AIMEDIA2025, The First International Conference on AI-based Media Innovation

A Novel Synthetic Dataset for Broadcast Motorsports Scene Understanding

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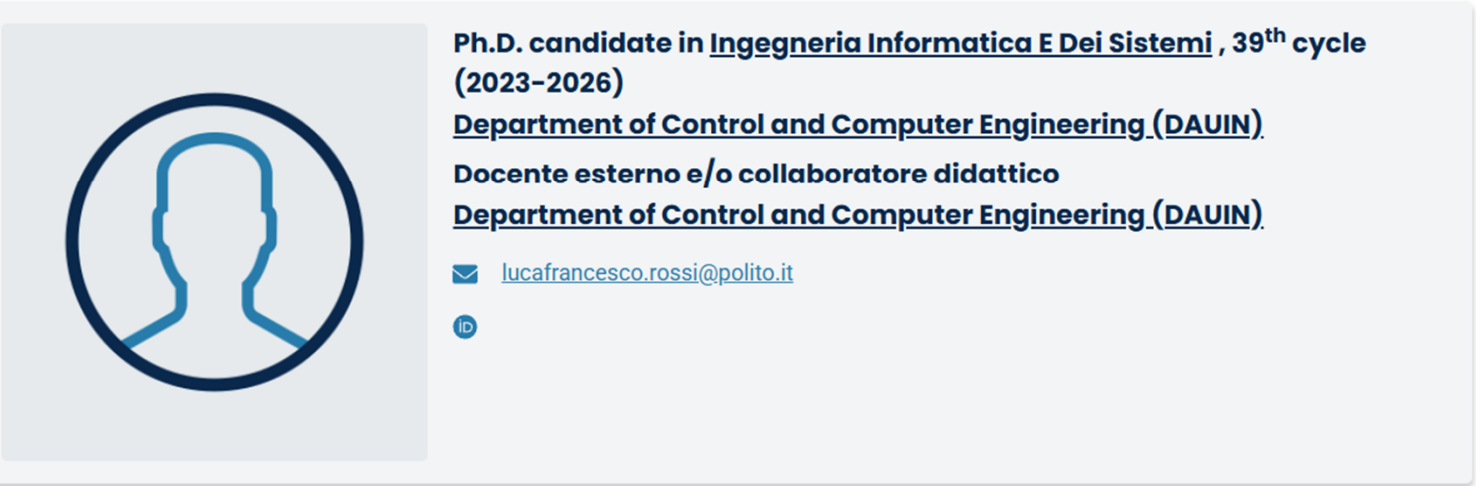
Research Group(s): GRAINS

Presenter

Luca Francesco Rossi



programme path as **executive Ph.D.** built on an **industrial collaboration** with netventure, a company specializing in live broadcast graphics, augmented reality, and virtual graphics for international sporting events, live shows, and entertainment productions worldwide.

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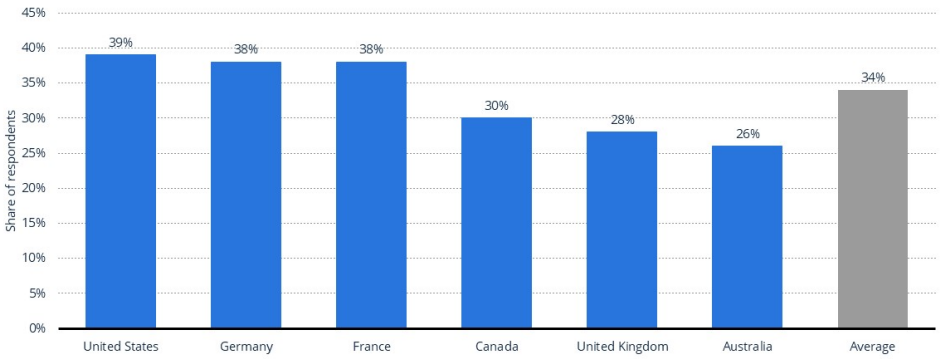
Scenario and motivations

AI solutions are increasingly being customized to serve the needs of the automotive, healthcare, finance, entertainment, and other industries:

- **computer vision** as a tool to perceive and understand the surrounding environment;
- shifting from vanilla **recognition** to a more proactive **comprehension** of the scene.

