# VeHICaL: Verified Human Interfaces, Control, and Learning for Semi-Autonomous Systems

Challenge:

- *Co-design human interfaces and control* for human-cyber-physical systems with *provable guarantees*

- Apply to semi-autonomous vehicles (ground and air)

Solution:

- Integrate Human Modeling, Machine Learning, Formal Methods and Control

- *Integrative Industrial-Scale Experiment*: Formal scenario-based testing of AVs in simulation and on the road

- *Perception Hand-Off*: Novel framework for involving human in perceptual tasks for autonomous driving via active information gathering queries and POMDP model
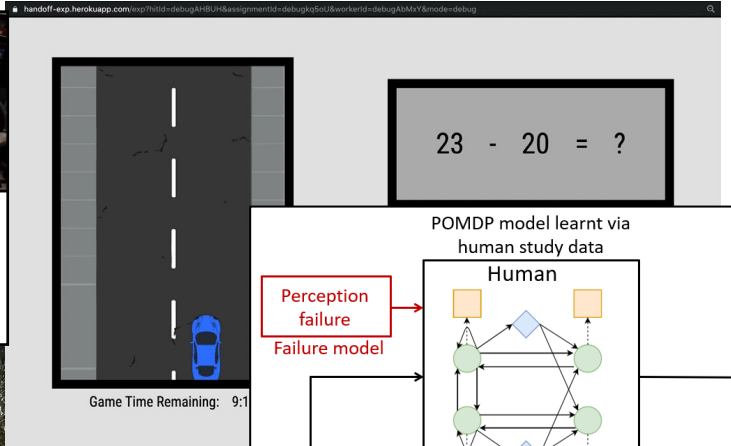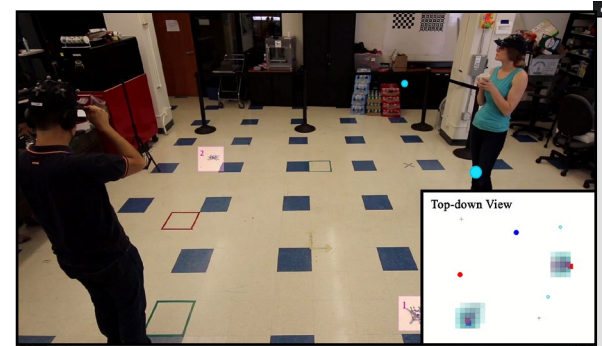

```
ego = EgoCar at 38.6 @ 183.9,   # LGSVL coordinate
        facing 10 deg relative to roadDirection,
        with behavior DriveTo(40 @ 225.2)
ped = Pedestrian at 19.782 @ 225.680,
        facing 90 deg relative to roadDirection,
        with behavior Hesitate,
        with startDelay (7, 15),    # (a,b) = unifo
        with walkDistance (4, 7),   # distribution
        with hesitateTime (1, 3)    # that interval
```
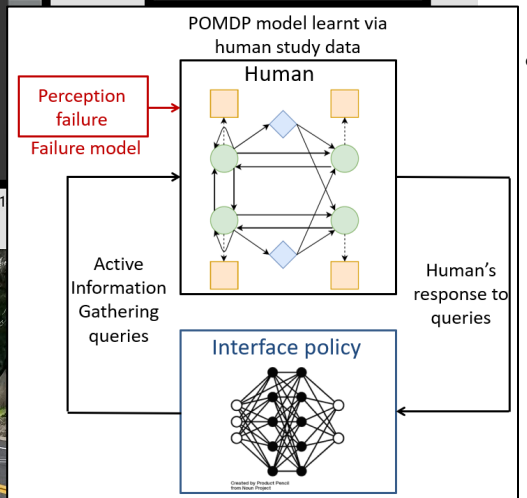
Scientific Impact:

- Developing a Science of Co-Design of Human Interfaces and Control

- Bridging Model-Based and Data-Driven Design of CPS

Broader Impact:

- Significantly improve safety, security, and performance of systems where humans interact closely with automation

- Involve middle/high-school and undergraduate students in VeHICaL activities

- Open-source tools Scenic and VerifAI demonstrated on industrial case studies and integrated with commercial simulators

- WEF Safe Drive Initiative