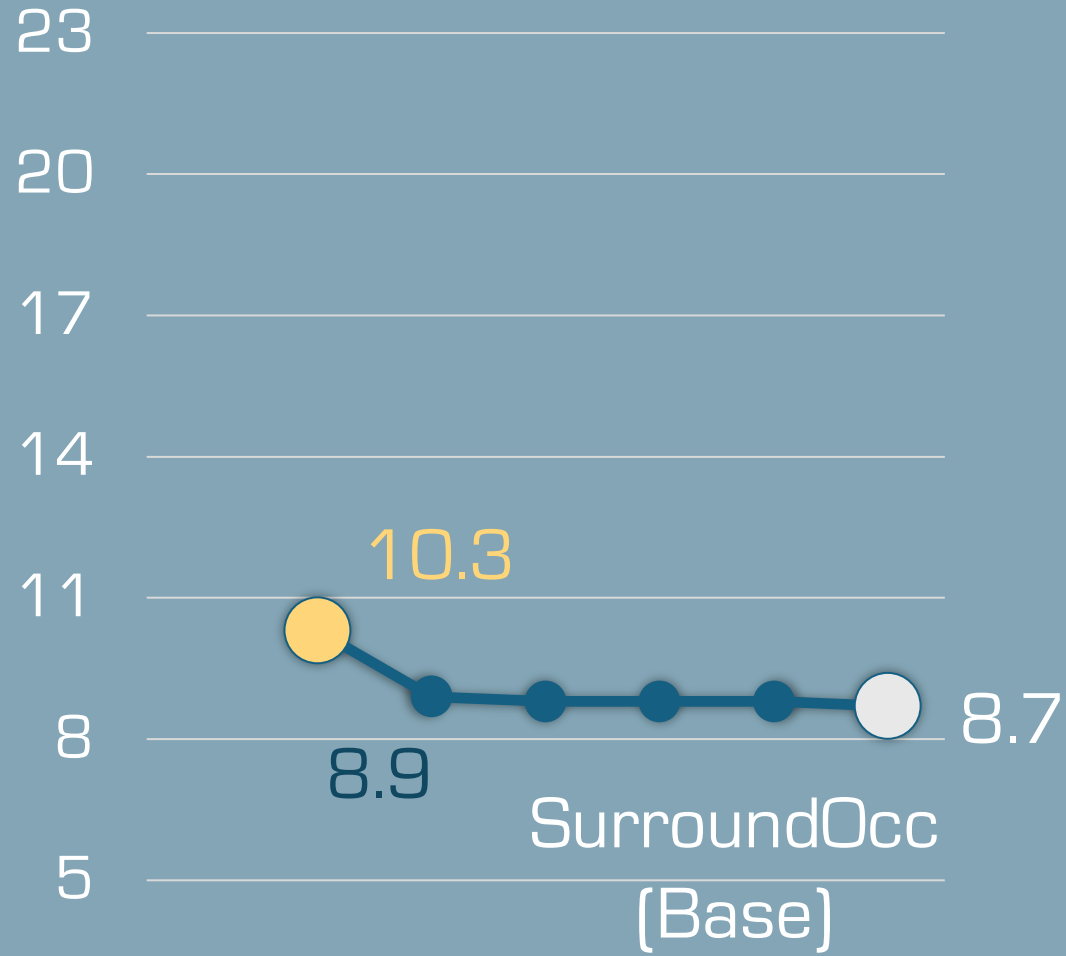


ICRA2024
YOKOHAMA | JAPAN

3rd Place

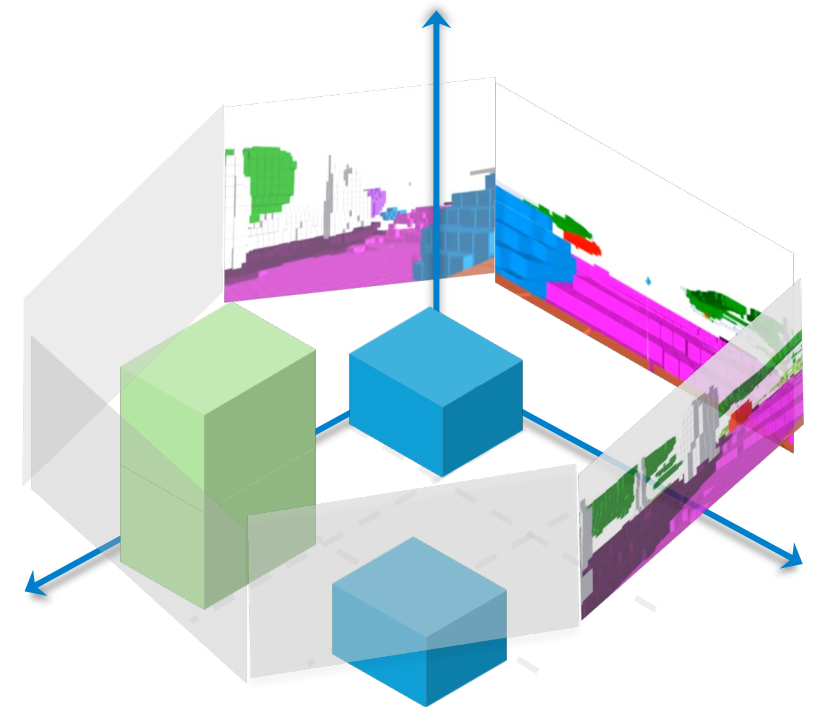


mIoU



Team

APEC Blue



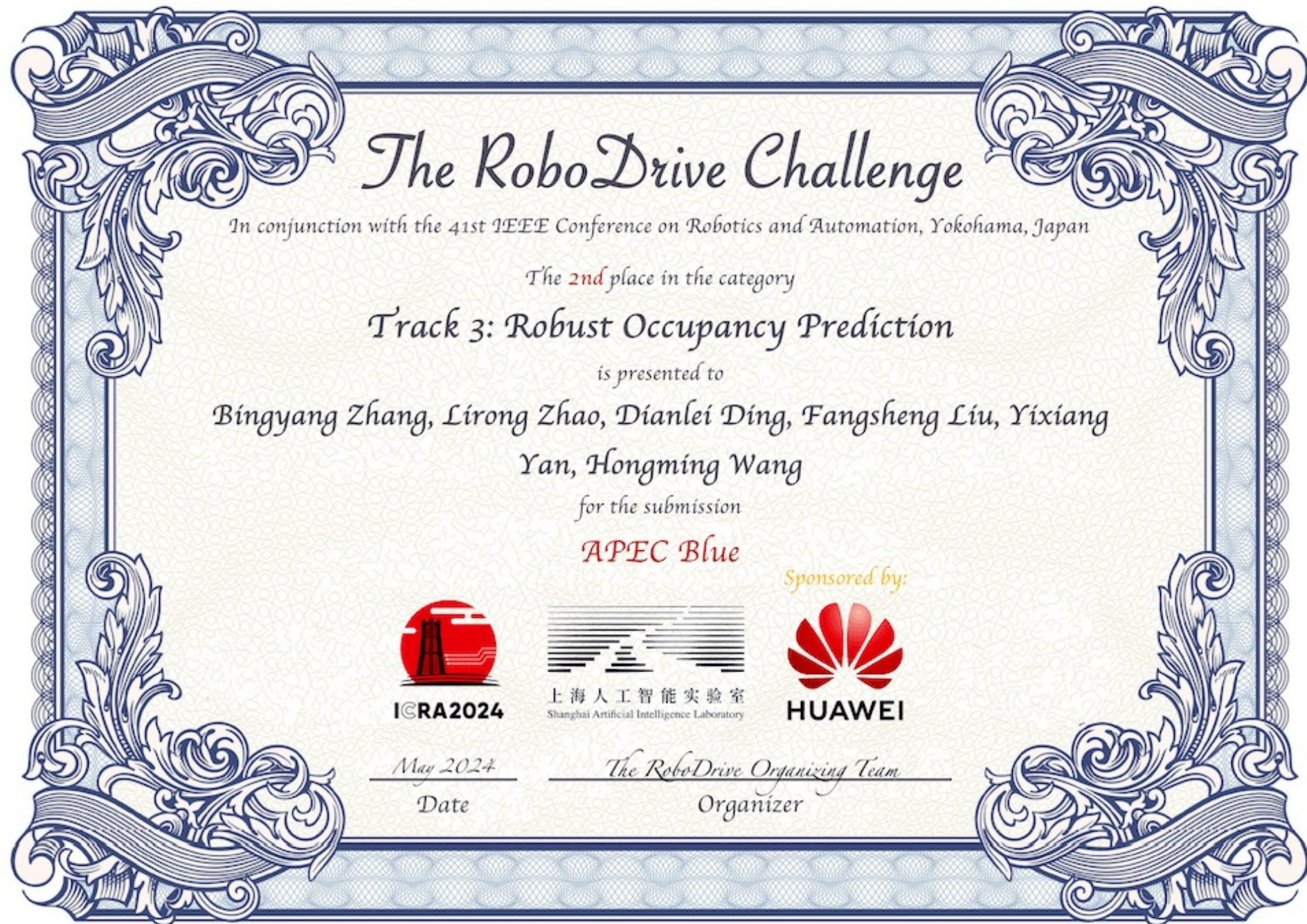
ICRA2024
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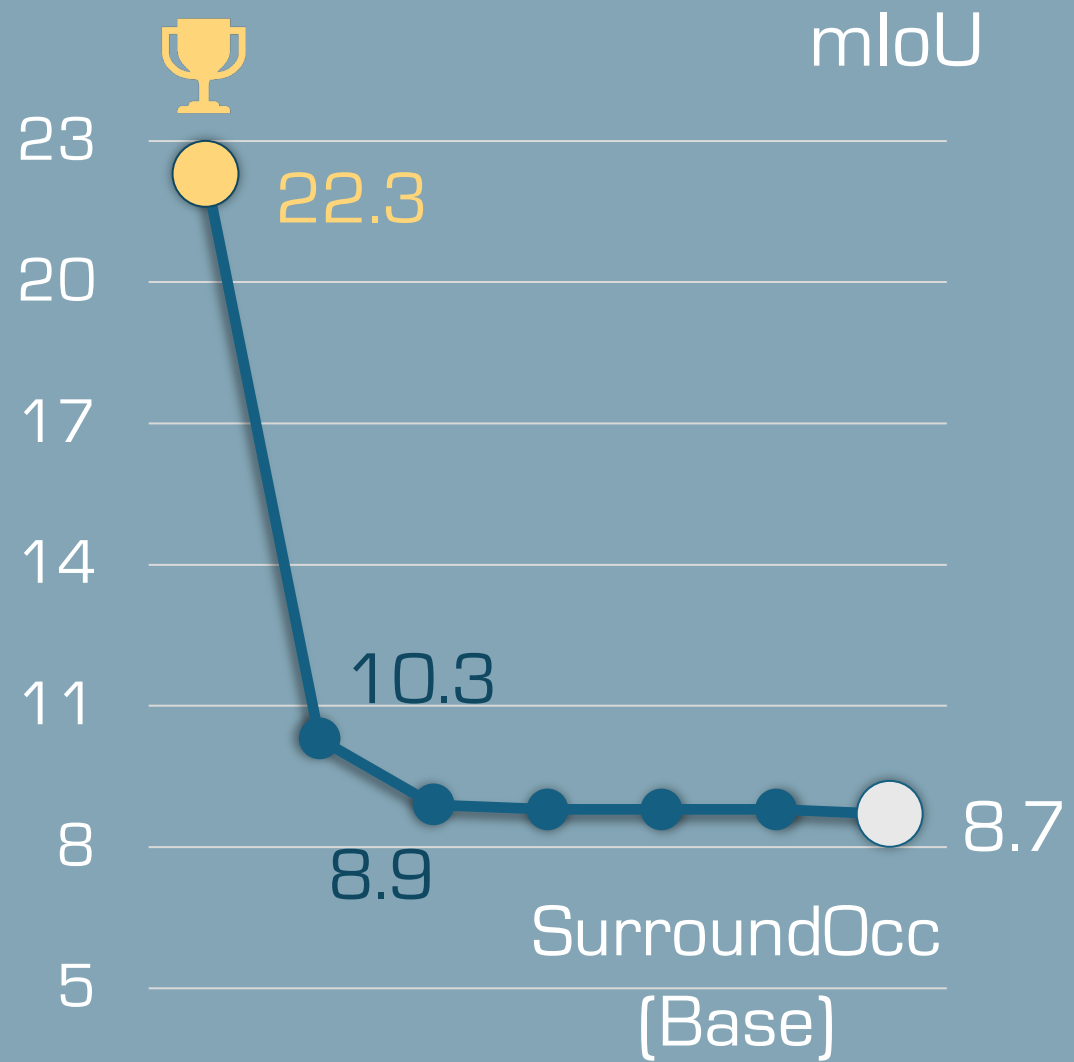