Share of fans who regularly watch sports at a venue in selected countries worldwide as of April 2023

Sports fans who watch sports in-venue worldwide 2023

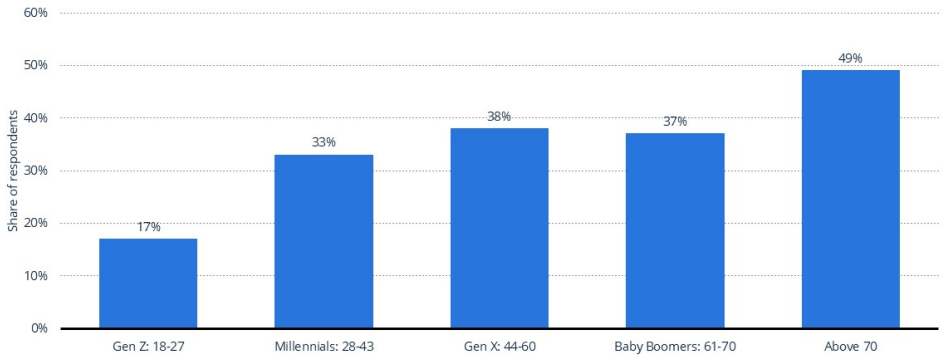


Description: During a global survey conducting in April 2023, almost 40 percent of sports fans from the United States claimed to regularly watch sports live from the venue. This figure fell to just over 25 percent among respondents from Australia. Read more
Note(s): Worldwide; March to April 2023; 7,081 respondents; sports fans who regularly watch and follow sports
Source(s): Capgemini

statista

Share of sports fans who regularly visit a stadium worldwide as of April 2023, by age

Regular visitors to sports stadiums worldwide 2023, by age



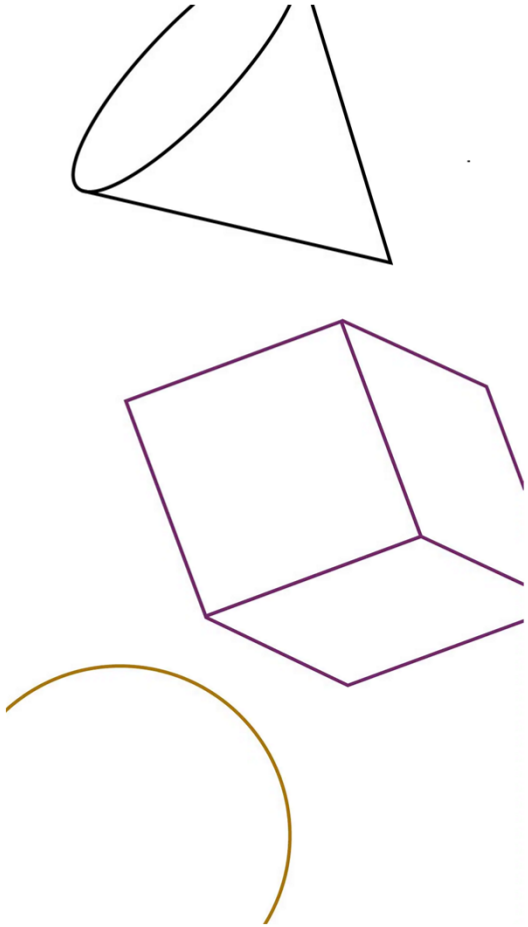
Description: During a March 2023 survey, one third of sports fans aged 28 to 43 stated that they often watched sports at a live venue. This figure dropped to just 17 percent among respondents aged 18 to 27. Read more
Note(s): Worldwide; March to April 2023; 12,004 respondents; sports fans who regularly watch and follow sports globally
Source(s): Capgemini

statista

Scenario and motivations

> *"**25%** of respondents **use AI**, a significant rise from just 9% in the 2024 report, **highlighting its growing adoption** in broadcast workflows."*
>
> HAIVISION, "AI in Broadcast: Current & Future Applications", in 2025 Broadcast Transformation Report, p. 16

