Drive++ A Safe Autonomous Driving Algorithm

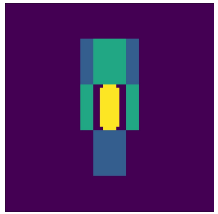
Jiaze Sun **Benedikt Kolbeinsson** **Pedro Castro**
{j.sun19, benedikt.kolbeinsson15, p.castro18}@imperial.ac.uk

Introduction

We present a safe and efficient autonomous driving algorithm which performs significantly better than the baseline.

Observations

- Signed Distance to Center
- **Future Waypoint Headings**
- Time-To-Collision*
- Lane Distance*
- **Social Vehicle Headings**
- **Speed of Closest Vehicle**
- Speed
- Steering
- **Proximity Map**



Actions

- Output **acceleration** post-processed into throttle and braking.
- **Residual Steering**

$$a^t = clip(a^{t-1} + 25 \cdot \psi, -45, 45)$$

Rewards

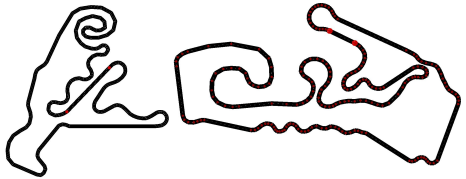
- Environment Reward
- **Crash Penalty**

$$r_{crash} = -5 \cdot I\{\|p_{ego} - p_{closest}\|_2 < 6\}$$

- **Steering Penalty**

$$r_{steer} = -I\{s > 60\} \cdot \left(\frac{s - 60}{20} \cdot \frac{a}{4}\right)^2$$

- Center Penalty
- **Flip Penalty**



Training

- **PPO** with 2 FC layers with ReLU
- 30M iterations
- **26 new tracks**

Safety and Comfort

- Predictable and **deterministic.**
- No vehicle **weaving.**
- **Deceleration in anticipation** of future turns.
- **Aware of surrounding** obstacles.