Human Centered Autonomy

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A Survey of the State of the Art in Modeling and Predicting Human Driver Behavior

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- Canonical tasks
  - State estimation
  - Internal state estimation
  - Motion prediction
  - Motion planning
- Input Features
- Dataset
- Model Scope
- Evaluation Metrics
Predictive Modeling

Informative Models

Robust Models
Empirical Reachable Sets

Approximate stochastic reachability with an *empirical reachable set*, by:

- maximizing precision
- while maintaining accuracy

\[
\arg\min_{\Delta \subset \mathbb{R}^n} \lambda(\Delta)
\]

subject to \( \hat{P}_X[\Delta] \geq \alpha \)

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Reachability for Behavior Prediction

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Optimizing Disturbances for Reachable Sets

Accuracy: 0.75  Risk: 0.92

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Driver Modeling and Active Safety

If we can identify the driver state and effectively predict their likely behavior, can we design better, less invasive active safety systems?

Driver Prediction

Intervention Function
\[ G_k(\alpha, \tau) = \begin{cases} 1, & \text{if } \exists k \text{ s.t. } |A_k \cap C_k| \geq \tau \\ 0, & \text{otherwise} \end{cases} \]

Environment Model

Model Predictive Control

If we can predict likely driver responses in cooperative maneuvers, can we design autonomous systems that can effectively integrate with human drivers?

Optimize cost function subject to dynamic feasibility safety constraints: <insert human model>