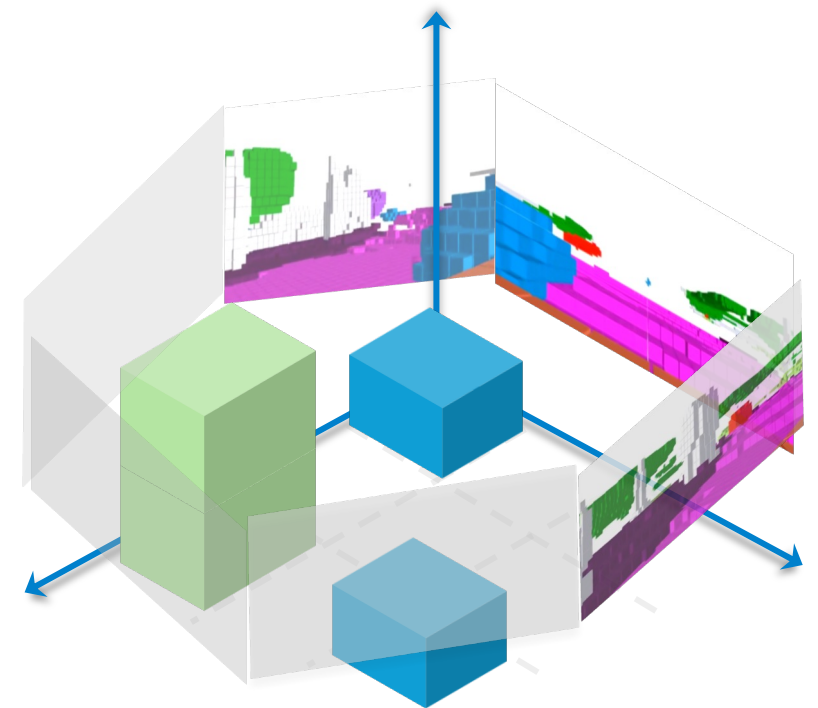
ICRA2024
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2nd Place





