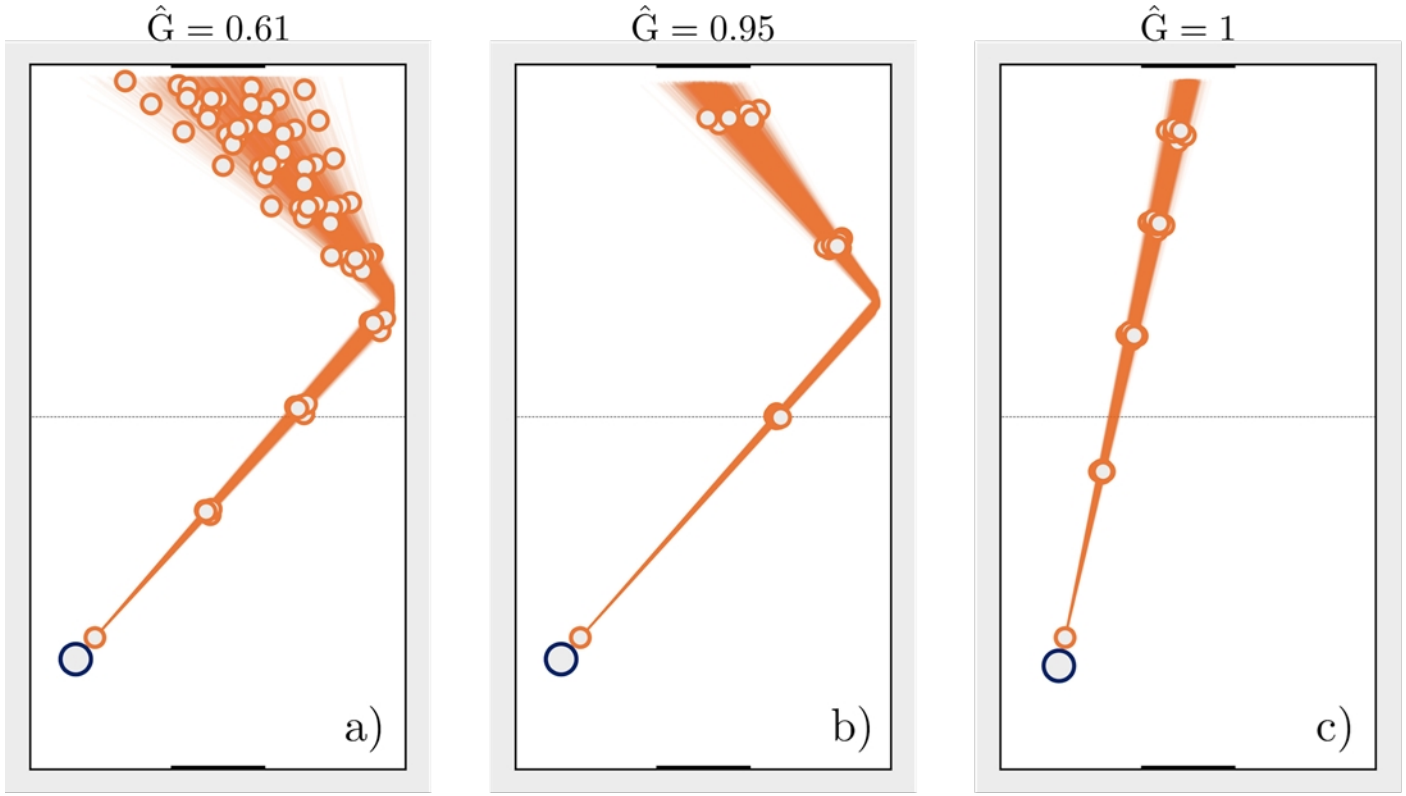
Energy-based Contact Planning under Uncertainty for Robot Air Hockey

