CPS: Medium: Robust Learning for Perception-Based Autonomous Systems

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Challenge:

- Shift from simple sensing devices to rich perceptual sensors: design of safety-critical CPS?
- ML/DL are key, but are they suitable for safety-critical control loops?

Solution:

- **TA1:** Modular but co-designed pipeline w/ uncertainty as interface
- **TA2:** Mid-level representations (MLR)
- **TA3:** Robust perception-based MPC
- **KI1:** Uncertainty-aware perception-based control barrier functions
- **KI2:** Data-driven risk verification applied to perception-based control
- **KI3:** Uncertainty-driven exploration in semantic-goal navigation problems.
- **KI4:** Novel robust MPC schemes that are computationally efficient and significantly reduce conservatism as compared to state of the art.

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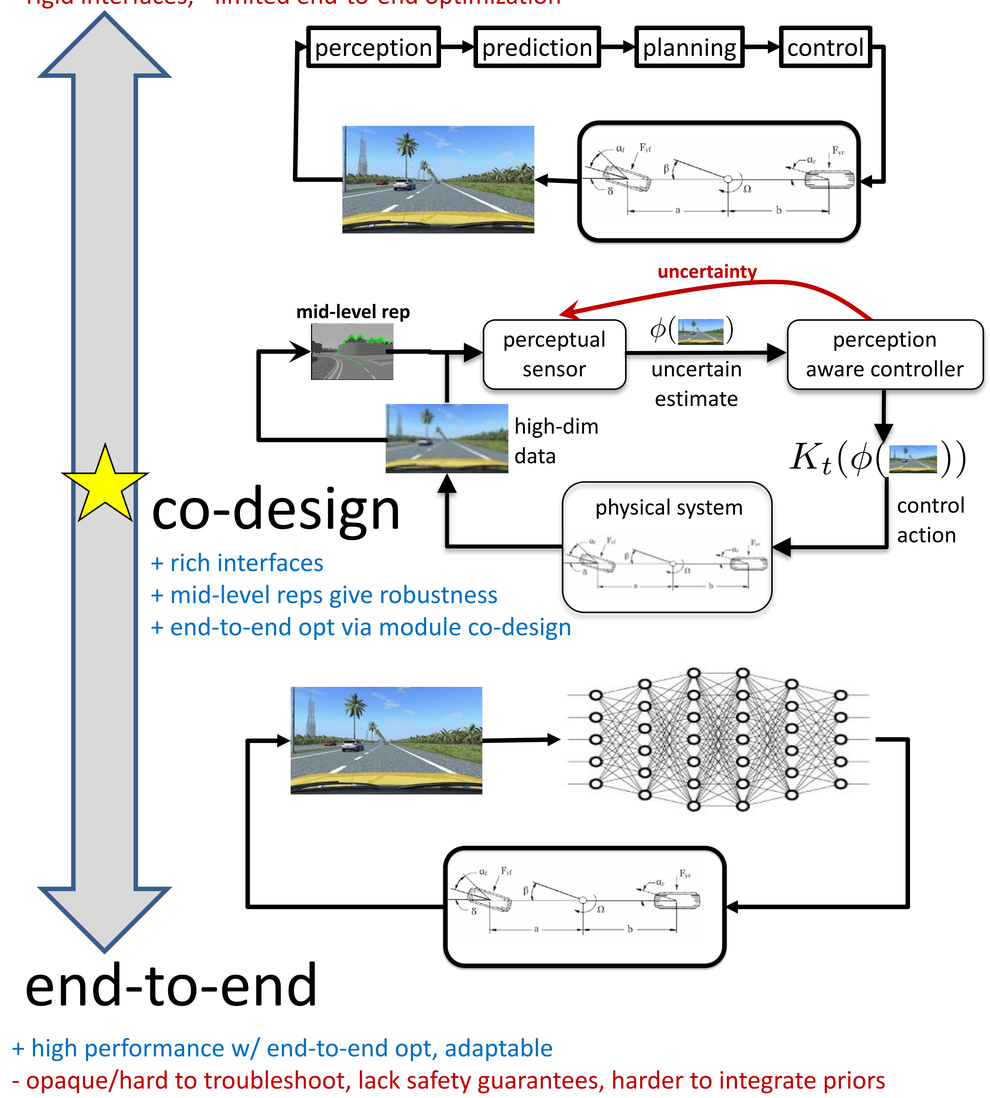

Scientific Impact:

- Principled integration of learning-based perception, prediction, planning, & control
- Modular design pipeline w/ meaningful interfaces that allow for end-to-end metrics to be optimized
- Fundamental limits of robustness/performance in perception-based CPS

Broader Impact:

- **Societal impact:** Autonomous transportation, search & rescue, disaster relief
- **Industry:** Google collaboration
- **Education:** new publicly available courses on L4DC
- **Outreach:** CDC '21 workshop on robust deep learning-based control

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