CAREER: Robust Verification of Cyber-Physical Systems

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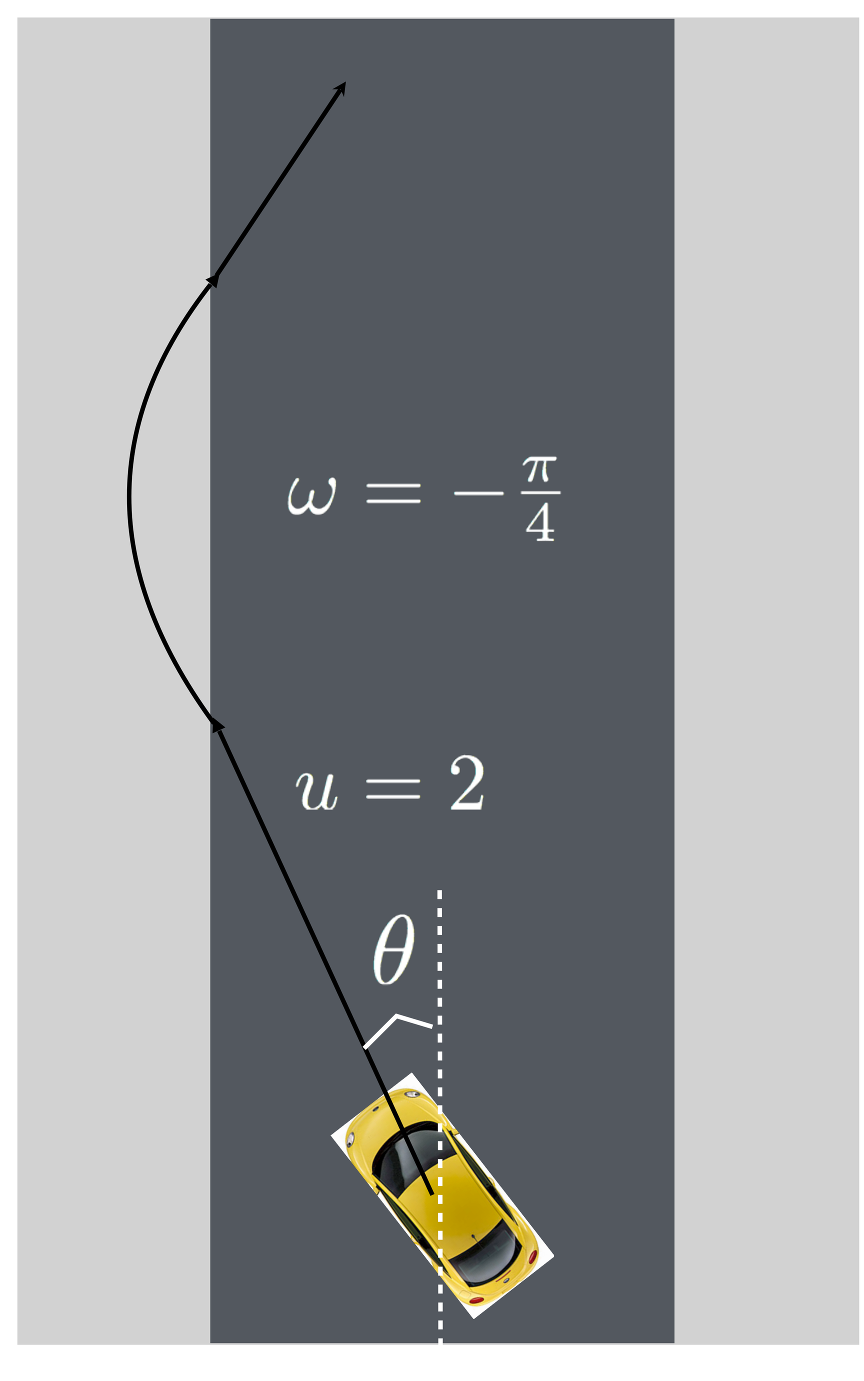
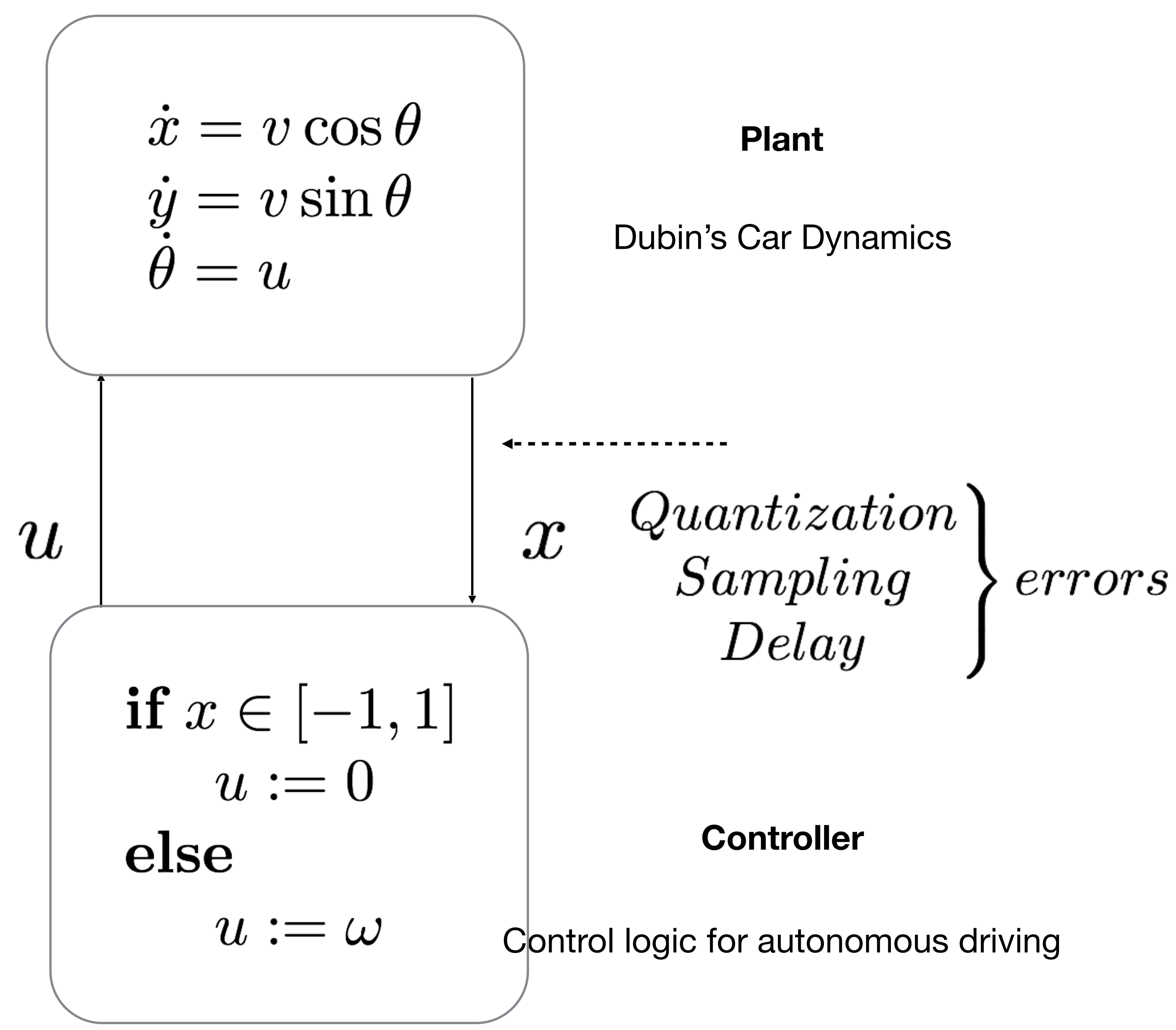
Robust Verification:

