

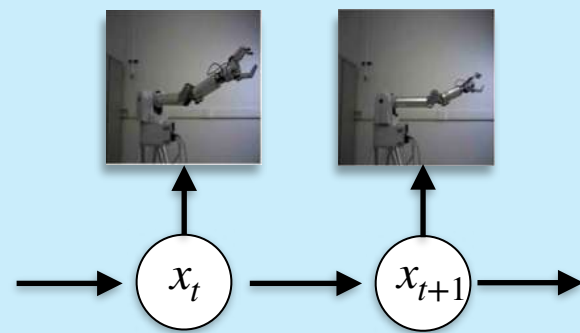
Visual

Learned Perceptual Models

Tactile

Flow-based Image Prediction

(ICRA '18)



- Combined parametric / non-parametric representation for photo-realistic image prediction.
- Flow transformations generate novel viewpoints from key-frame data.
- Used for tracking tasks and detecting occlusions.

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Contact Force Estimation

(ICRA '19)

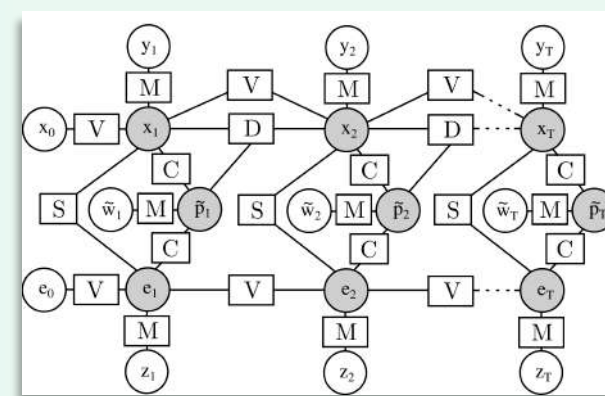


- Perceptual model for biomimetic tactile sensor predicts contact forces.
- Architectural integration of spatial sensor structure and geometry.
- Multi-task generalization for various contact modes and applications is demonstrated.

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video

Priors for Multi-Sensory Integration (ICRA '19)



- Framework for online, joint inference using visual and tactile perceptual models during robot manipulation tasks.
- Geometric and physics-based priors shown to be effective for cross-modal compensation in robot manipulation tasks.
- Cross-modal compensation is demonstrated for pushing under heavy occlusion.
- Pose estimates from visual tracking systems can be enhanced by using contact force measurements, and visual information can alleviate biases in tactile estimation.

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video

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Structured and distributed approaches for robot Perception and Control.

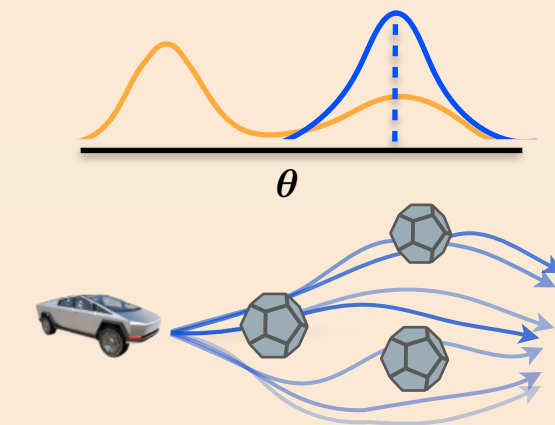
Research Interests:

stochastic optimal control - motion planning - model-based reinforcement learning - imitation learning - bayesian inference - state estimation

Particle Variational Inference

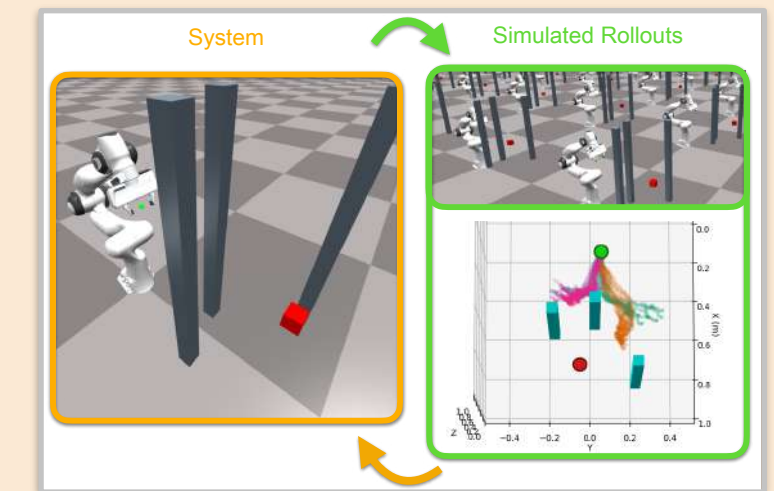
Stein Variational Model Predictive Control (CoRL '20)

$$q^* = \operatorname{argmin}_q KL(q || p)$$



- Bayesian formulation of sampling-based stochastic optimal control.
- Posterior distributions over low-cost control sequences and policy parameters can be approximated using non-parametric, particle-based representations.

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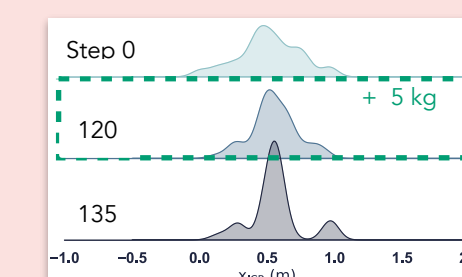
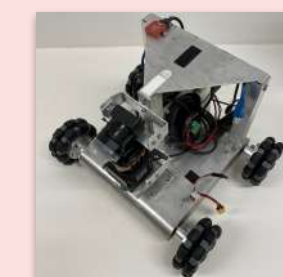


- SVGD uses gradient-based information.
- Factored kernels designed for trajectories.
- Efficient parallel computation on GPU.
- Comparisons and theoretical connections to existing sampling-based SOC methods.

video

Online Model Adaptation

(RSS '21)

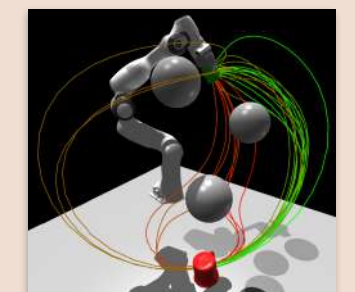


- Extended SV-MPC for estimating uncertainty over dynamics parameters.
- Tested on a skid-steer Autonomous Ground Vehicle with dynamic loading.
- Adapting the distribution for the Center of Rotation online improves recovery.

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Entropy-Regularized Motion Planning

(RSS '21)



- Approximate inference for Planning using trajectory-wise particles provides a distribution of collision-free solutions.
- Uses a Gauss-Newton SVGD formulation.
- Factor-graph representation enables efficient computation.

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