

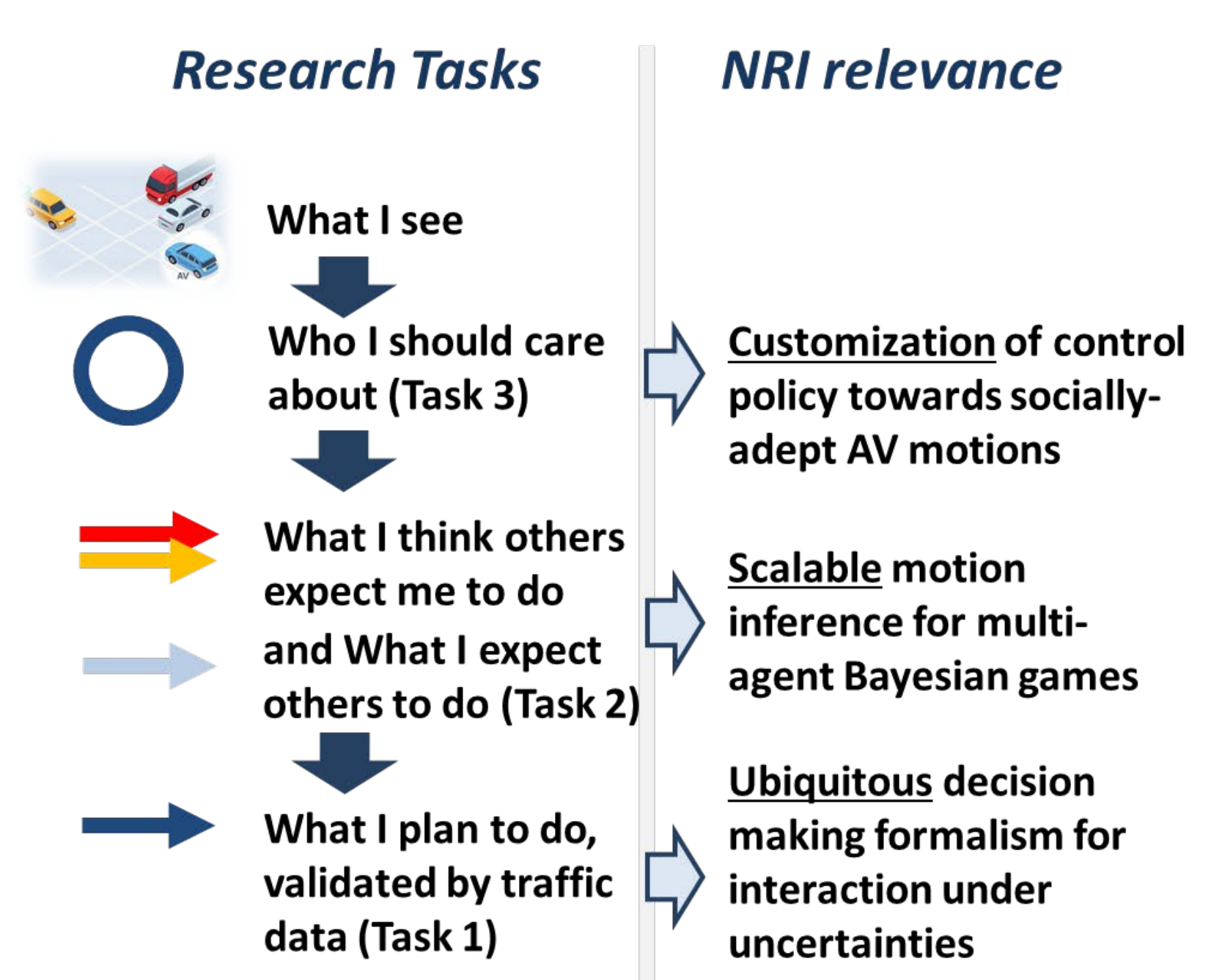
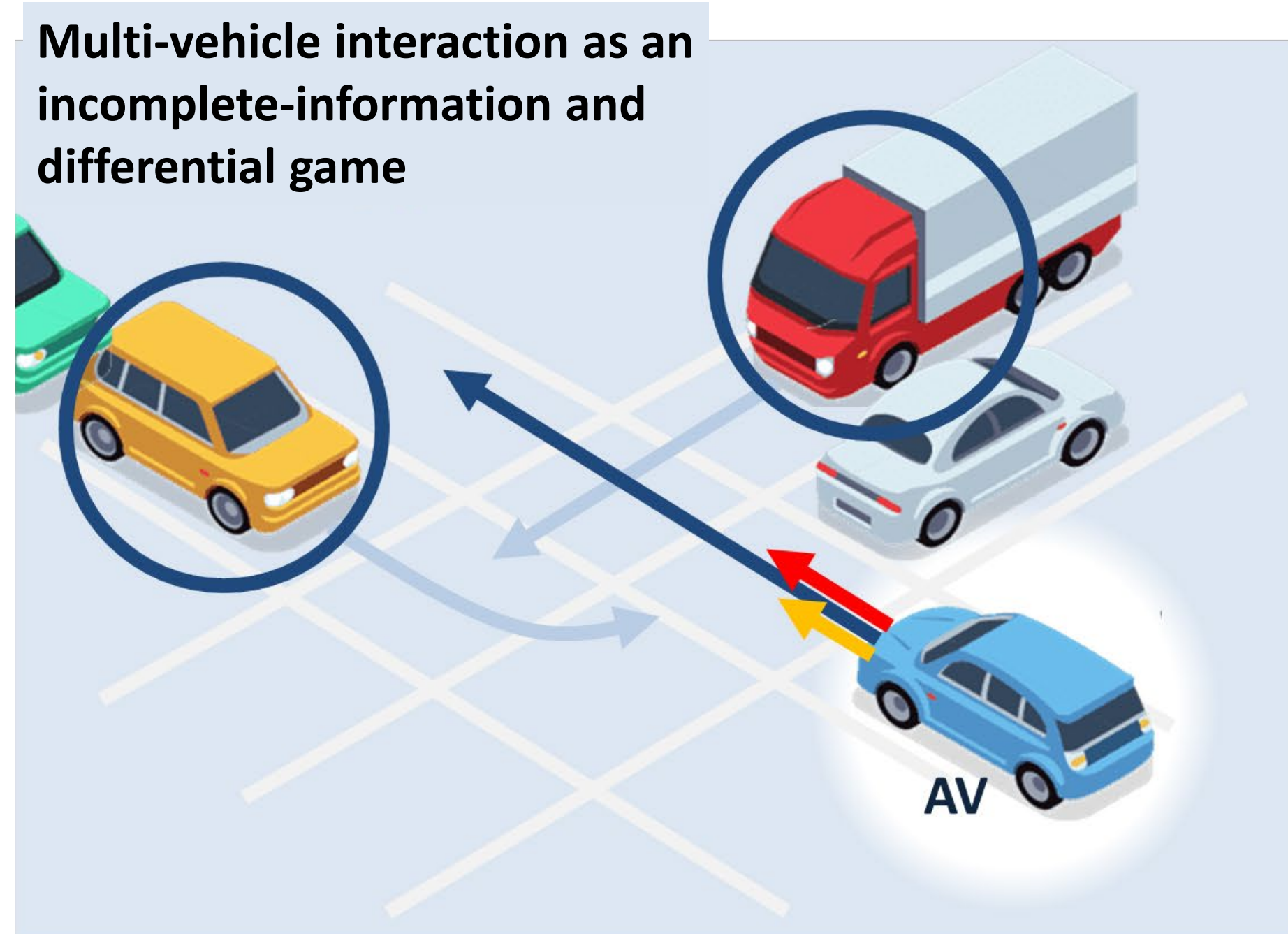
# NRI: FND: Scalable and Customizable Intent Inference and Motion Planning for Socially-Adept Autonomous Vehicles