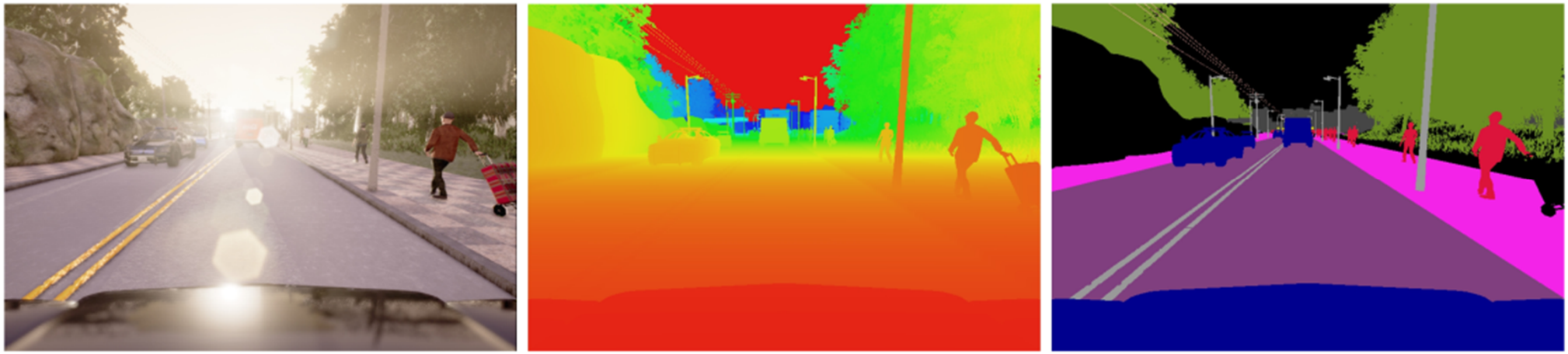
- huge opportunities for **motorsport** racing;
- lack of common benchmarks or **publicly available** datasets;
- bridge the **gap** between industrial and academic solutions;



Synthetic data generation to provide a standardized setting.

CARLA – Car Learning to Act

- UE5-based **open-source simulator** for autonomous driving research.
- Support for training, prototyping and validation of autonomous driving models, including both **perception** and **control**.
- flexible setup of **sensor** suites.

