

GRIAD: General Reinforced Imitation for Autonomous Driving

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▶ To cite this version:

R Chekroun, M Toromanoff, F Moutarde. GRIAD: General Reinforced Imitation for Autonomous Driving. PAISS summer school, Jun 2021, Paris, France. hal-04232465

HAL Id: hal-04232465

https://hal.science/hal-04232465

Submitted on 8 Oct 2023

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GRIAD: General Reinforced Imitation for Autonomous Driving

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Context and Setup

The CARLA Simulator [1]

 Open-source simulator in urban environment for research in autonomous driving.

Our goal

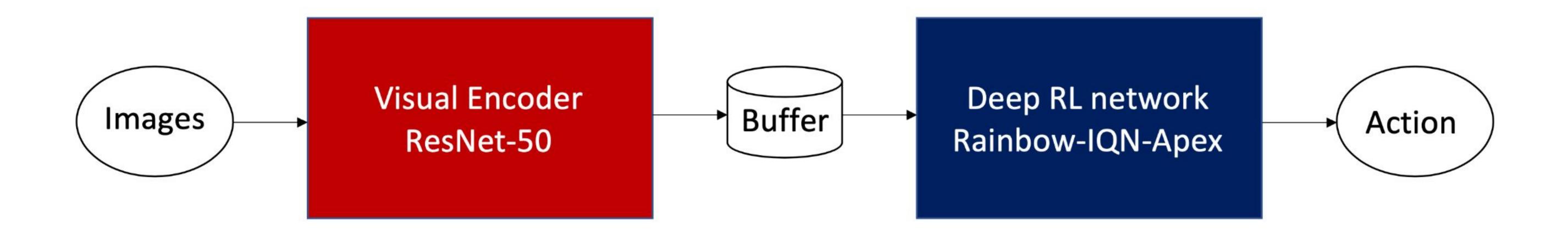
- Best score on CARLA leaderboard.
- Important metrics: driving score, route completion.



The baseline

End-to-end AD pipeline [2]

• Images are encoded to what is called *Implicit Affordances (IAs)*, then used as RL state.



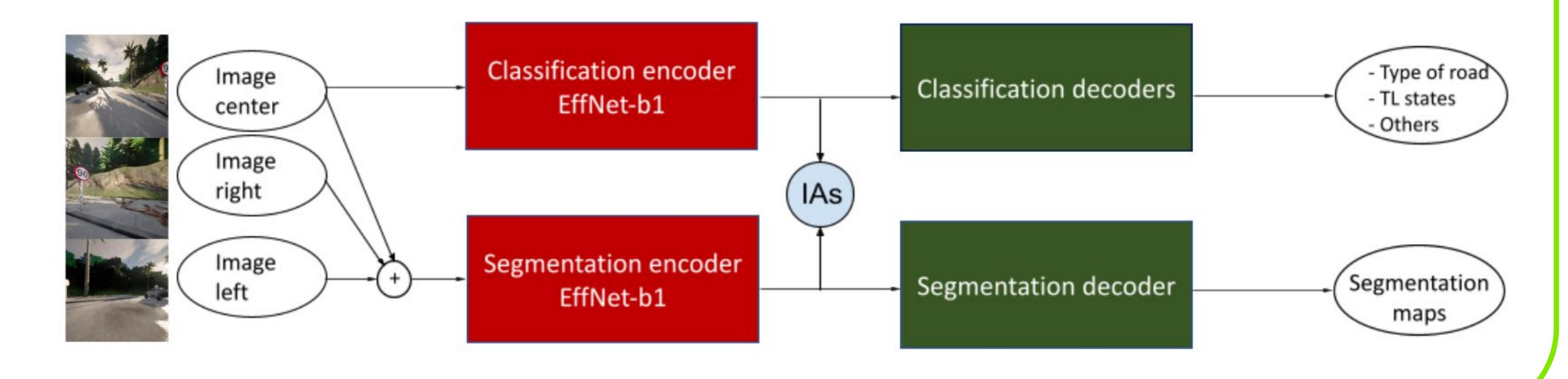
Design of the visual encoder

Design of the visual encoding part

- Two small specialized EfficientNet [6]: one for classification tasks, one for segmentation. Results are concatenated.
- Three cameras front center, front right and front left.

Training the network

• Visual encoding block is pre-trained with carefully chosen decoders, then frozen.



Design on the RL part

DRL architecture

• Rainbow-IQN-Apex: distributed DQN with some optimizations [3].