Team ViewFormer



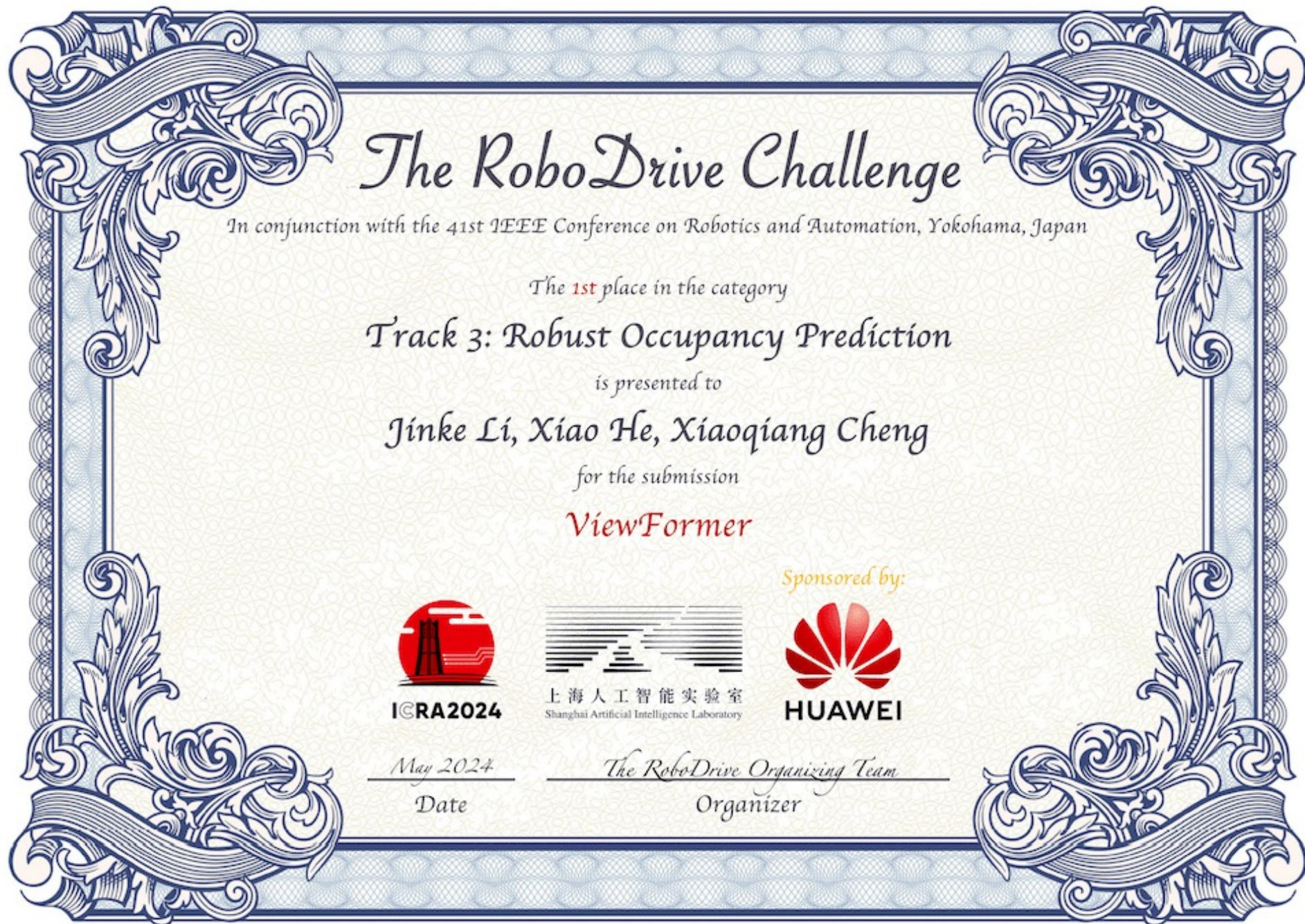
ICRA2024
YOKOHAMA | JAPAN





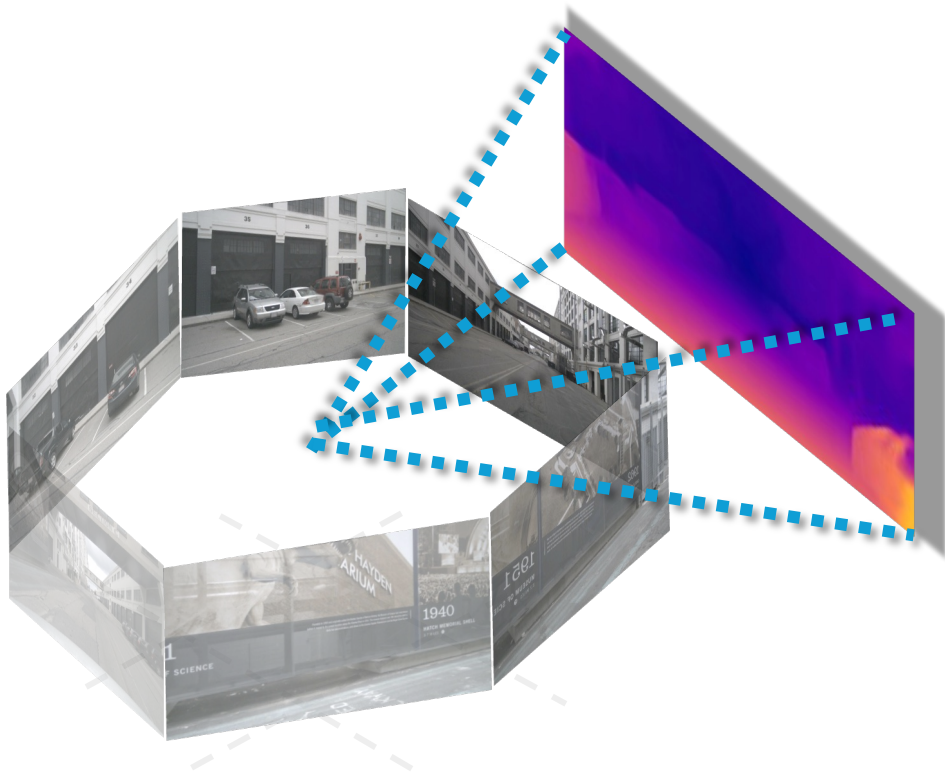
ICRA2024
YOKOHAMA | JAPAN

1st Place



Track 4

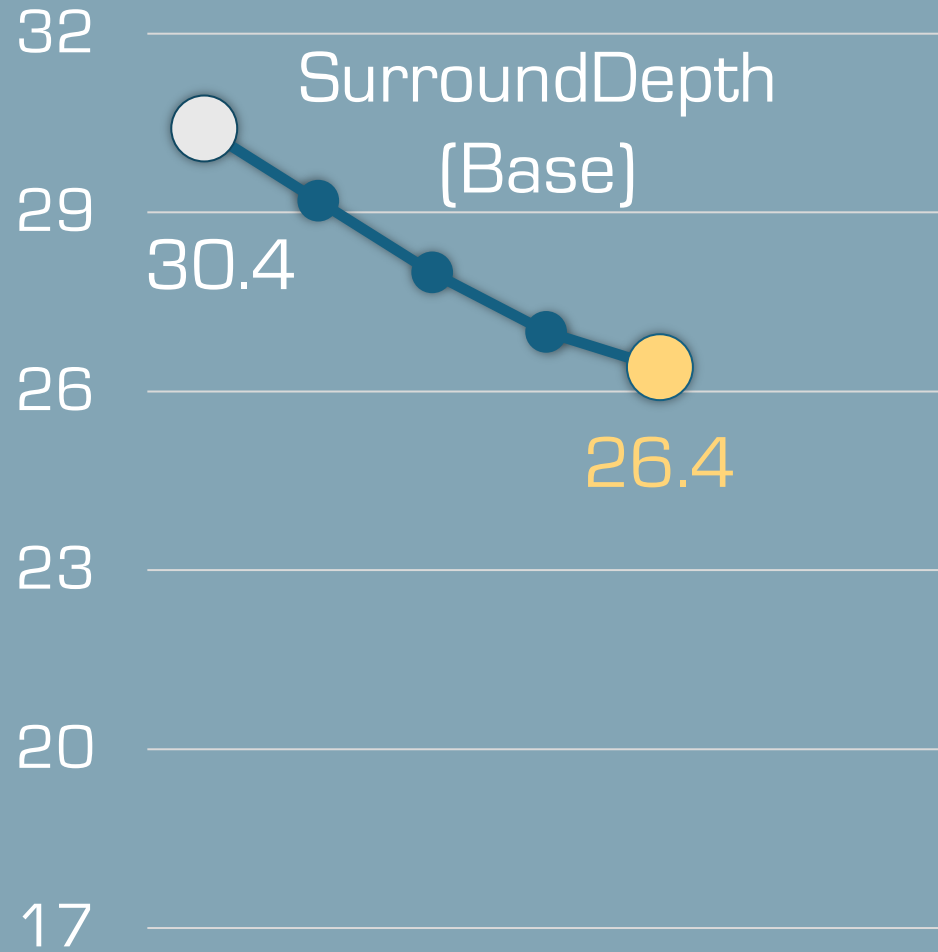
Robust Depth Estimation



Winning
Solution



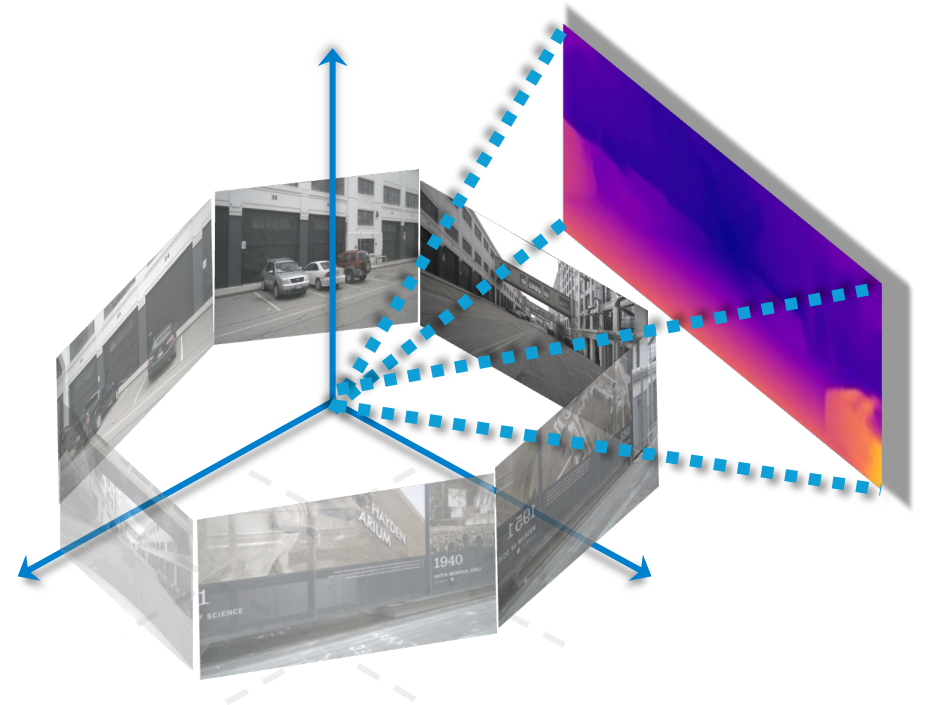
Abs Rel



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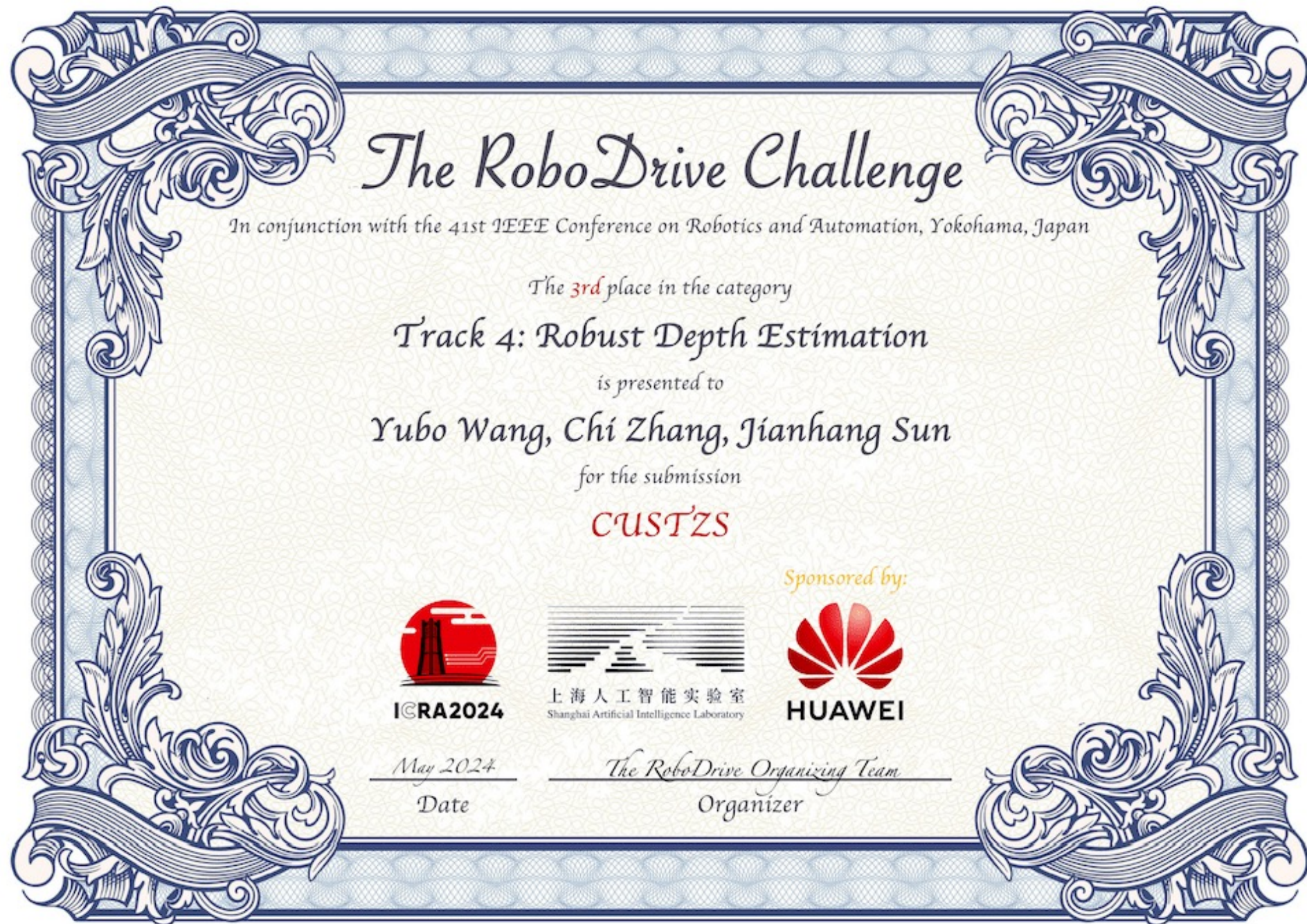
Team
CUSTZS