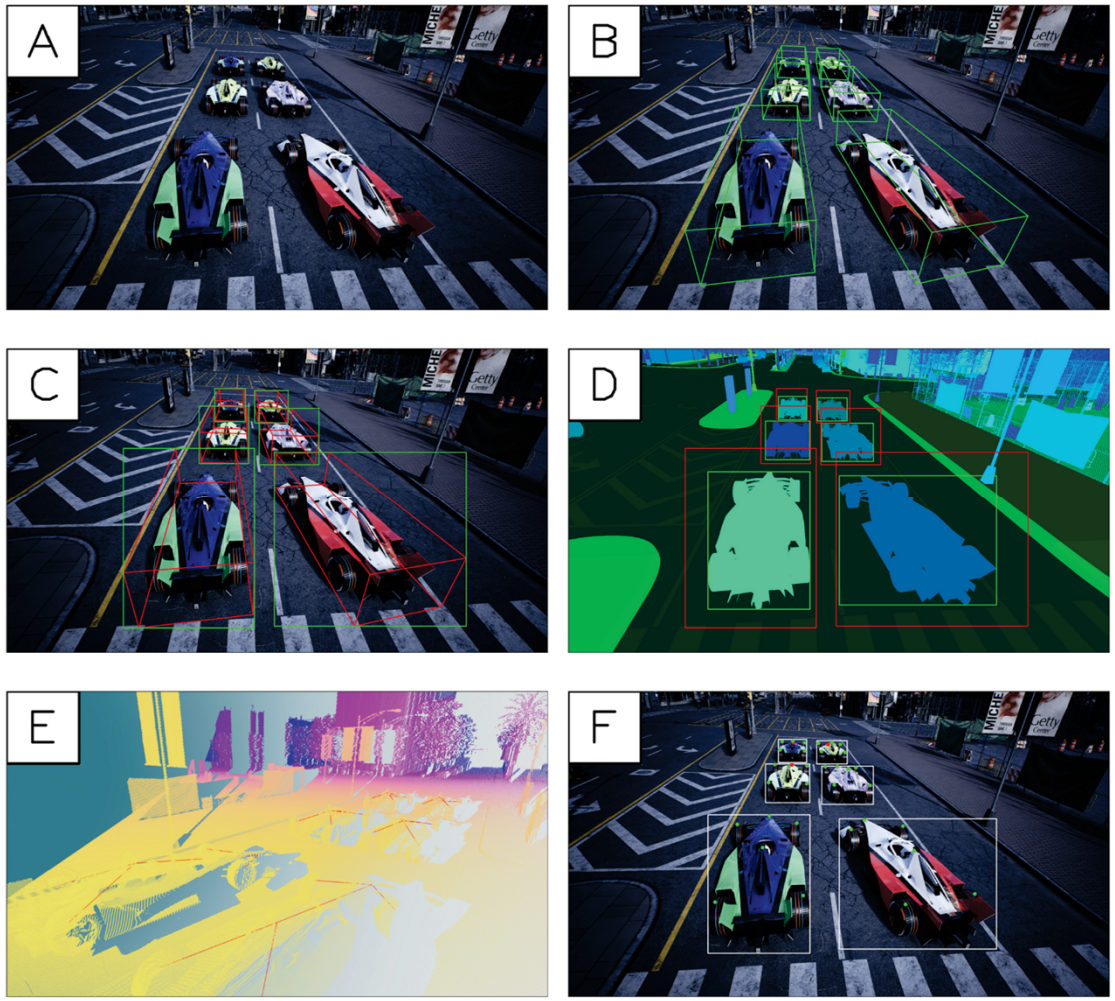


Dosovitskiy, A., Ros, G., Codevilla, F., Lopez, A. and Koltun, V. (2017). CARLA: An Open Urban Driving Simulator. Proceedings of the 1st Annual Conference on Robot Learning, in Proceedings of Machine Learning Research 78:1-16 Available from https://proceedings.mlr.press/v78/dosovitskiy17a.html

Synthetic data generation

Goal: fully-automated pipeline.

A. RGB frame capture
B. 3D bounding boxes detection
C. 2D bounding boxes **estimate**
D. 2D bounding boxes **refinement** via **segmentation**
E. LiDAR point cloud for keypoint **visibility**
F. Detection and pose merge