Ante Marić

Contact Planning under Uncertainty

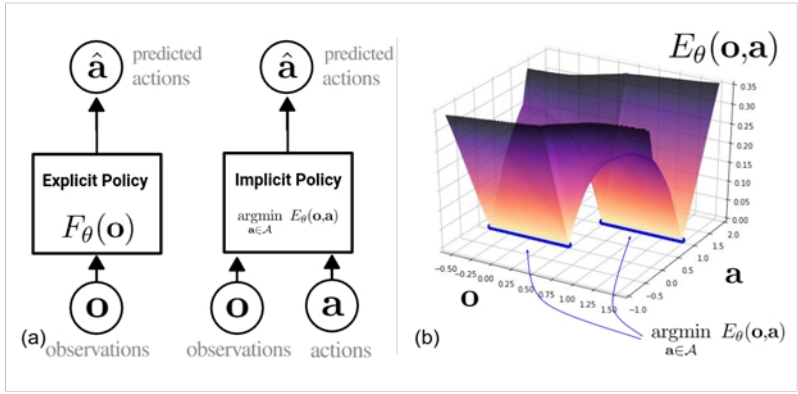


- **Learned** Piecewise linear-Gaussian **dynamics model**
- Kalman Filter **state estimation**
- Stochastic **Optimal Control** for Shooting

- *Jankowski, J.*, Marić, A.*, Liu, P., Tateo, D., Peters, J. & Calinon, S. (2024). Energy-based Contact Planning under Uncertainty for Robot Air Hockey.*

Contact Planning under Uncertainty

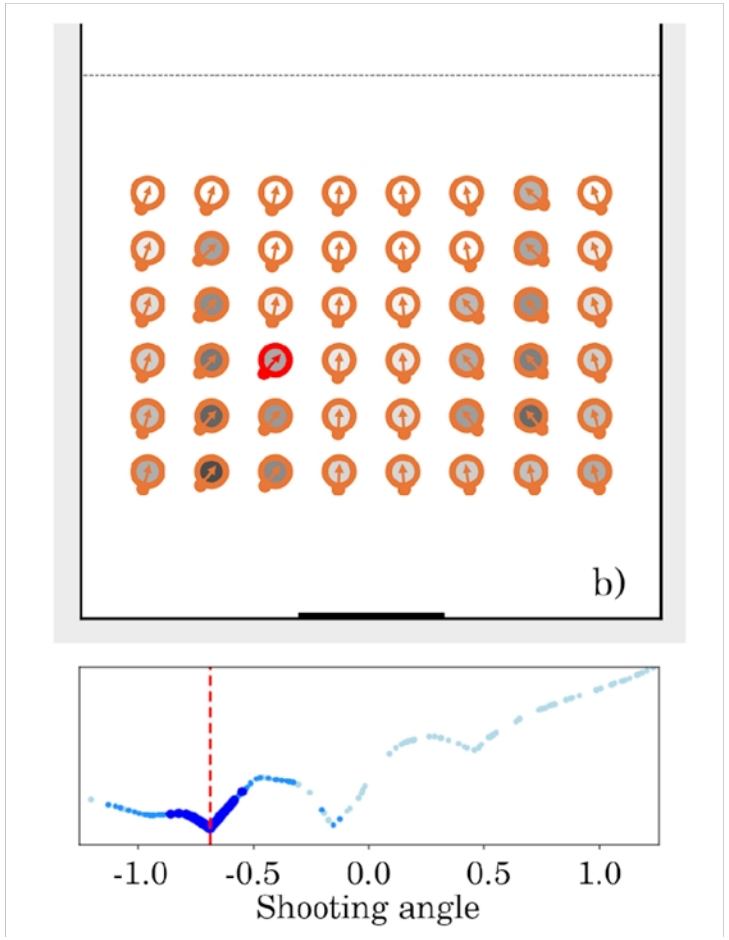
- Energy-based Shooting policy



Florence et al.

