Artificial Race Driver

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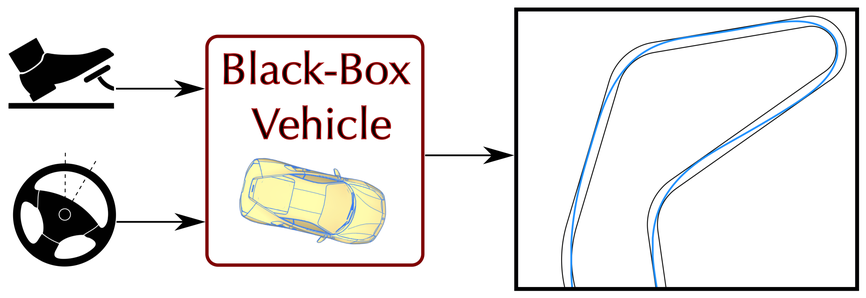
Our group!

Watch it!

MOTIVATION

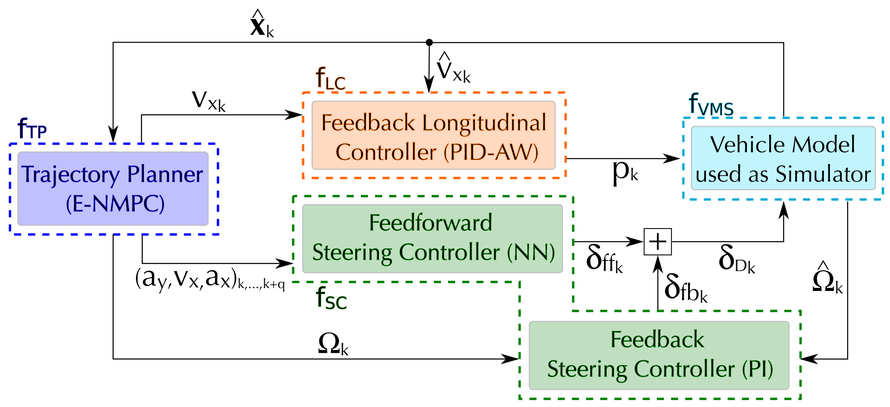
- Set the **best lap times** with a ***black-box* autonomous vehicle**
- Plan feasible **emergency manoeuvres** for passenger cars
- Develop a framework to **learn vehicle dynamics and low level vehicle control loop**