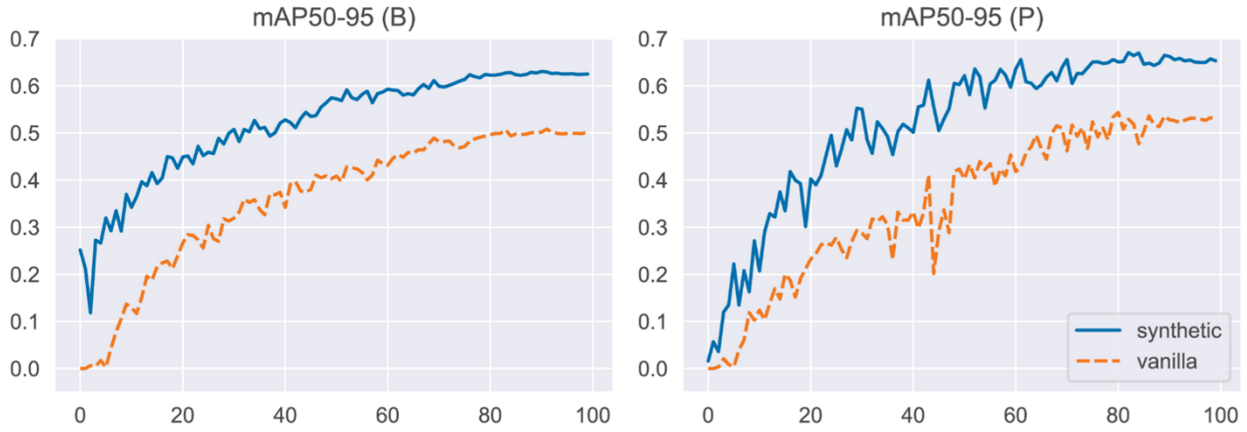
Bridging the gap

TABLE I. SYNTHETIC DATASET METRICS FOR BBOX DETECTION.

Split	P_B	R_B	$mAP50_B$	$mAP50\text{-}95_B$
Validation	0.952	0.793	0.897	0.793
Test	0.962	0.773	0.884	0.784

TABLE II. SYNTHETIC DATASET METRICS FOR POSE ESTIMATION.

Split	P_P	R_P	$mAP50_P$	$mAP50\text{-}95_P$
Validation	0.924	0.728	0.842	0.816
Test	0.918	0.716	0.827	0.795

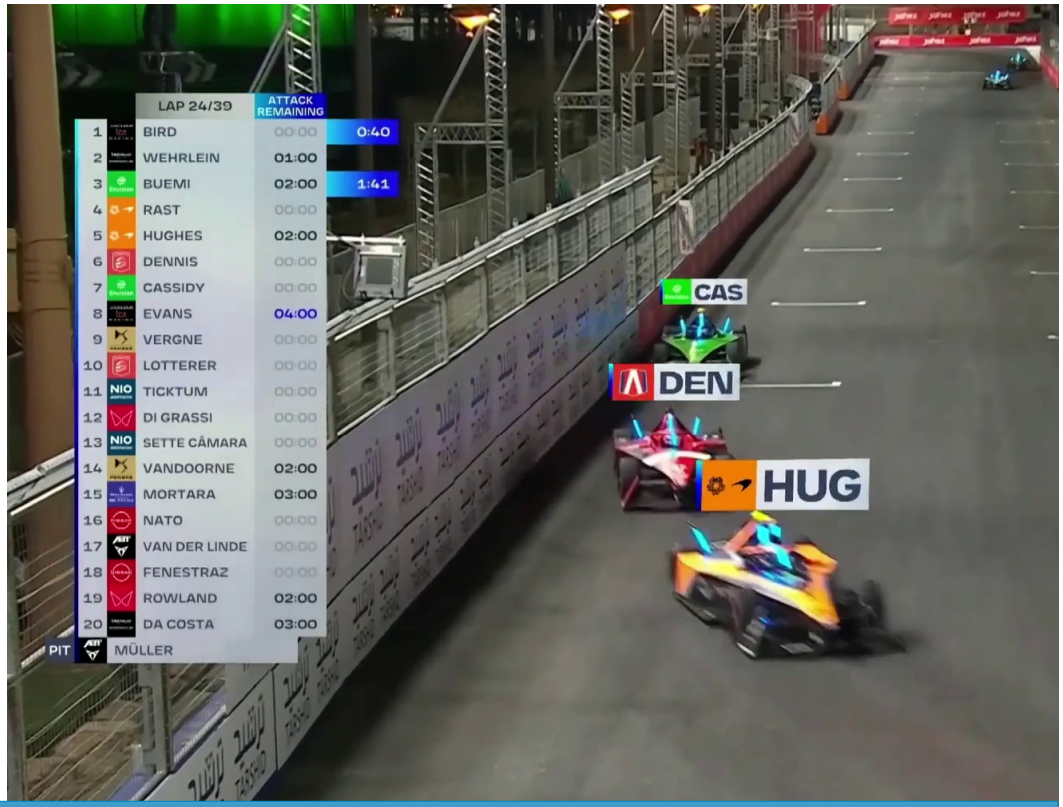


Synth2Real adaptation: disparity in performance between synthetic and real-domain data.

