Conformalized Teleoperation:

Confidently Mapping Human Inputs to High-Dimensional Robot Actions

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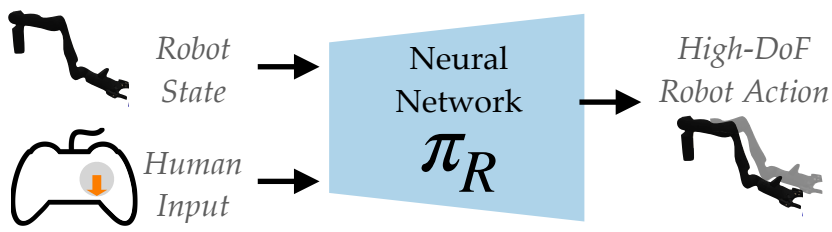
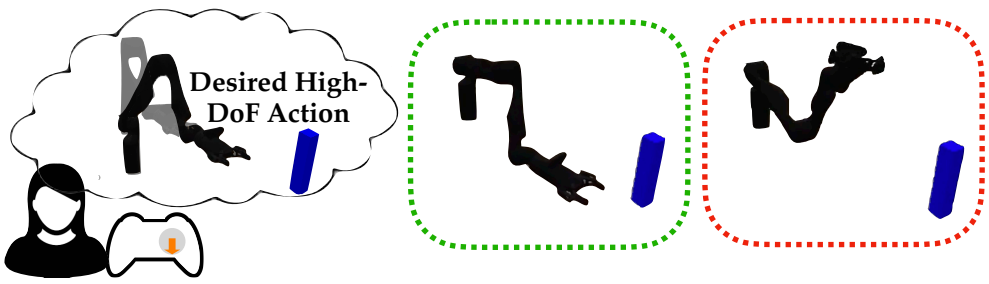


Learned assistive controllers map robot state and low-DoF human input onto the robot's high-DoF action space.

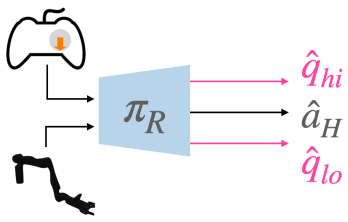


How can we trust the learned assistive mapping?

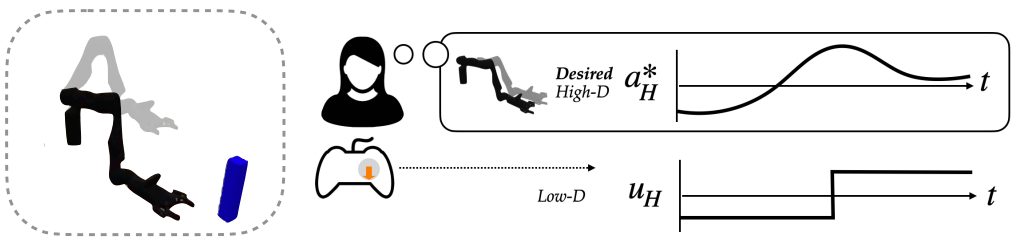
Use conformal prediction to calibrate the learned controller based on how well the model is working for a particular user

Adaptive Conformal Quantile Regression

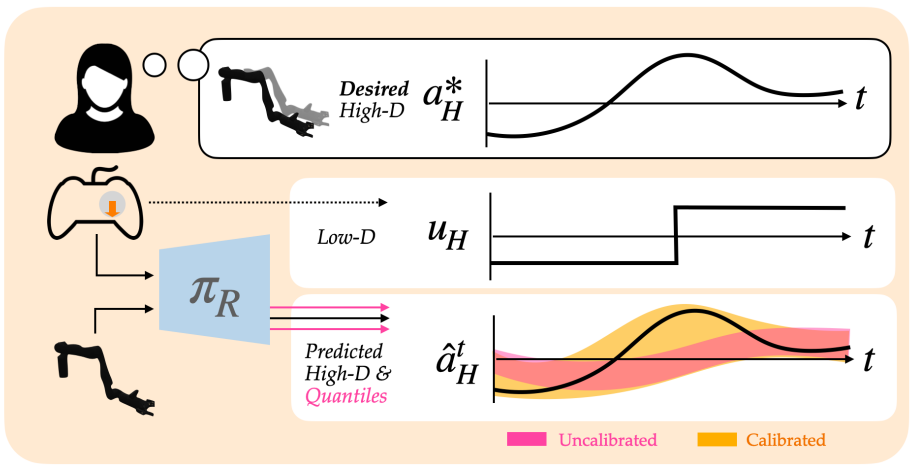
1. Adapt assistive controller to estimate its own uncertainty via upper and lower quantiles.



