End-to-End Race Driving with Deep Reinforcement Learning

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**Self-supervised learning**
Using Asynchronous Reinforcement Learning (A3C) framework

- Achieves experience decorrelation without experience replay
- Learn to maximize discounted reward from sparse reward

**Main related works**
1. Mnih et al., Asynchronous reinforcement learning (A3C)
2. Chen et al., Learning high level feature for direct perception
3. Bojarski et al., Imitation learning from expert driver

**Contributions**

- **New state encoder**
  Use a deeper encoder with past actions and speed to allow far away vision

- **Control strategy**
  Learn full control (steering, gas, brake, handbrake)
  Stochastic choice of discrete commands (as good as continuous)

- **Respawn strategy**
  Maximize environment variance for better asynchronous learning

**Reward shaping**
New frame-wise rewards
Enforce smooth reward using road distance as a penalty

**Training setup**
Trained asynchronously with 15 agents (on 3 PC)
Simultaneously driving on 3 tracks (mountains, snow, coast)

**Gaming performance**
Study of training tracks driving style
Learned to drive at 72.9km/h and covers 0.72km per run
Driving style is significantly smoother

- **Influence of speed limits**
  Use road curvature to limit speed from real road design (dashed lines)

- **Real data performance**
  Tested on real videos (web-footage) using open-loop predictions

- **Check out the videos**

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