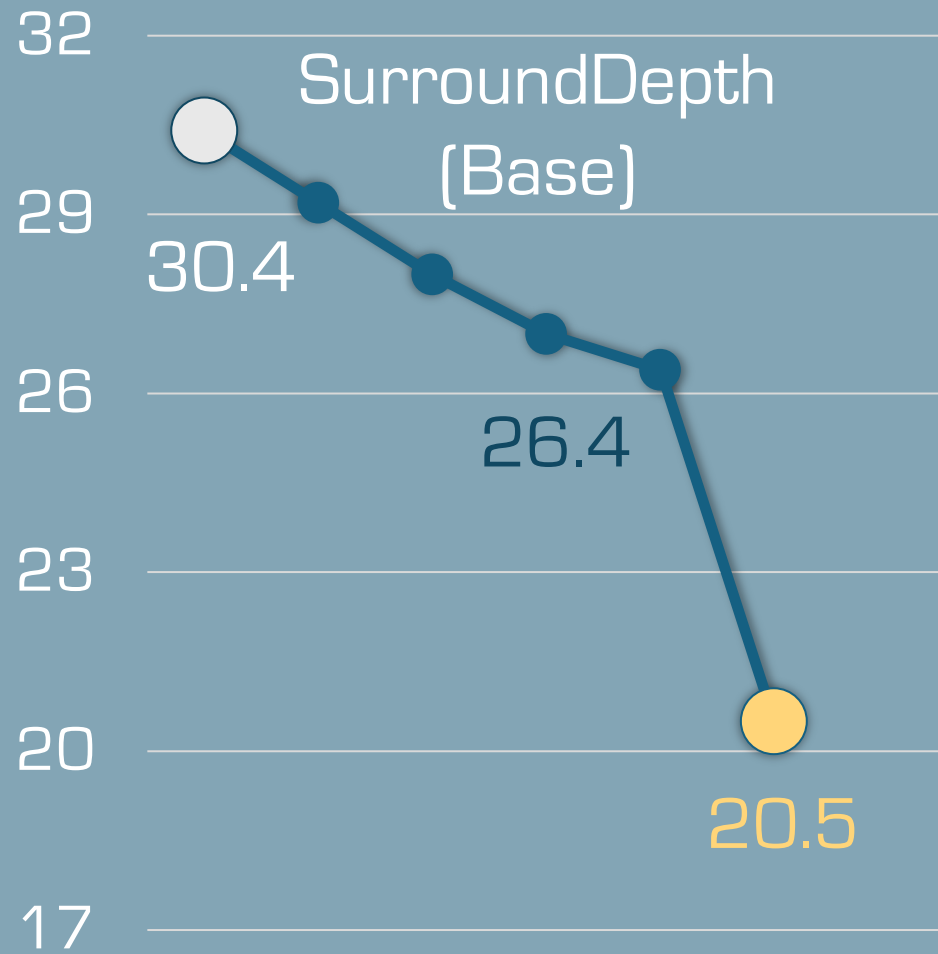


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YOKOHAMA | JAPAN

3rd Place



Abs Rel

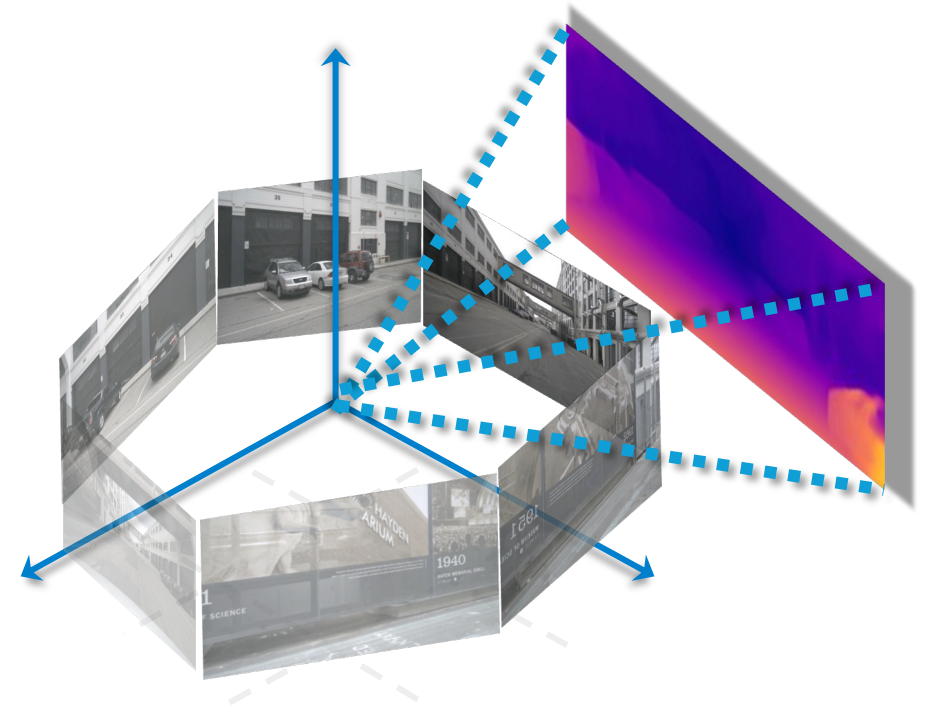


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Team

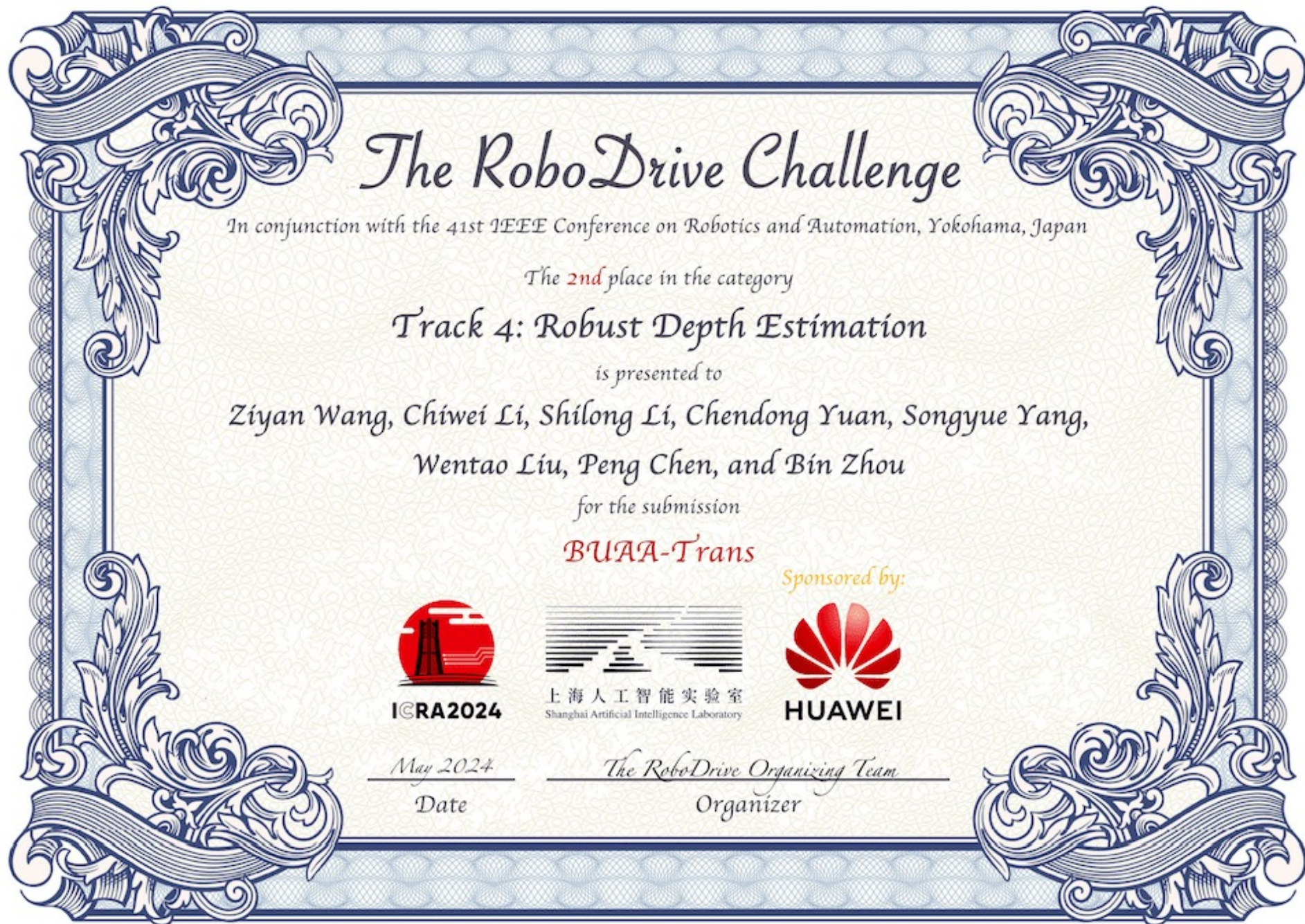
BUAA-Trans



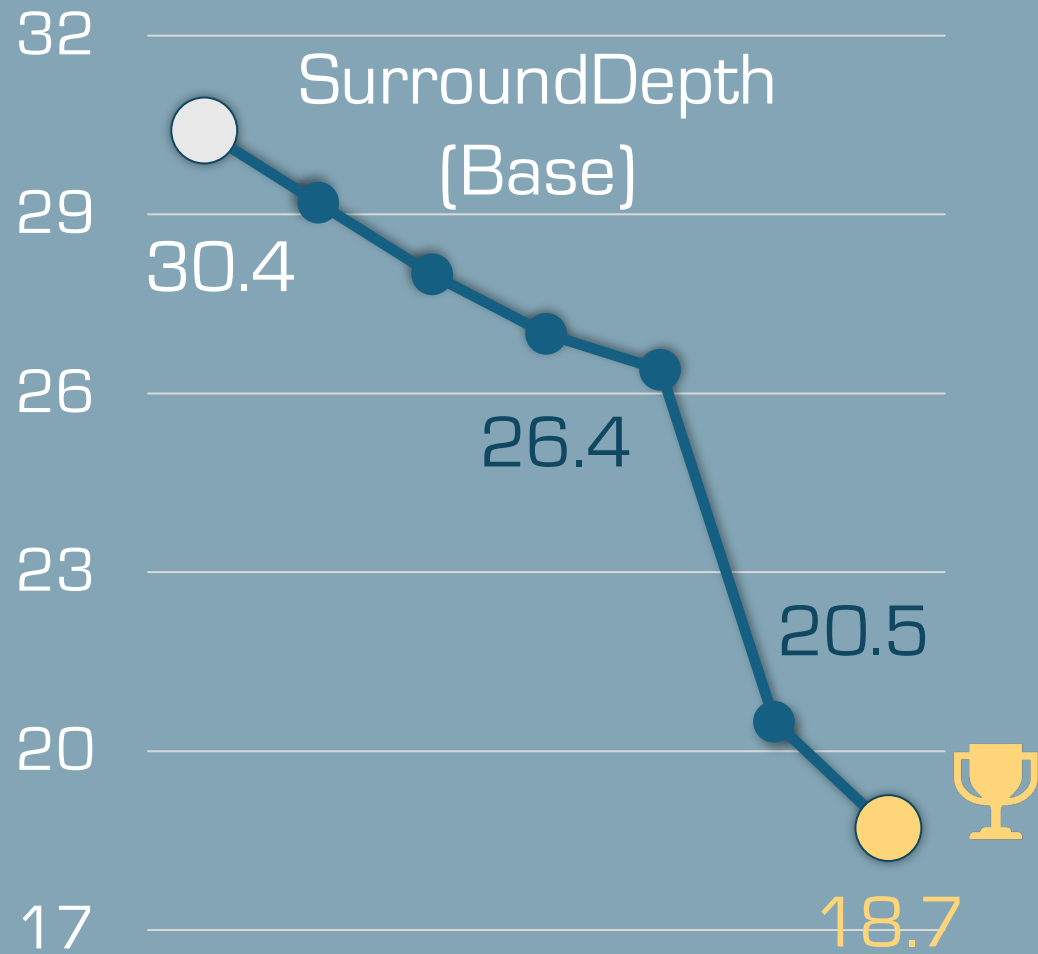


ICRA2024
YOKOHAMA | JAPAN

2nd Place



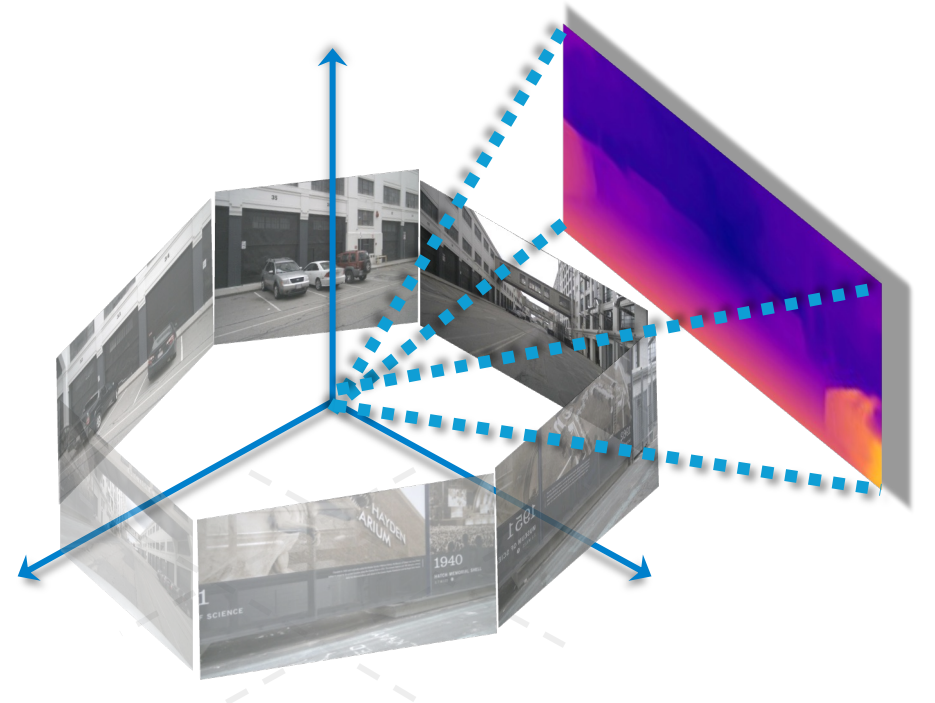
Abs Rel



ICRA2024
YOKOHAMA | JAPAN



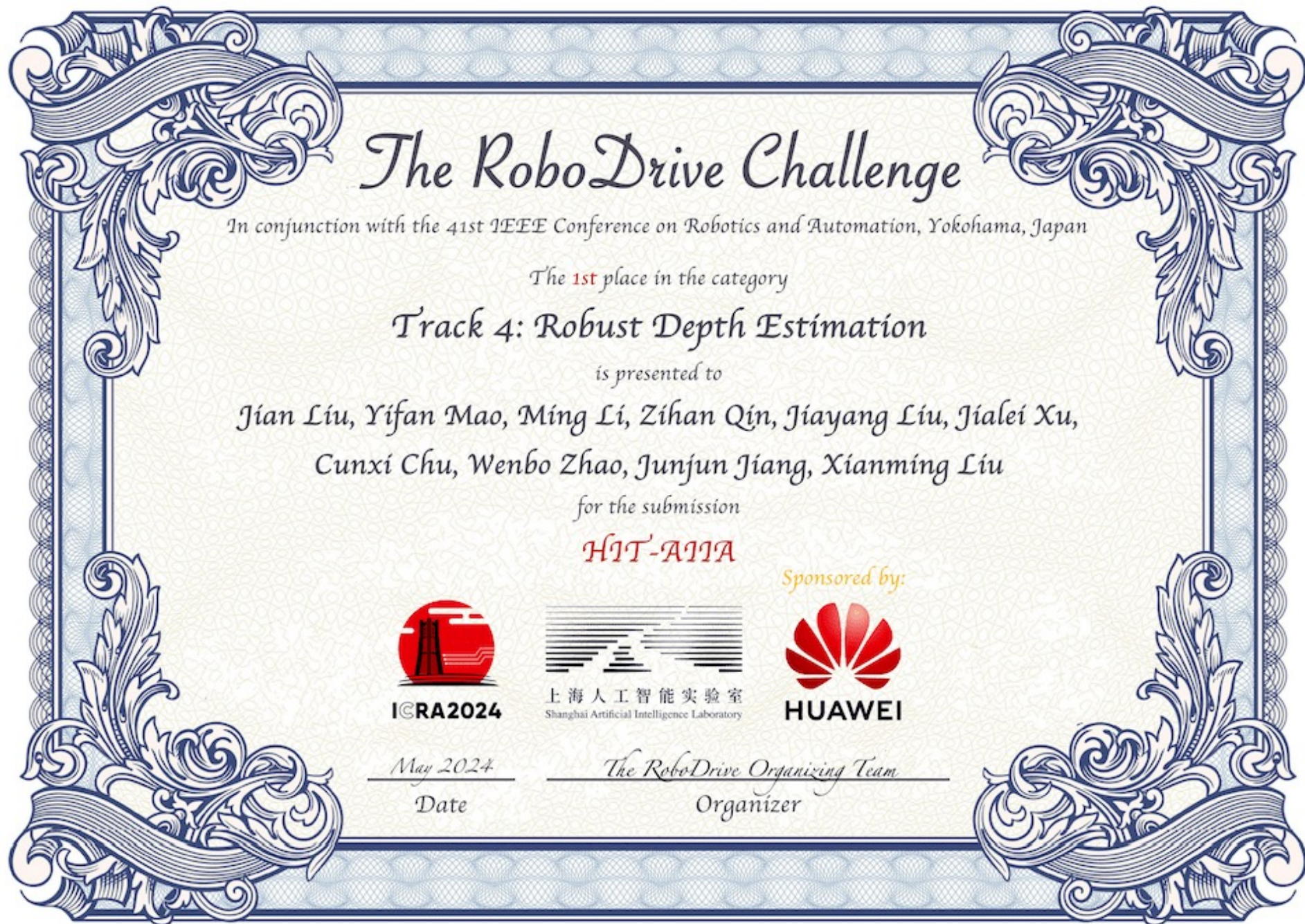
Team