Guarantee system correctness even in the presence of perturbations

Autonomous Vehicle Controller





Goal in autonomous driving:

Keep the vehicle in the lane even in the presence of perturbations due to quantization of sensor data, sampling and delays in sensing, actuation and communication.

Challenges:

Classical analysis techniques do not extend in a straightforward manner to the robust verification problem owing to its quantitative/ topological aspects.

Classical vs Robust Verification:

$\mathcal{M} \models \phi \qquad \mathcal{M}_\delta \models \phi_\epsilon$

for a given $\delta - \epsilon$ relation

Main Results:

- A novel algorithmic approach for stability analysis of hybrid systems using graph theoretic analysis:
  - Hybridization [RTSS'20,HSCC'16]
  - Counter-example guided abstraction refinement [CAV'16]
  - Averist [HSCC'18]
  - Bisimulations [ADHS'21, DEDS'18, CDC'16]
- Verification of parameterized systems using compositional analysis [CDC'17,MEMOCODE'19]
- Verification of probabilistic hybrid systems using a specification driven abstraction-refinement approach [EMSOFT'20, EMSOFT'19,QEST'18,Allerton'18,ICCPS'17]
- Robust Verification of timed automata for omega-regular properties [HSCC'17]
- Relating syntactic and semantic robustness [CONCUR'18]