PI: Wenlong Zhang, Co-PI: Yi Ren, Yezhou Yang | Arizona State University

[https://designinformatics.github.io/Social\\_Gracefulness\\_of\\_Autonomous\\_Systems/](https://designinformatics.github.io/Social_Gracefulness_of_Autonomous_Systems/)

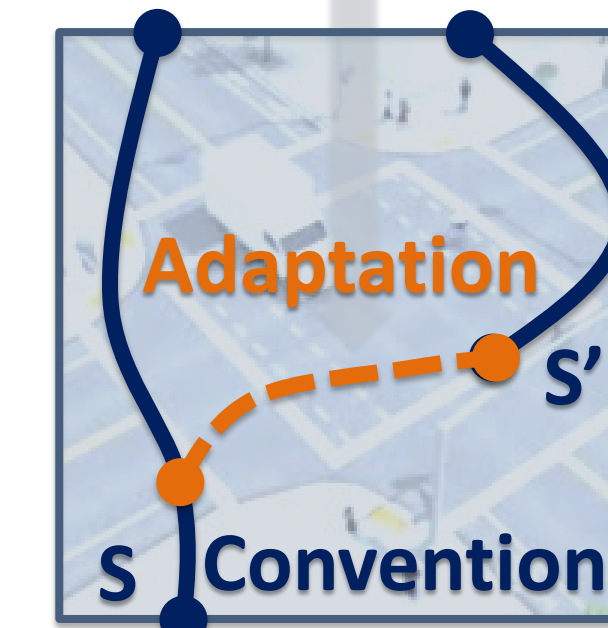
**Objectives:** To improve the scalability, generalizability, robustness, and social adeptness of real-time intent inference and motion planning algorithms in collaborative robots (co-robots), with an application in autonomous vehicles.



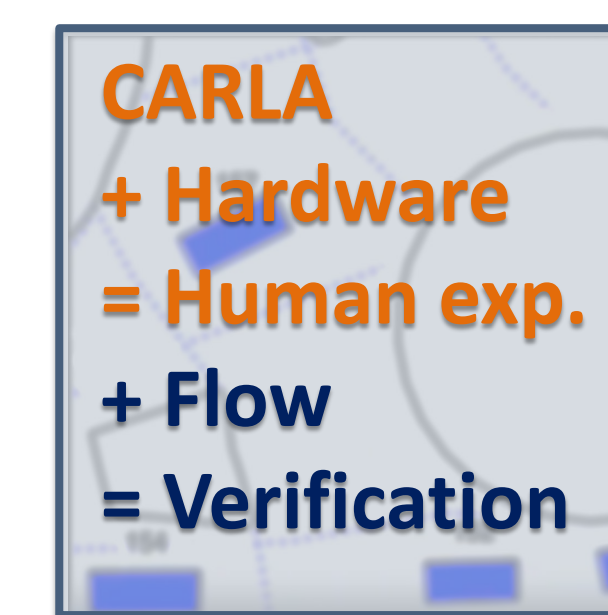
## Scientific Impact:



**New theories of mind for social interactions:** Is “being graceful” graceful? *Convergence* and *stability* analysis of coupled knowledge and physical dynamics of *socially-adept* policies in incomplete-information and differential games. Analysis enabled by *analytical* Theory-of-Mind models tailored for vehicle interactions.



**New theories and methods for real-time vehicle-vehicle interactions:** Integrate convention, memory, and reasoning in learning to improve *generalizability* and *robustness* of real-time policies. Enable fast policy adaptation to customized social contexts (driving cultures).



**New software-hardware v&v platform** for open-source collaborations on algorithm development between academia and industry, human/transportation data integration, and safety specification development (based on SUMO, FLOW and CARLA).

## Challenges:

Human-machine interactions on road are incomplete-information and differential games. Computation of Bayesian equilibria often cannot be achieved in real time, while offline solutions, e.g., through reinforcement learning, have limited generalizability and robustness. New theories and computational tools are needed for scalable, generalizable, robust decision making for real-time interactions.

## Societal Impact:

- Improve safety and efficiency of human-machine systems, e.g., autonomous driving, collaborative manufacturing, search and rescue, and robotic surgery
- Facilitate collaboration between academia and AV industry through open-source software
- Expedite the deployment of co-robots

## Education and Outreach:

- New course on interactive autonomous driving (driver modeling, perception, reasoning, motion planning) – to be offered at ASU and online
- Undergraduate research through NSF-REU supplements, ASU-FURI program, and ASU Honor’s thesis (currently 5 UG students)
- ASU Night of the Open Door, Phoenix Mobile & Emerging Tech Festival 2019

## Quantified Potential Impacts

- **37,461** - people killed in crashes on U.S. roadways in **2019**.
- **Five** fatal accidents involving Tesla (L-2) and **one** fatal accident involving Uber (L-3)
- **\$80 billion** - estimated investment in AV technology over the past three years
- **61%** - not inclined to ride in a self-driving car