HIT-AIIA





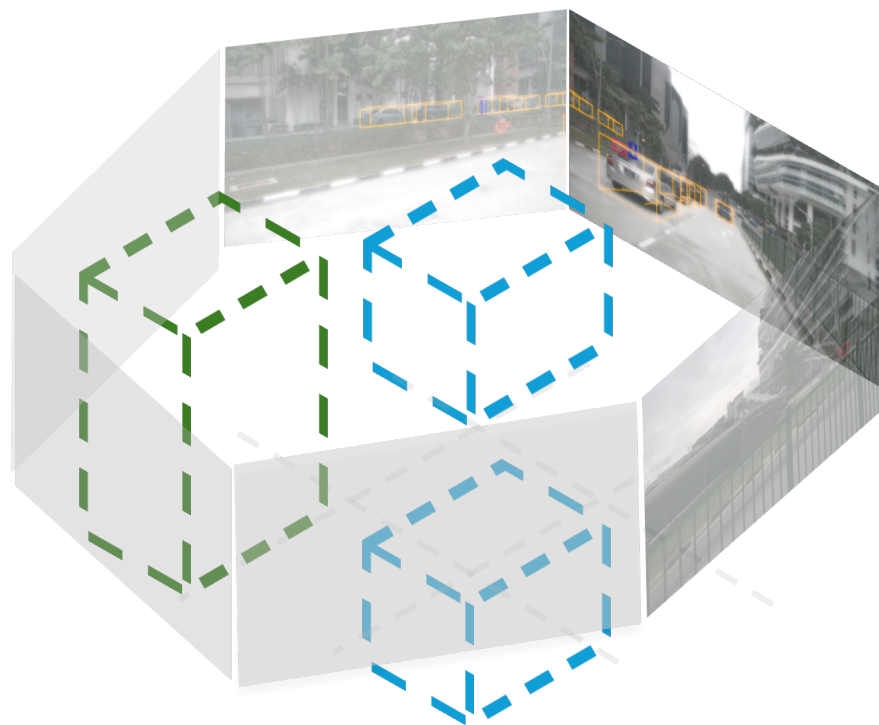
ICRA2024
YOKOHAMA | JAPAN

1st Place



Track 5

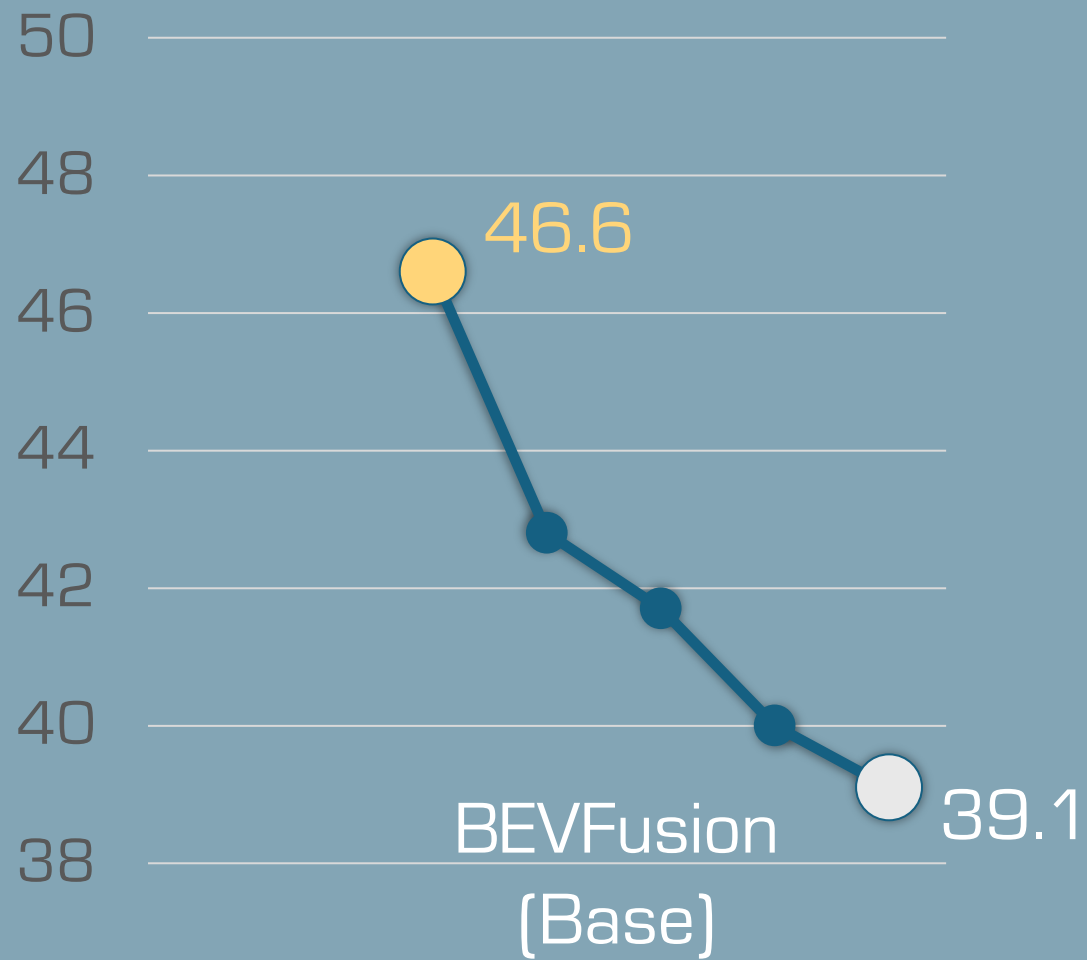
Robust Multi-Modal BEV
Detection



Winning Solution



NDS

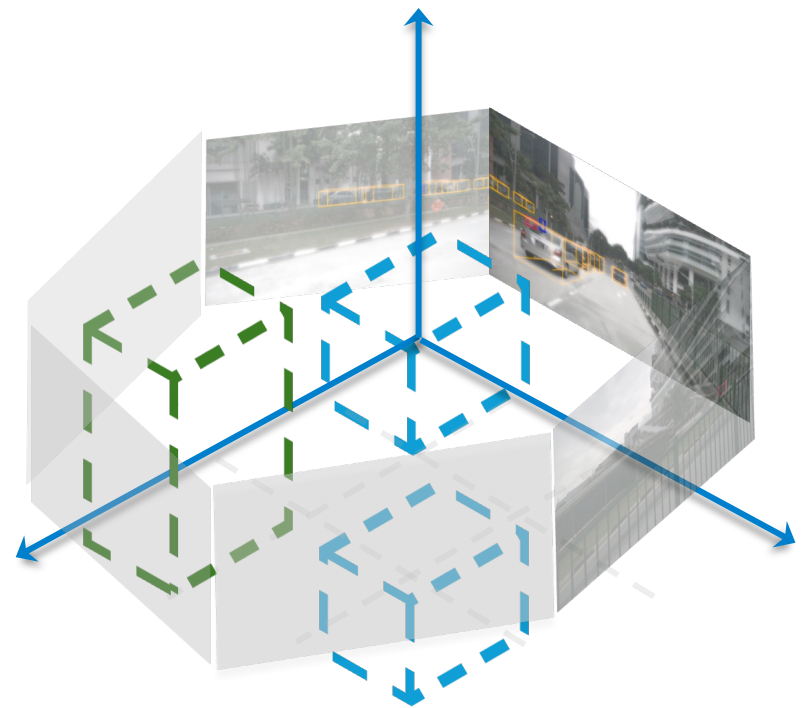


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Team

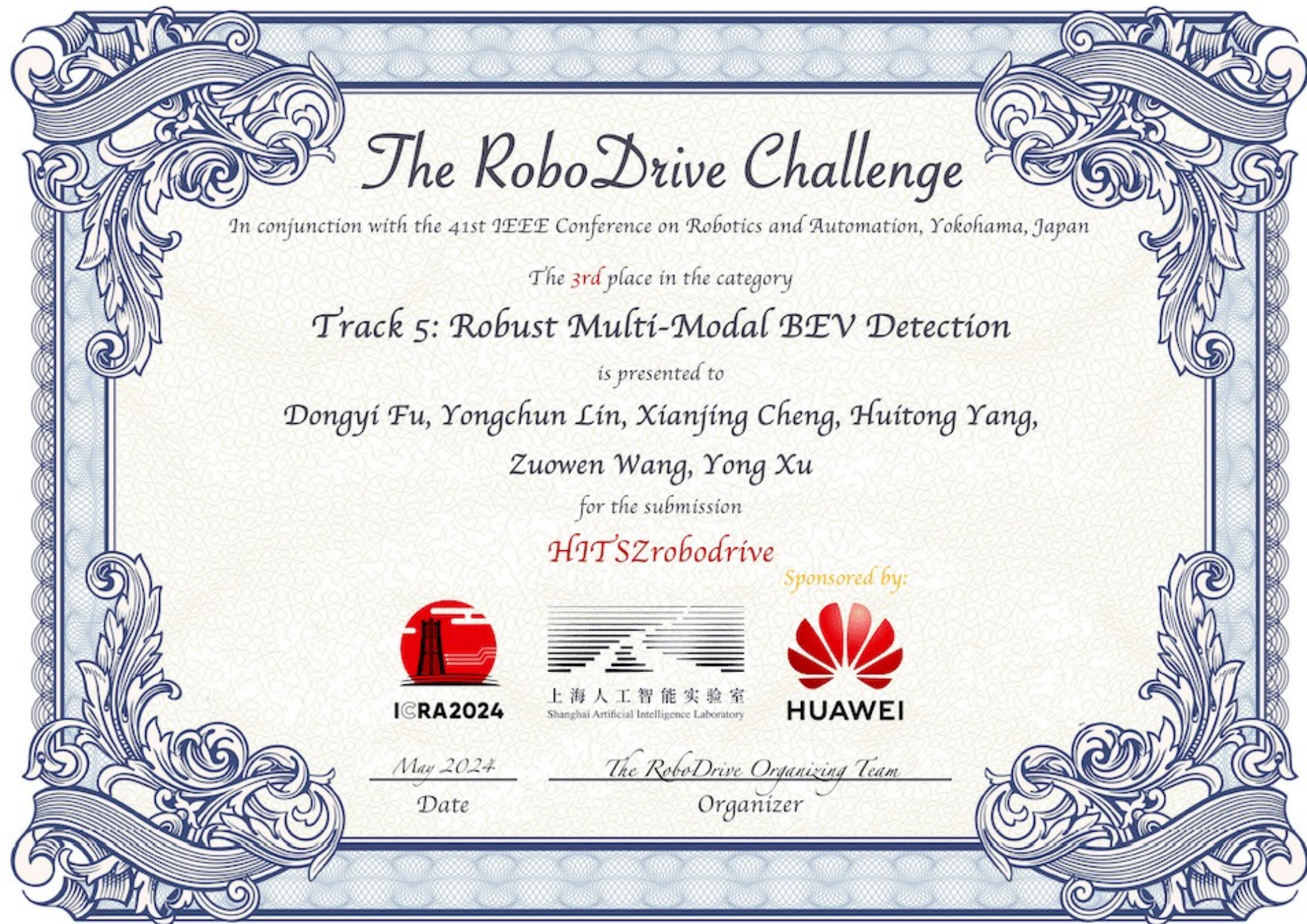
HITSZrobodrive



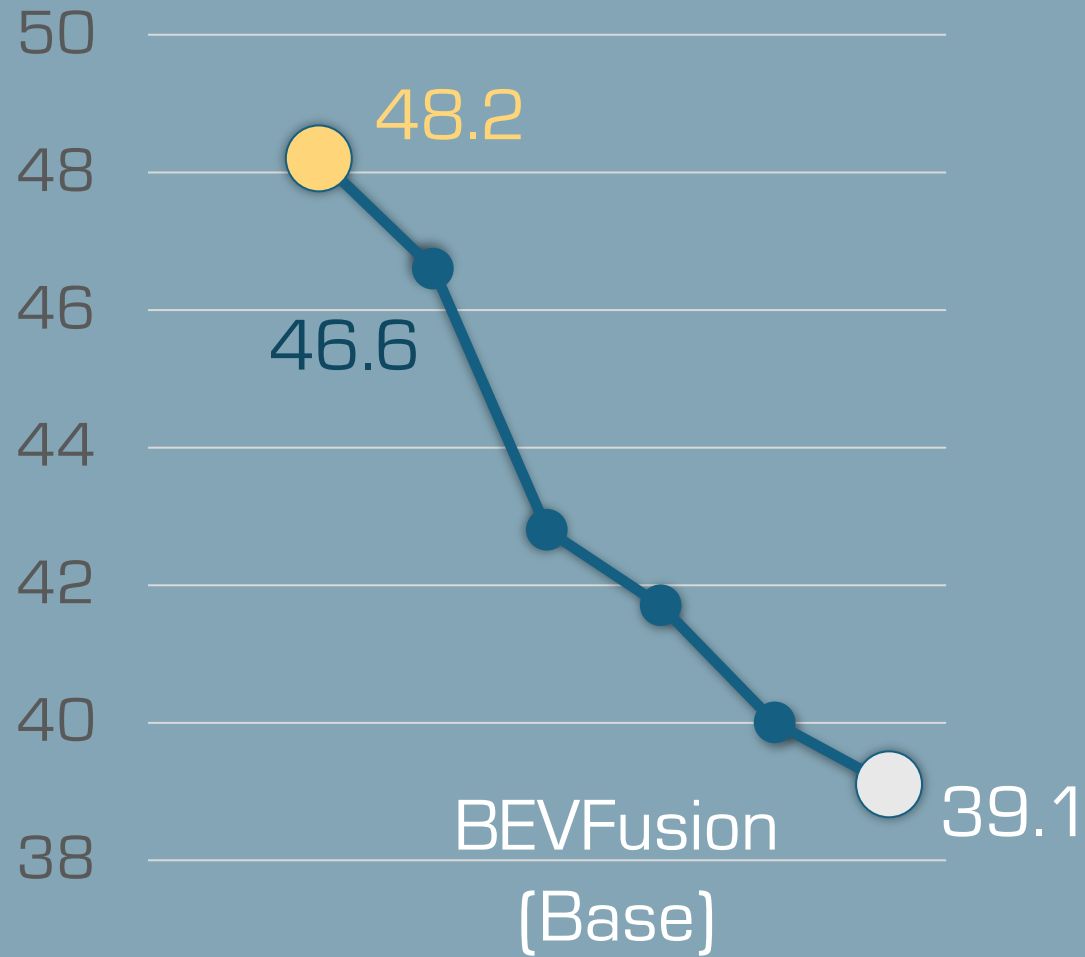


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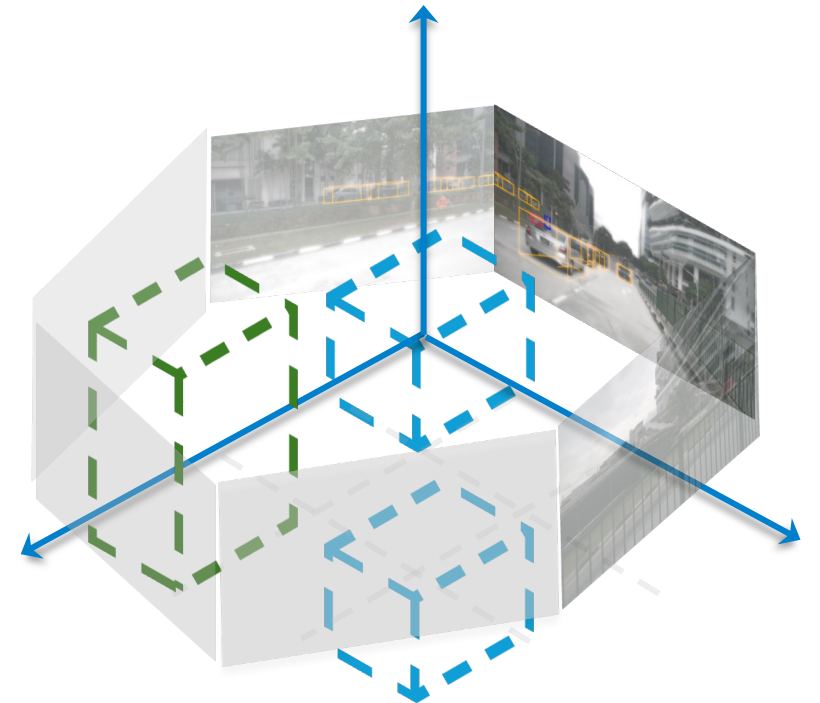
3rd Place