Addressing the reliability of the generated dataset via **transfer learning** on a real dataset comprising 293 frames from Mexico City ePrix (**train**) and 42 frames from Portland ePrix (**validation**).

Nikolenko, Sergey I. (2021). Synthetic Data for Deep Learning. In Springer Optimization and Its Applications, Springer Cham. Series ISSN: 1931-6828, under exclusive license to Springer Nature Switzerland AG 2021, doi: 10.1007/978-3-030-75178-4

Bridging the gap (broadcasting)

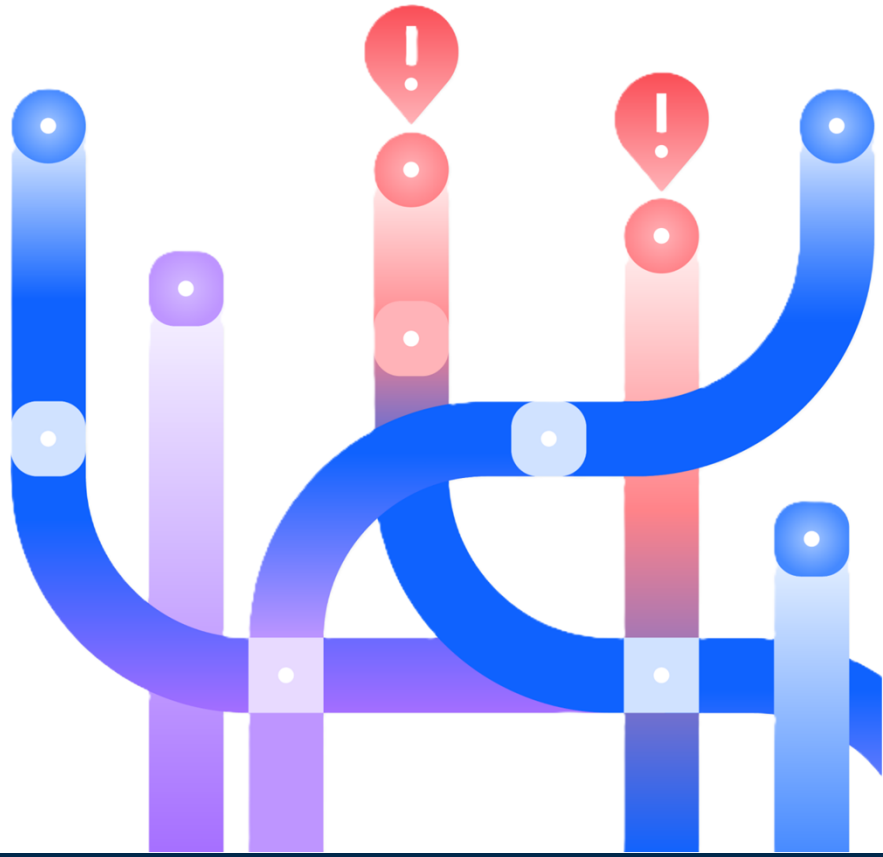


Reverse-engineer the PnP problem to achieve 3D orientation from pose in real-time.

Next steps

Future research should prioritize the development of advanced **domain adaptation strategies**, and the integration of **physics-based simulations** to further mitigate the domain gap:

- enhancing the fully automated generation pipeline to produce even **more reliable synthetic data**,
- incorporating additional detection classes to facilitate **livery recognition** (thus mitigating the often-biased distribution of real-world data).



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