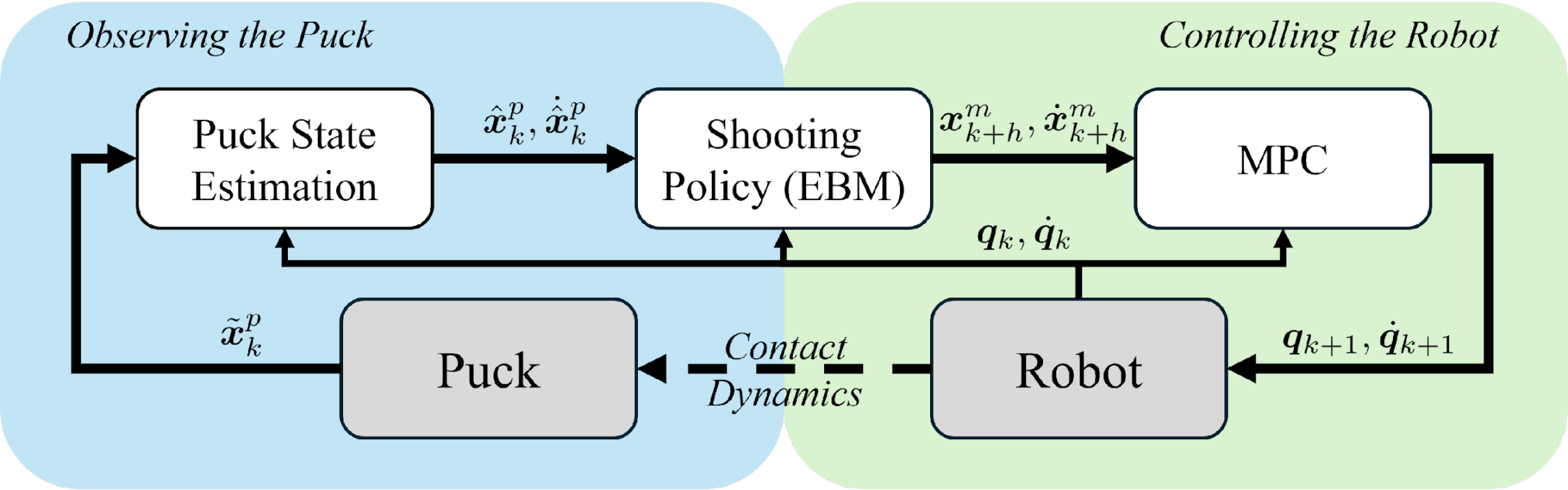
- Online Inference with Warm-starting (50 Hz)

$$\hat{u} = \underset{u\in\mathcal{U}}{\arg\min}\, E_\theta(\hat{\boldsymbol{s}}_{0-}, u)$$