NDS



Team Ponyville Autonauts Ltd



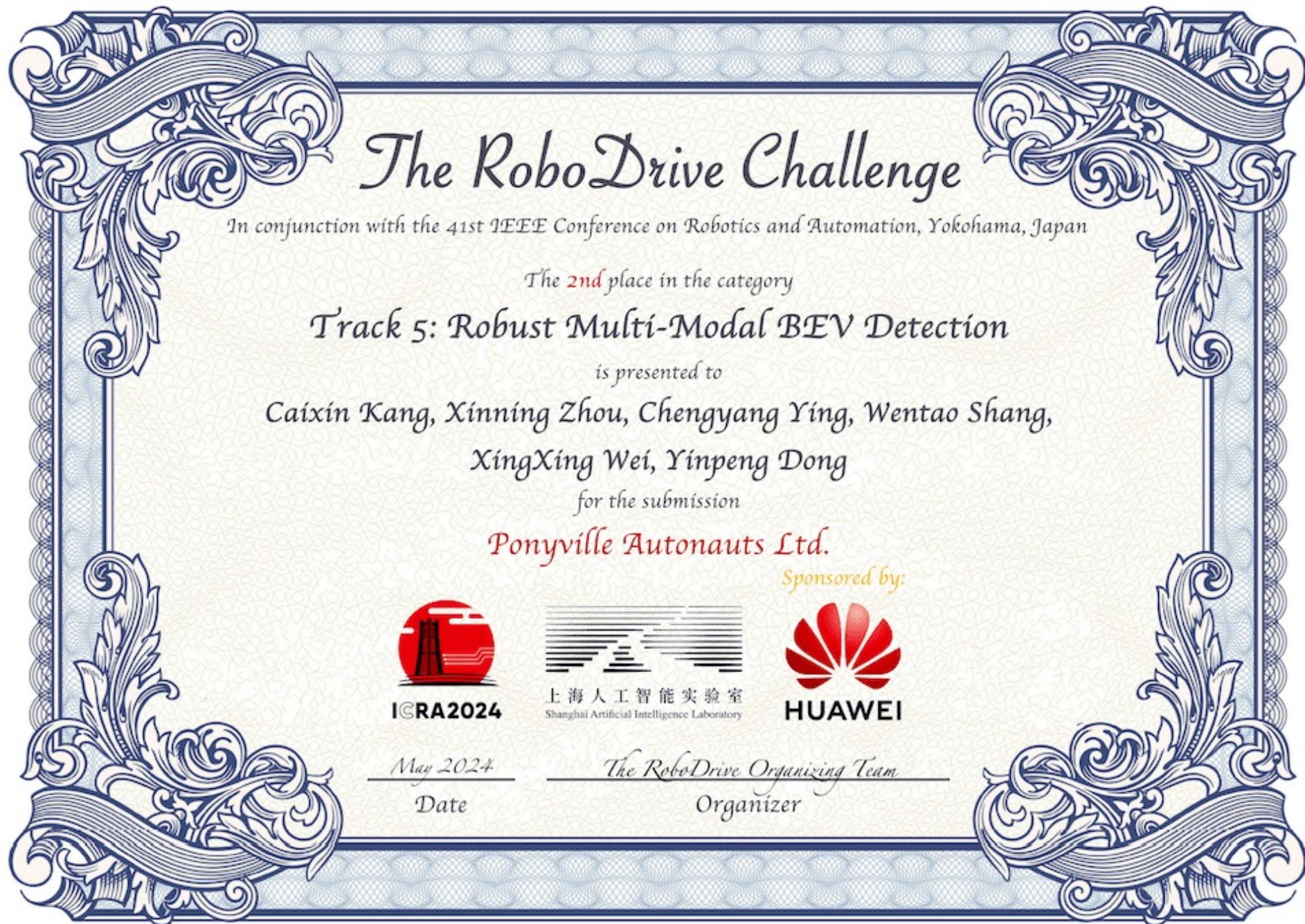
ICRA2024
YOKOHAMA | JAPAN

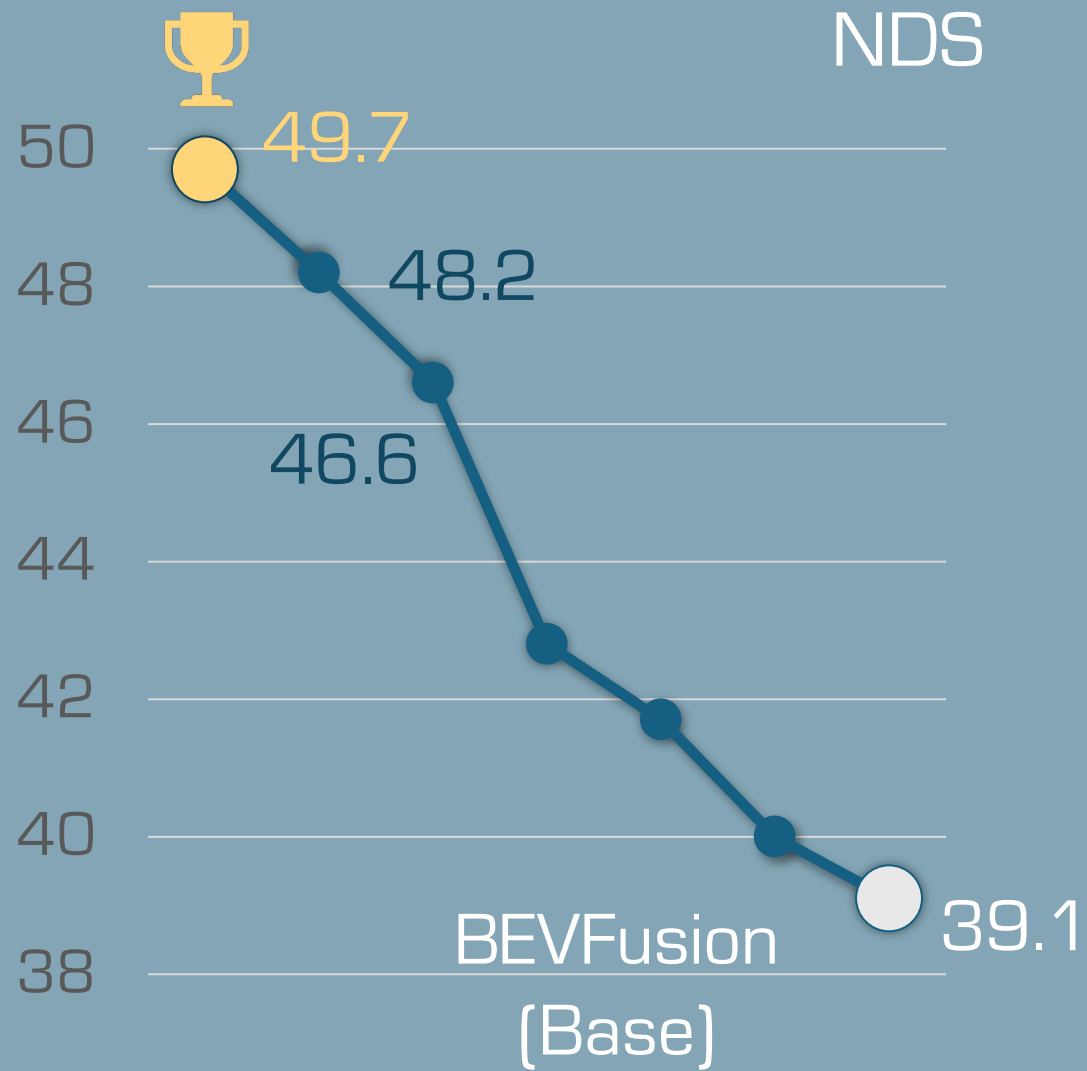




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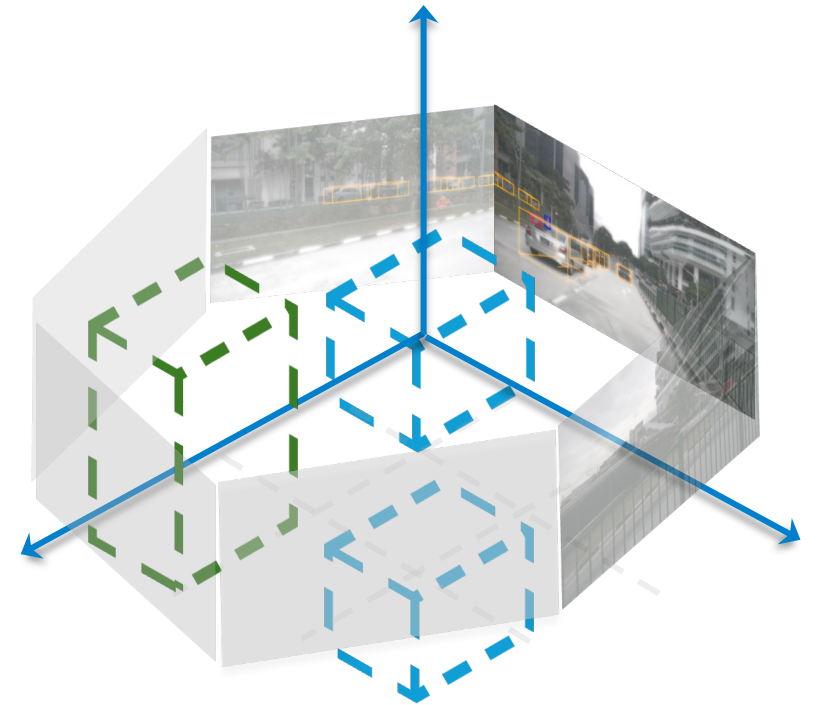
2nd Place





Team

SafeDrive-ProMax



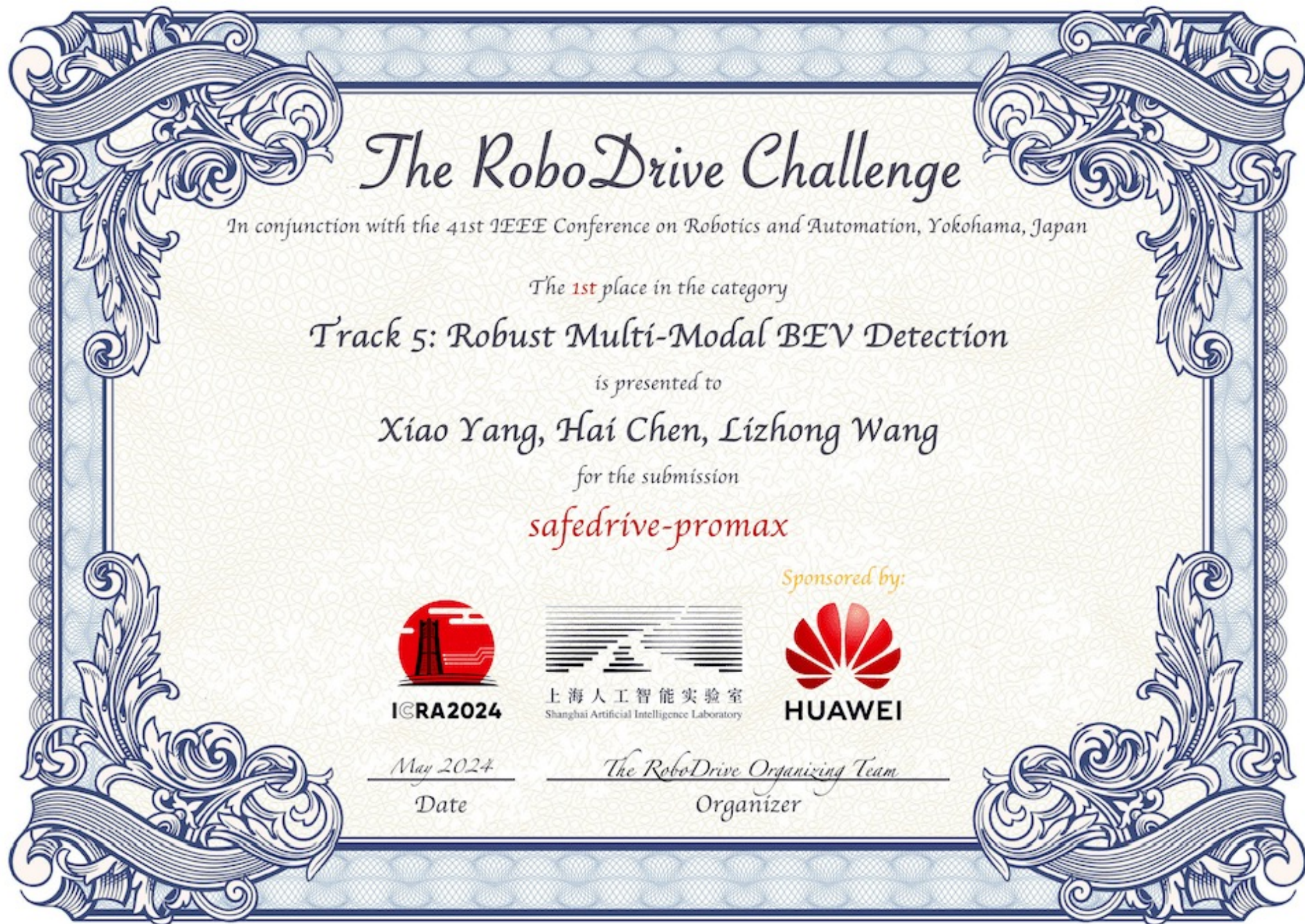
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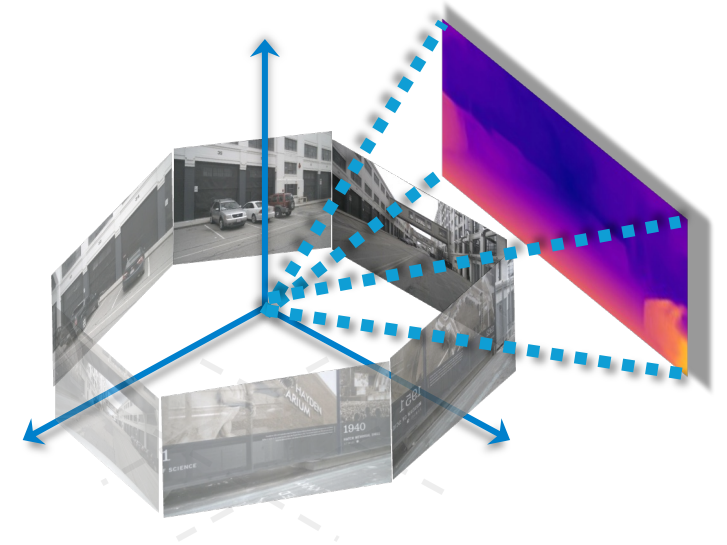
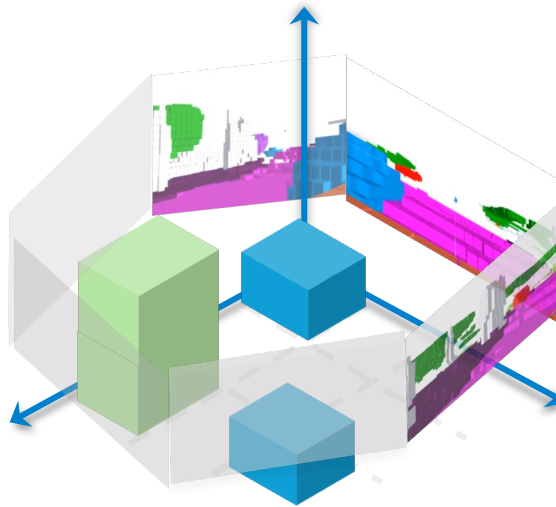
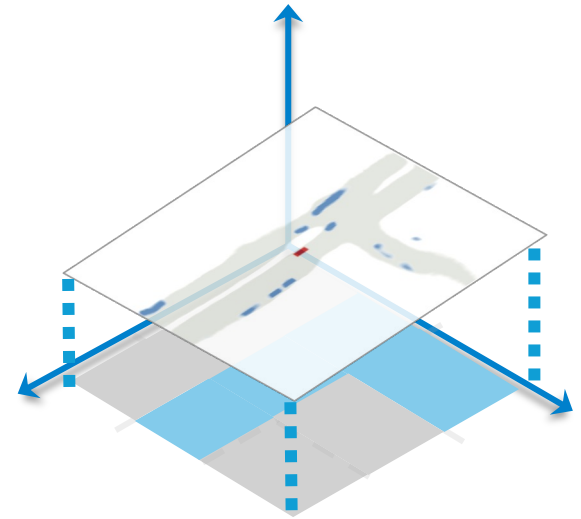
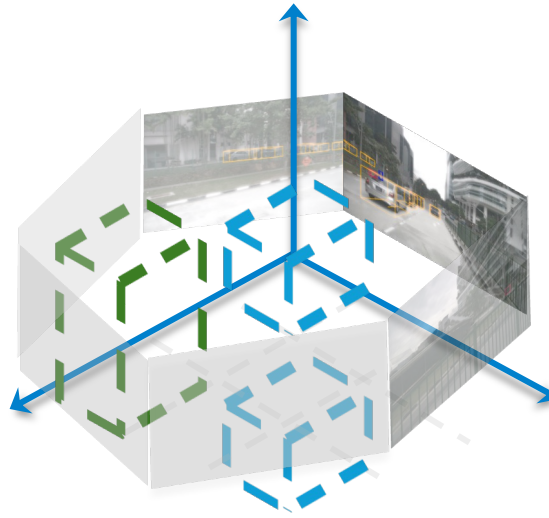