Limitations

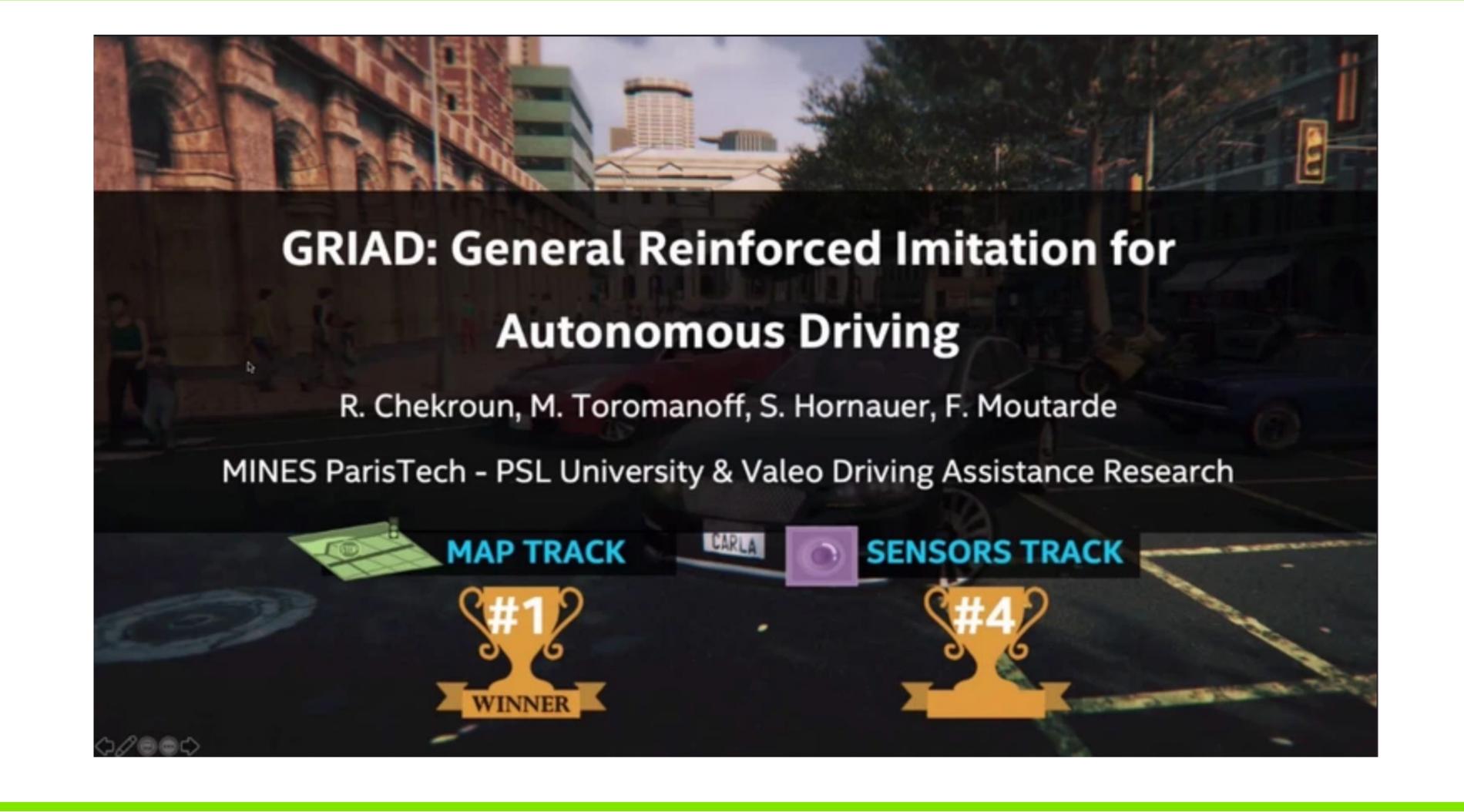
- Slow training: exploration in CARLA is expensive. Offline RL might be a solution [4].
- Complex task: RL is difficult to train and design

Reinforced Imitation Learning (RIL)

- GRI: New RL scheme also using expert data. Training is 5x faster and metrics 30% better. [5]
- CARLA Challenge 2021 Winner

Conclusions

- Showed the advantages of two specialized visual encoders over a single bigger one.
- Introducing the GRI scheme, shown to accelerate training and improve final results.
- Winner of the CARLA Challenge 2021. Presented at NeurlPS 2021, ML4AD Workshop. Updated version published in Robotics in 2023.



References

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- [4] Levine et al., Offline Reinforcement Learning: Tutorial, Reviews and Perspectives on Open Problems, 2020
- [5] Chekroun et al., GRI: General Reinforced Imitation and its Application to Vision-Based Autonomous Driving, 2021
- [6] Tan et al., EfficientNet: Rethinking Model Scaling For Convolutional Neural Network, 2020