METHODS

ARCHITECTURE

- Hierarchical **motion planning & control** framework



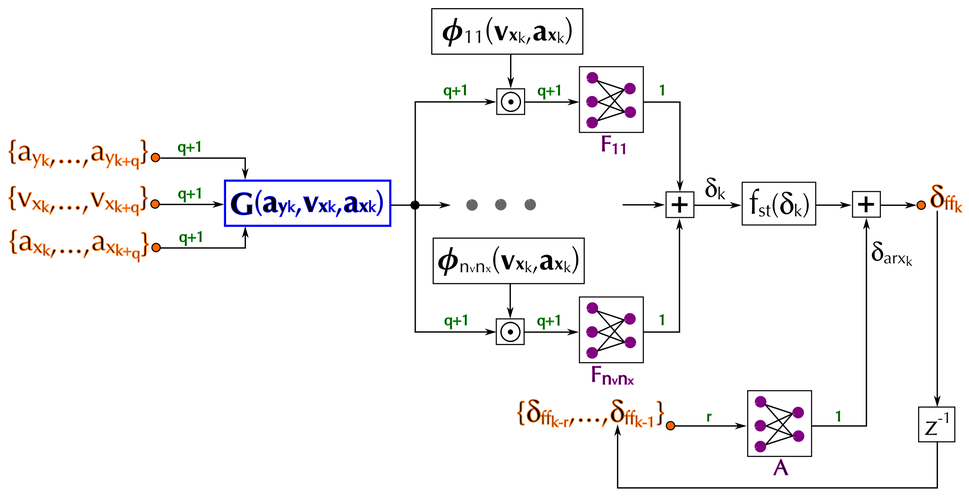
MOTION PLANNER

- **Kineto-dynamical** vehicle model

$$
\begin{cases}
\dot{v}_x(t) = a_x(t) \\
\tau_{a_x}\,\dot{a}_x(t) + a_x(t) = a_{x0}(t) \\
\tau_{\Omega}(v_x(t))\dot{\Omega}(t) + \Omega(t) = \Omega_{0_s}(t) \cdot \Omega_{\max_s}(v_x(t)) \\
\tau_{v_y}(v_x(t))\dot{v}_y(t) + v_y(t) = F_{v_y}(a_y(t), v_x(t), a_x(t))
\end{cases}
$$