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1st Place



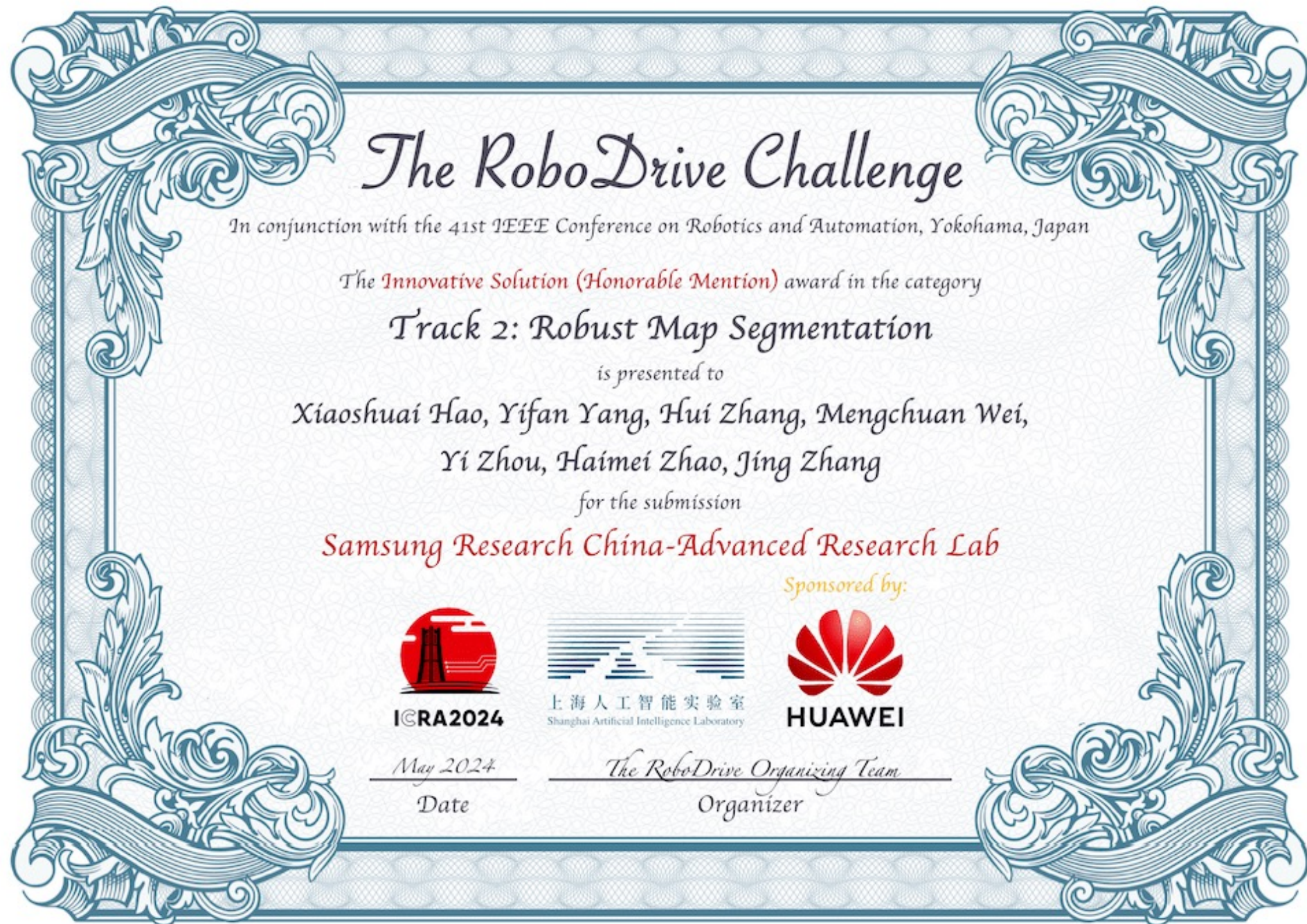
Innovative Solution





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Innovation
Honorable
Mention



Innovative Solution (Honorable Mention)

Key Innovations:

The team implemented a temporal fusion module that integrates data across multiple frames, along with a strong backbone and effective data augmentation techniques.

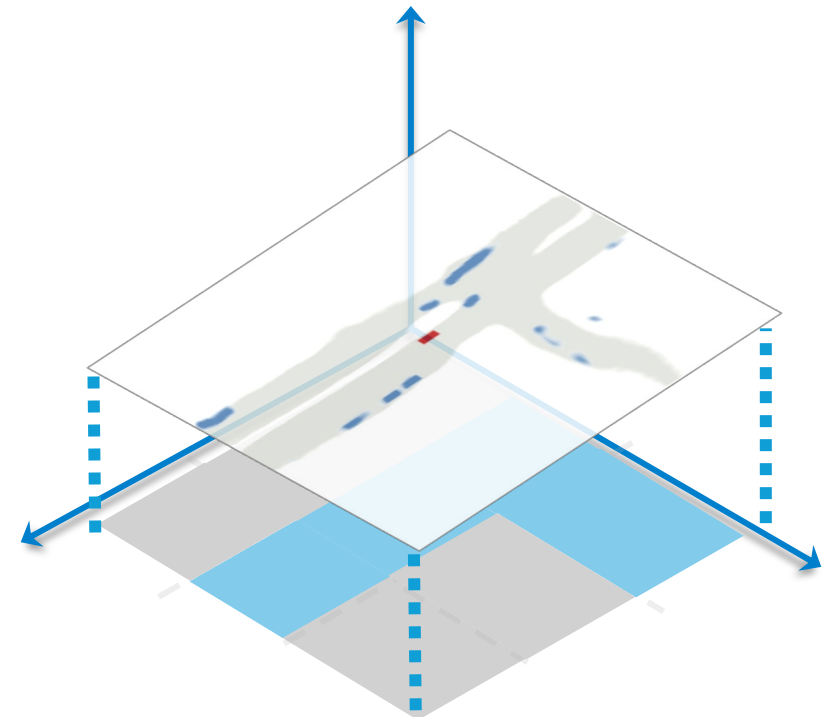


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Team

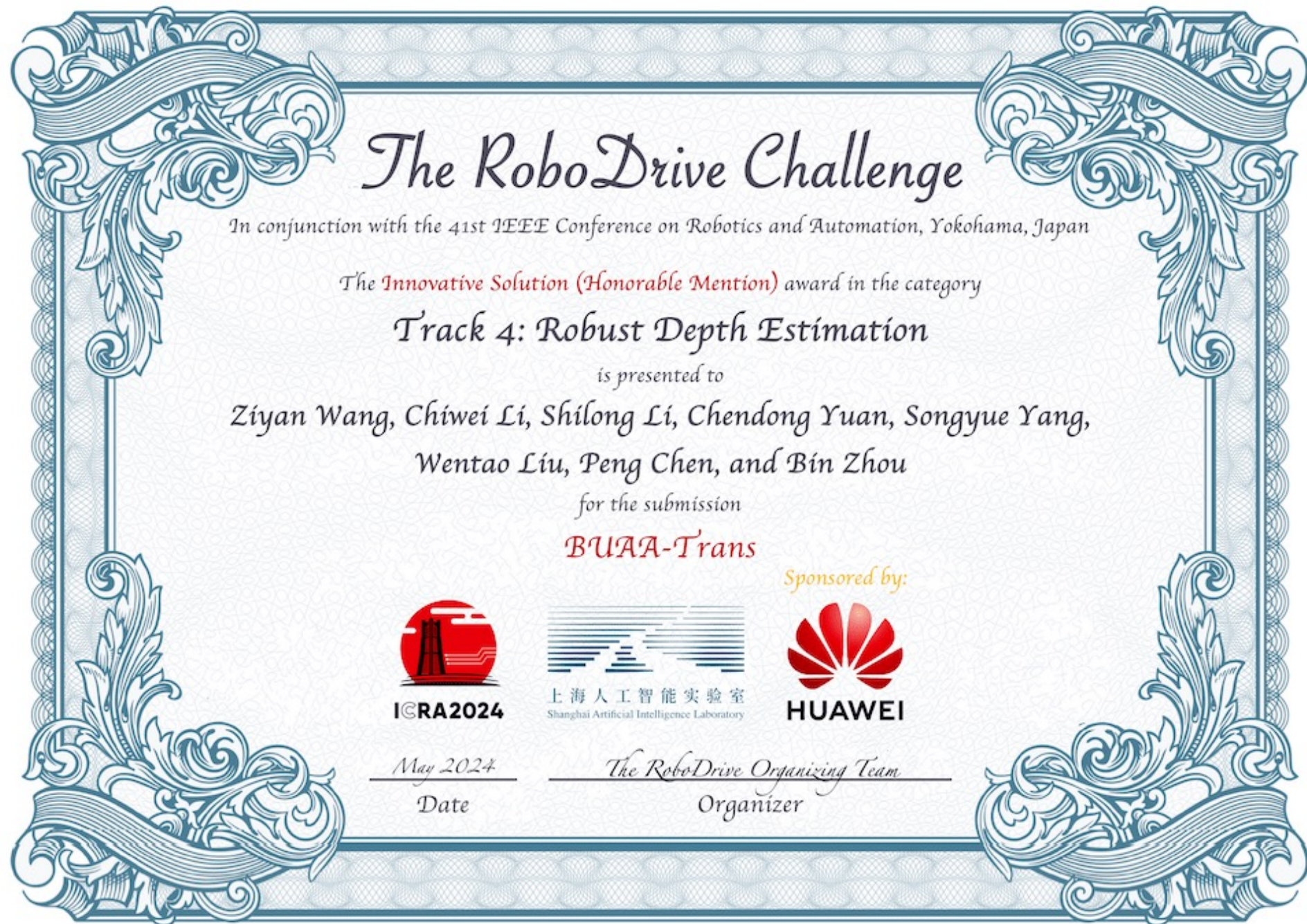
Samsung (Track 2)





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Innovation
Honorable
Mention



Innovative Solution (Honorable Mention)

Key Innovations:

The team introduced the Fusing Features Across Scales Depth Estimation (FFASDepth) framework, with multi-branch network architectures and advanced data augmentations.