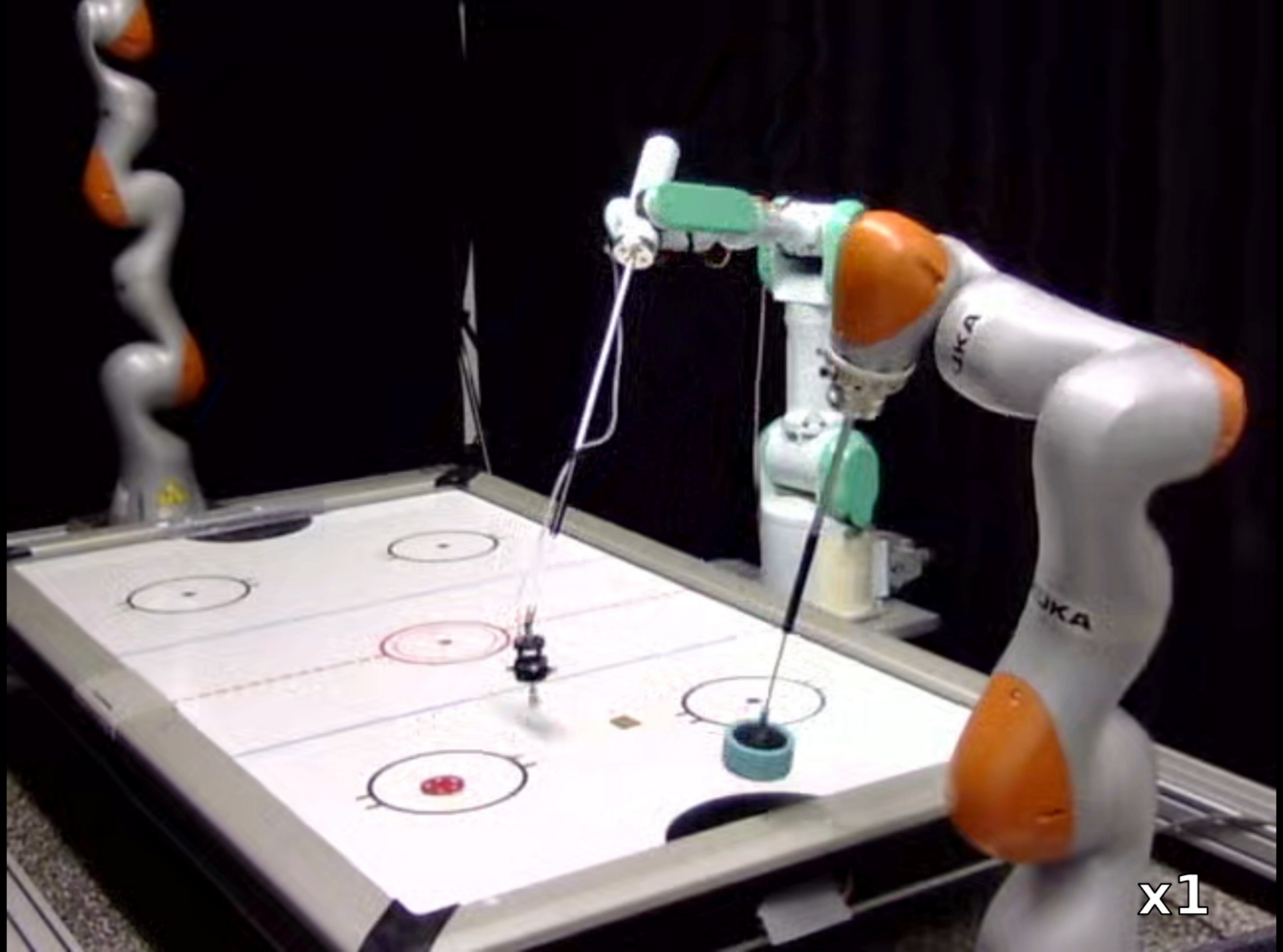


- *Florence, P., Lynch, C., Zeng, A., Ramirez, O., Wahid, A., Downs, L., Wong, A., Lee, J., Mordatch, I., & Tompson, J. (2021). Implicit Behavioral Cloning. Conference on Robot Learning (CoRL).*
- *Jankowski, J.*, Marić, A.*, Liu, P., Tateo, D., Peters, J. & Calinon, S. (2024). Energy-based Contact Planning under Uncertainty for Robot Air Hockey.*

System overview



- *Jankowski, J.*, Marić, A.*, Liu, P., Tateo, D., Peters, J. & Calinon, S. (2024). Energy-based Contact Planning under Uncertainty for Robot Air Hockey.*
- *Liu, P., Günster, J., Funk, N., Gröger, S., Chen, D., Bou-Ammar, H., Jankowski, J., Marić, A., Calinon, S., Orsula, A., Olivares-Mendez, M., Zhou, H., Lioutikov, R., Neumann, G., Likmeta, A., Zhalehmehrabi, A., Bonenfant, T., Restelli, M., Tateo, D., Liu, Z., & Peters, J. (2024). A Retrospective on the Robot Air Hockey Challenge: Benchmarking Robust, Reliable, and Safe Learning Techniques for Real-world Robotics. In Proceedings of the NeurIPS Track on Datasets and Benchmarks.*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Thank you!