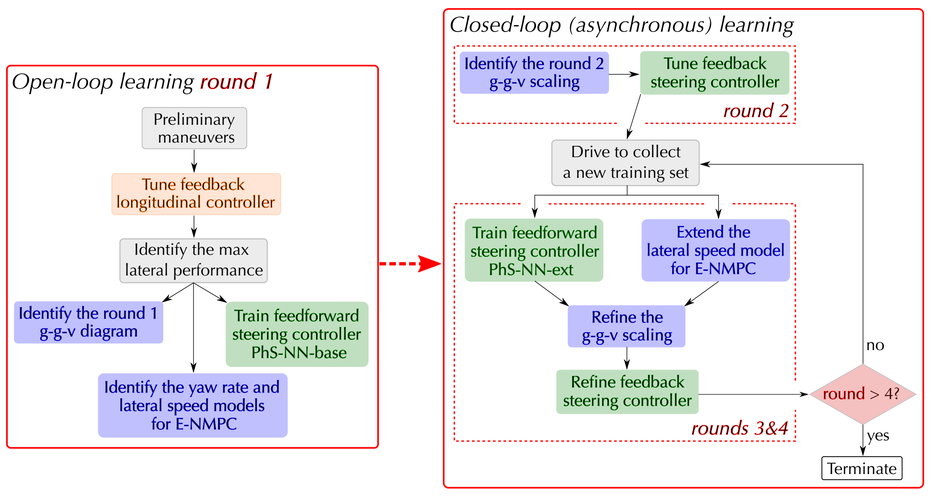
STEERING CONTROLLER

- **Physics-informed** neural networks



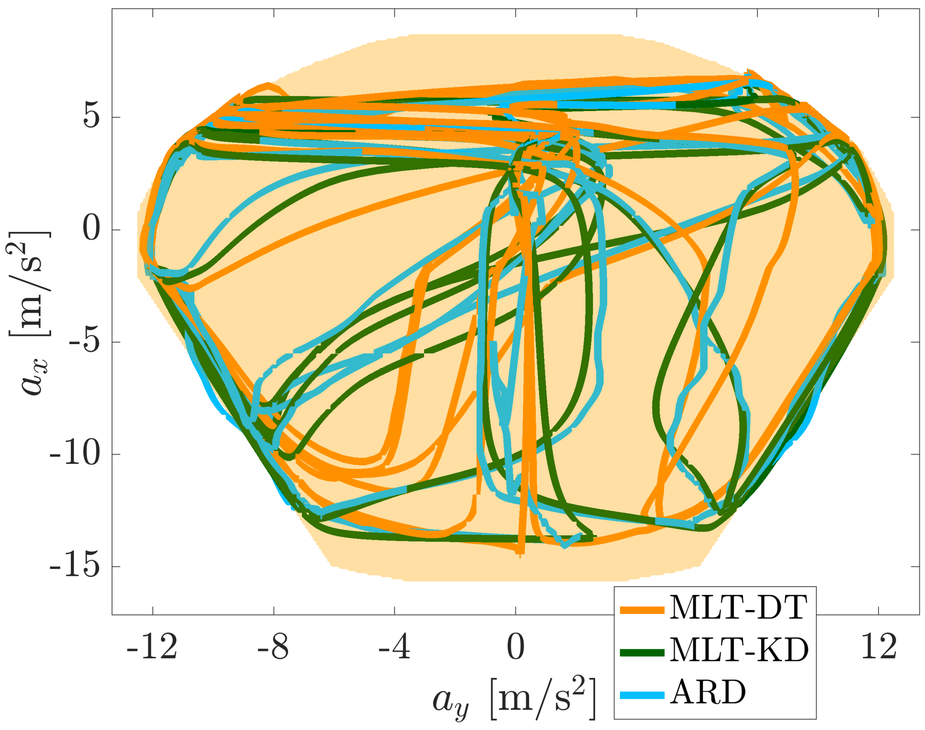
LEARNING METHOD

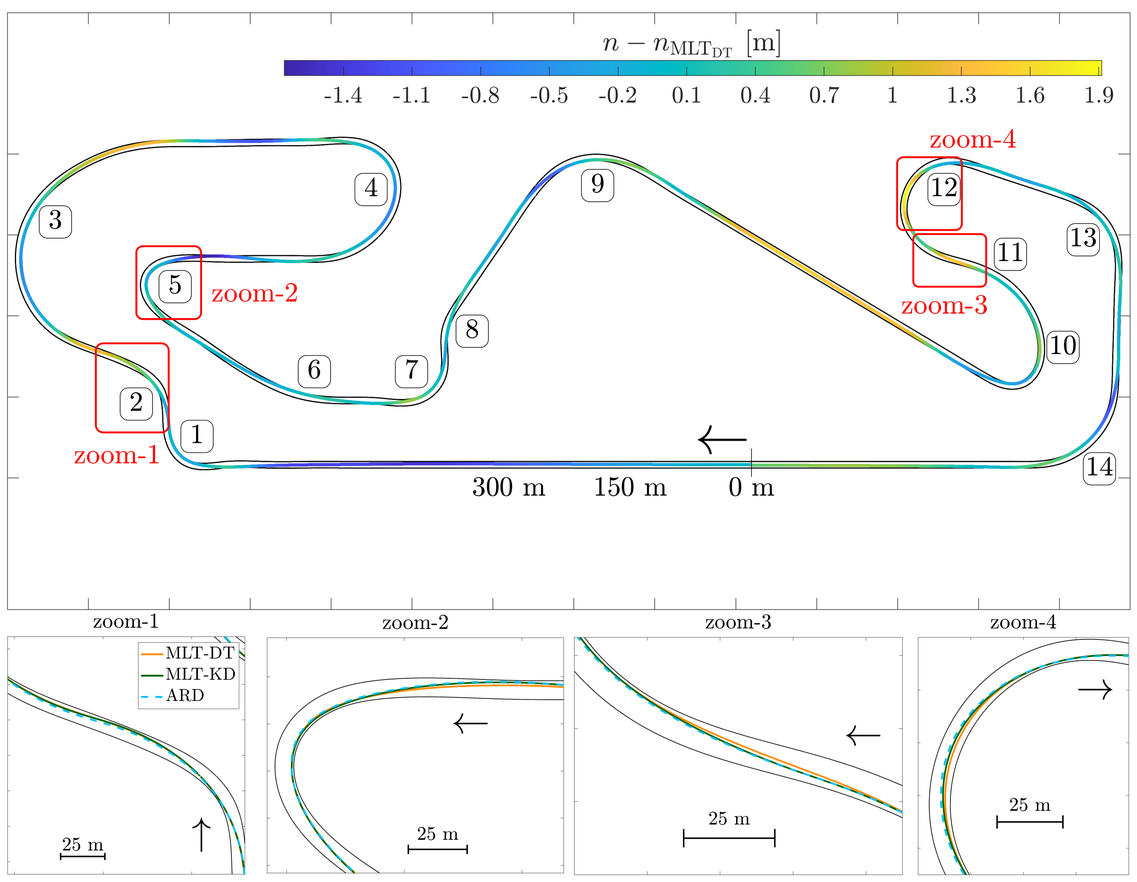
- **Automatic** learning scheme



RESULTS

- The **lap times** on unseen circuits are only 0.294 s from the benchmark **performance limits**
- Good **robustness** to variations of 15% in the vehicle mass





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