2. Collect a small set of correct input-output pairs provided by a target user.

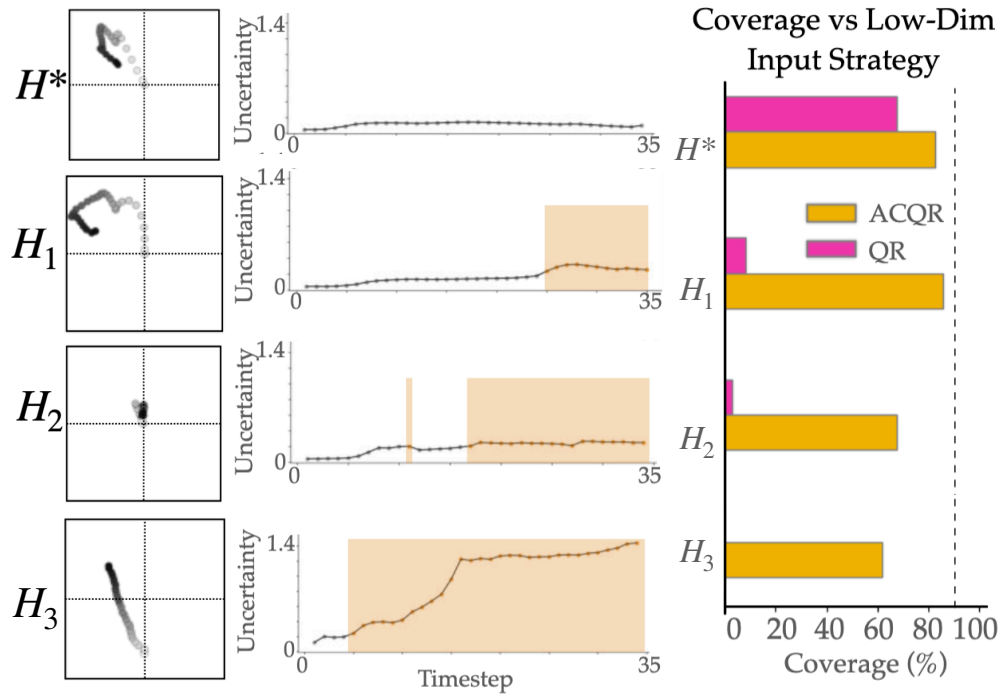


3. Automatically adjust the uncertainty intervals based on coverage error seen as time goes on.



Coverage Guarantee: As time goes on, the adjusted interval will contain the user's intended high-DoF robot action with high probability

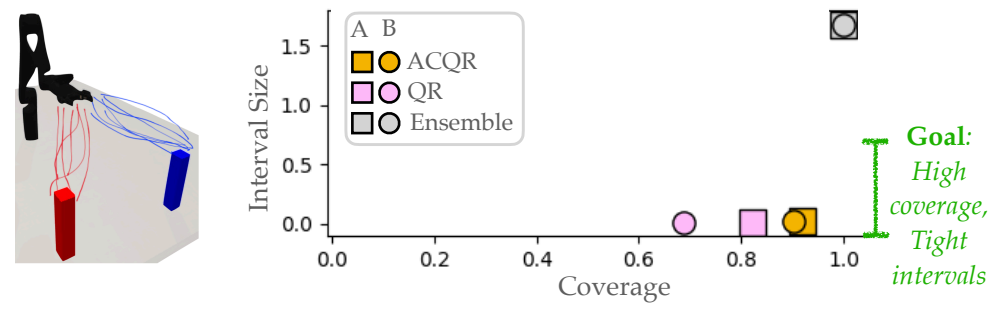
We can **detect** increasingly OOD input strategies with higher coverage %.

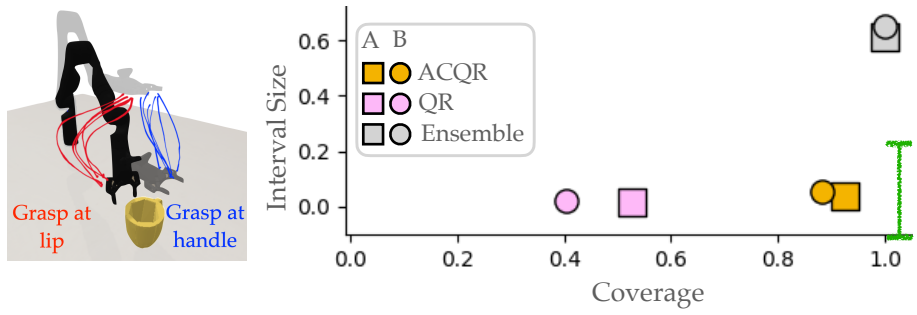


ACQR achieves **high** coverage % with **low** interval size.

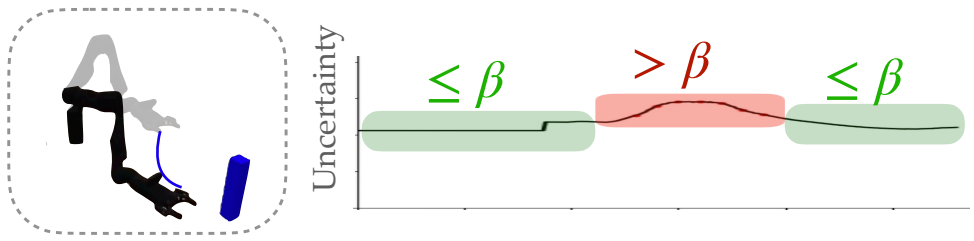
Latent Preferences:

*Training distribution for π_R is **multimodal** from latent preferences*





We monitor uncertainty via **separating** high and low uncertainty inputs, where high uncertainty inputs risk high prediction error.



There exists some threshold β that separates high and low uncertainty inputs such that *mean prediction error* is *higher* in uncertain inputs than certain inputs.

For more information, check out our paper!

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