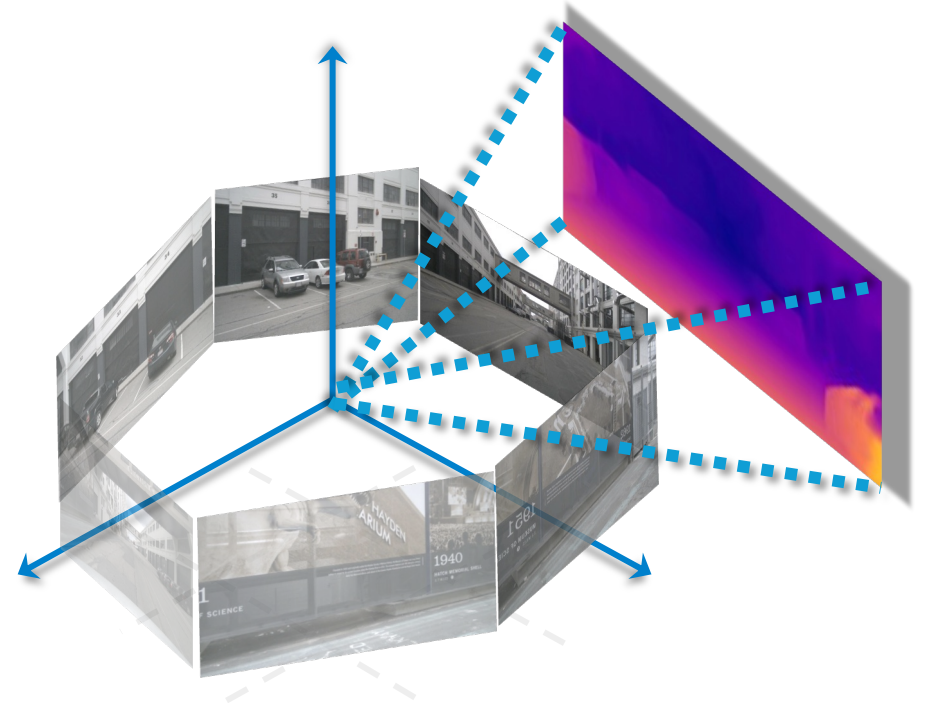


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Team

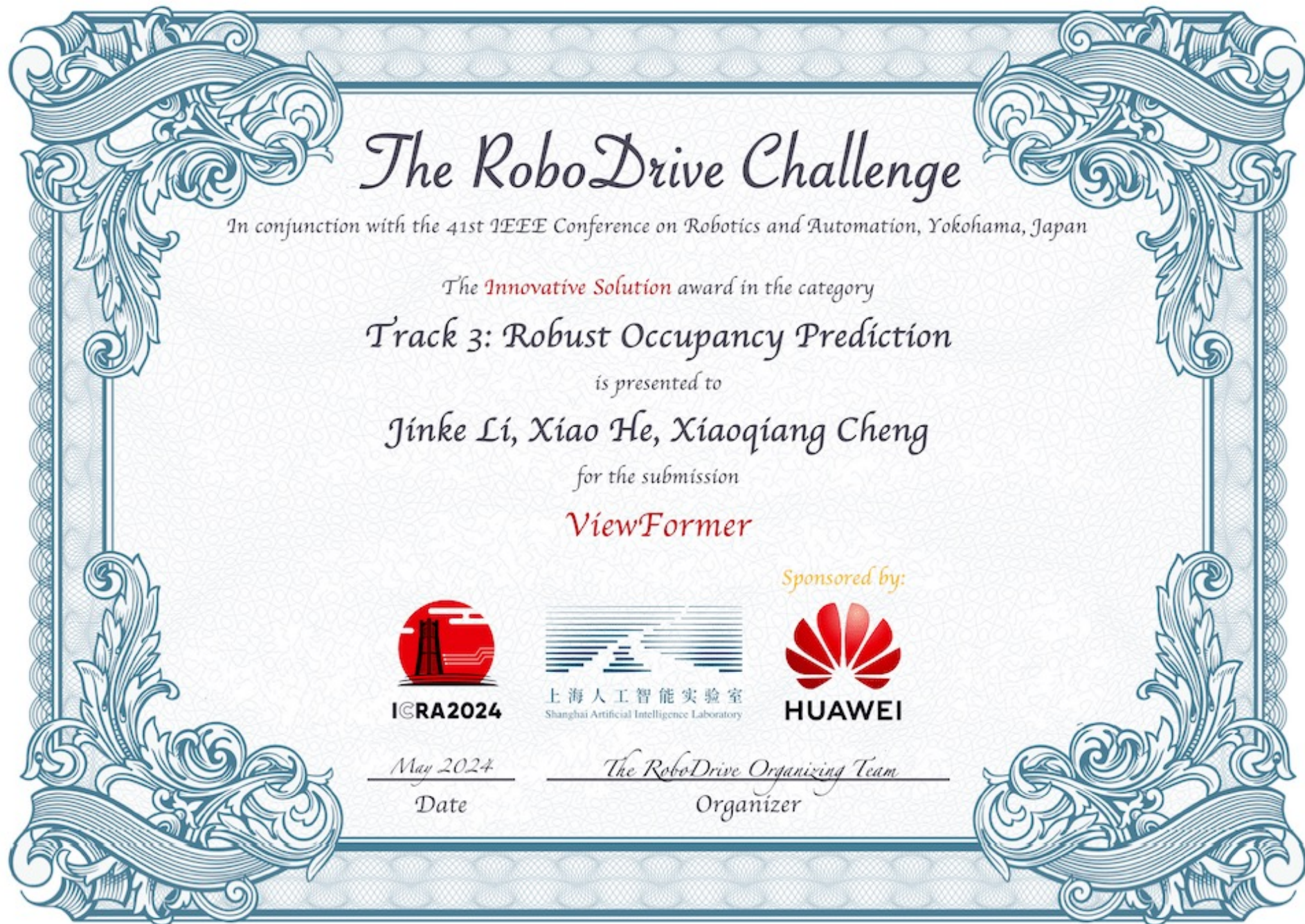
BUAA-Trans
(Track 4)





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Innovation



Innovative Solution

Key Innovations:

The team introduced the ViewFormer framework to encourage spatial interactions through view attention, as well as a streaming temporal attention module and a reverse video playback mechanism.

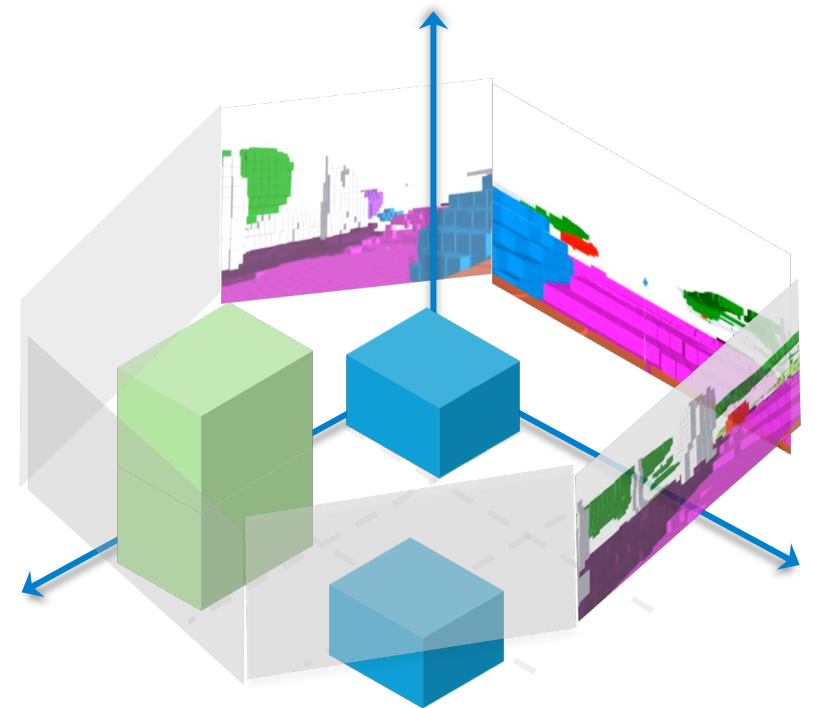


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Team

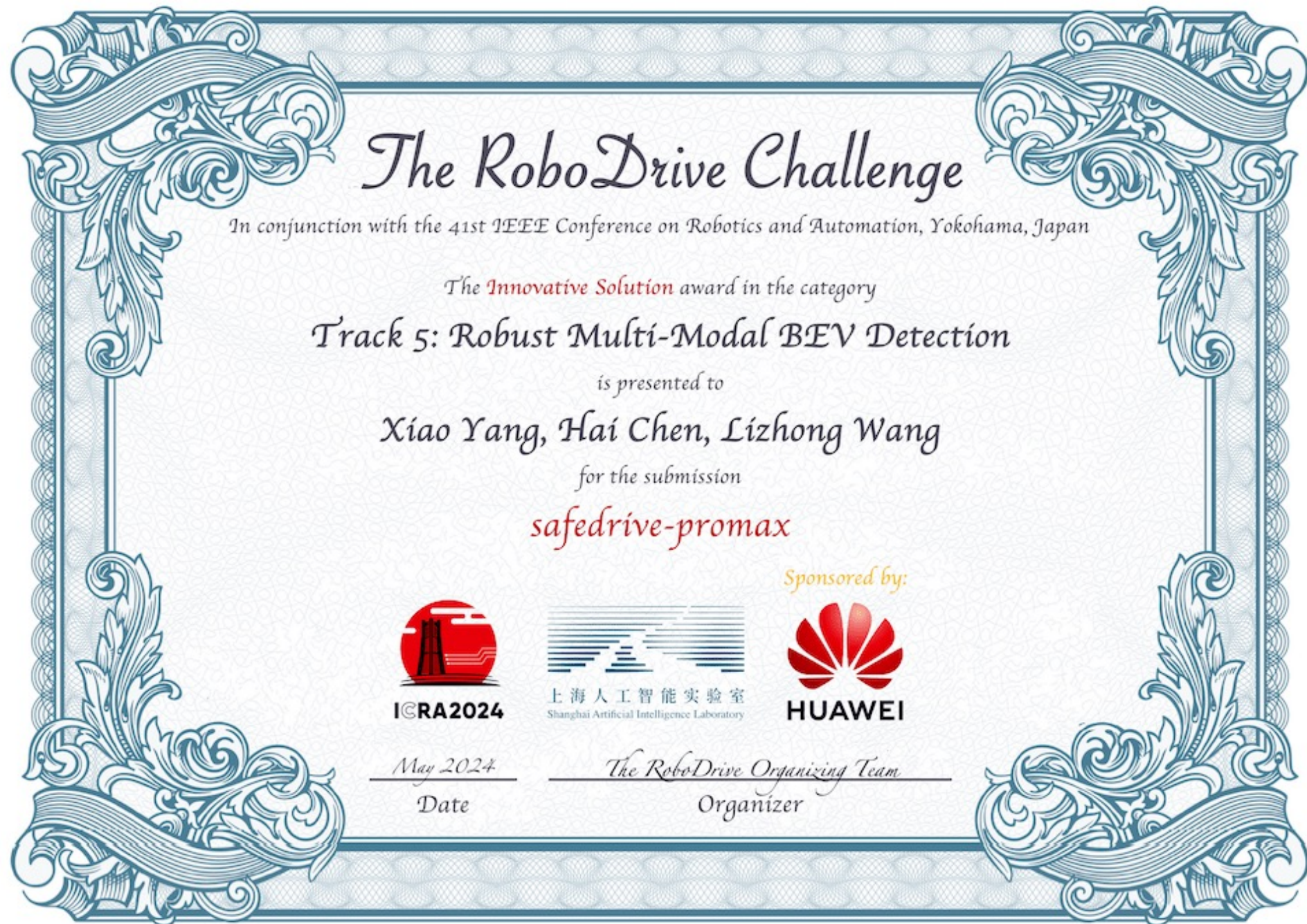
ViewFormer (Track 3)





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Innovation



Innovative Solution

Key Innovations:

The team developed the Against Sensor Failure (ASF) model, with designs on self-supervised feature reconstruction, image feature enhancement for LiDAR, and a robust fusion and decoding strategy.

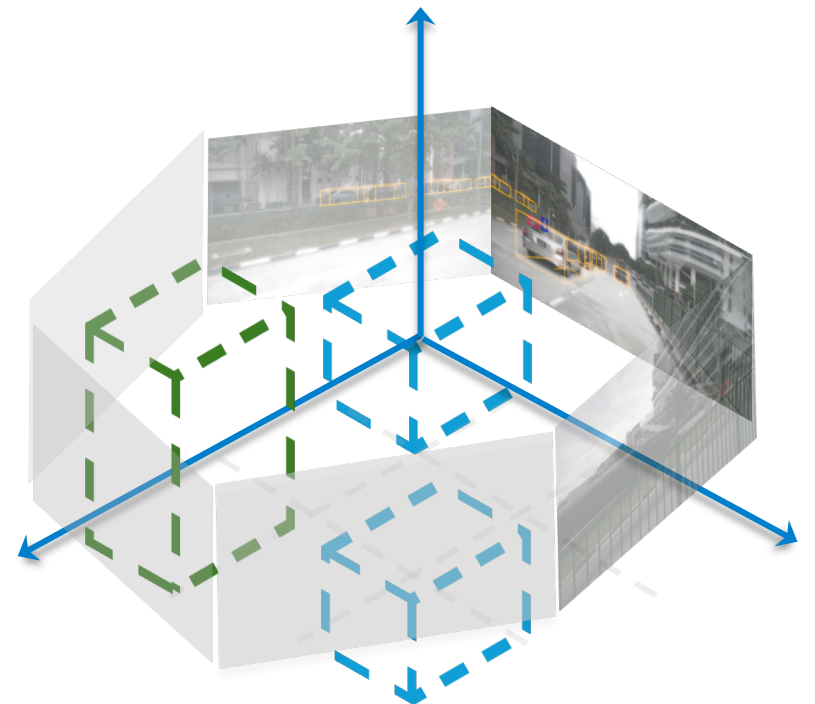


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Team

SafeDrive-ProMax (Track 5)



Concluding Remark



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Public Resources

- Video Recording:
<https://robodrive-24.github.io>
- Technical Report:
<https://arxiv.org/abs/2405.08816>
- Benchmark Toolkit:
<https://github.com/robodrive-24/toolkit>



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Technical Report

arXiv > cs > arXiv:2405.08816

Computer Science > Computer Vision and Pattern Recognition

[Submitted on 14 May 2024]

The RoboDrive Challenge: Drive Anytime Anywhere in Any Condition

Lingdong Kong, Shaoyuan Xie, Hanjiang Hu, Yaru Niu, Wei Tsang Ooi, Benoit R. Cottureau, Lai Xing Ng, Yuexin Ma, Wenwei Zhang, Liang Pan, Kai Chen, Ziwei Liu, Weichao Qiu, Wei Zhang, Xu Cao, Hao Lu, Ying-Cong Chen, Caixin Kang, Xinning Zhou, Chengyang Ying, Wentao Shang, Xingxing Wei, Yinpeng Dong, Bo Yang, Shengyin Jiang, Zeliang Ma, Dengyi Ji, Haiwen Li, Xingliang Huang, Yu Tian, Genghua Kou, Fan Jia, Yingfei Liu, Tiancai Wang, Ying Li, Xiaoshuai Hao, Yifan Yang, Hui Zhang, Mengchuan Wei, Yi Zhou, Haimei Zhao, Jing Zhang, Jinke Li, Xiao He, Xiaoqiang Cheng, Bingyang Zhang, Lirong Zhao, Dianlei Ding, Fangsheng Liu, Yixiang Yan, Hongming Wang, Nanfei Ye, Lun Luo, Yubo Tian, Yiwei Zuo, Zhe Cao, Yi Ren, Yunfan Li, Wenjie Liu, Xun Wu, Yifan Mao, Ming Li, Jian Liu, Jiayang Liu, Zihan Qin, Cunxi Chu, Jialei Xu, Wenbo Zhao, Junjun Jiang, Xianming Liu, Ziyang Wang, Chiwei Li, Shilong Li, Chendong Yuan, Songyue Yang, Wentao Liu, Peng Chen, Bin Zhou, Yubo Wang, Chi Zhang, Jianhang Sun, Hai Chen, Xiao Yang, Lizhong Wang, Dongyi Fu, Yongchun Lin, Huitong Yang, Haoang Li, Yadan Luo, Xianjing Cheng, Yong Xu



References

1. S. Xie, L. Kong, W. Zhang, J. Ren, L. Pan, K. Chen, and Z. Liu. "Benchmarking and Analyzing Bird's Eye View Perception Robustness to Corruptions," Preprint, 2023.
2. L. Kong, S. Xie, H. Hu, L. X. Ng, B. R. Cottureau, and W. T. Ooi. "RoboDepth: Robust Out-of-Distribution Depth Estimation under Corruptions," NeurIPS, 2023.
3. L. Kong, Y. Liu, X. Li, R. Chen, W. Zhang, J. Ren, L. Pan, K. Chen, and Z. Liu. "Robo3D: Towards Robust and Reliable 3D Perception against Corruptions," ICCV, 2023.





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RoboDrive

Thank You!

See you next year

