

Zero Moment Two Edge Pushing of Novel Objects with Center of Mass Estimation

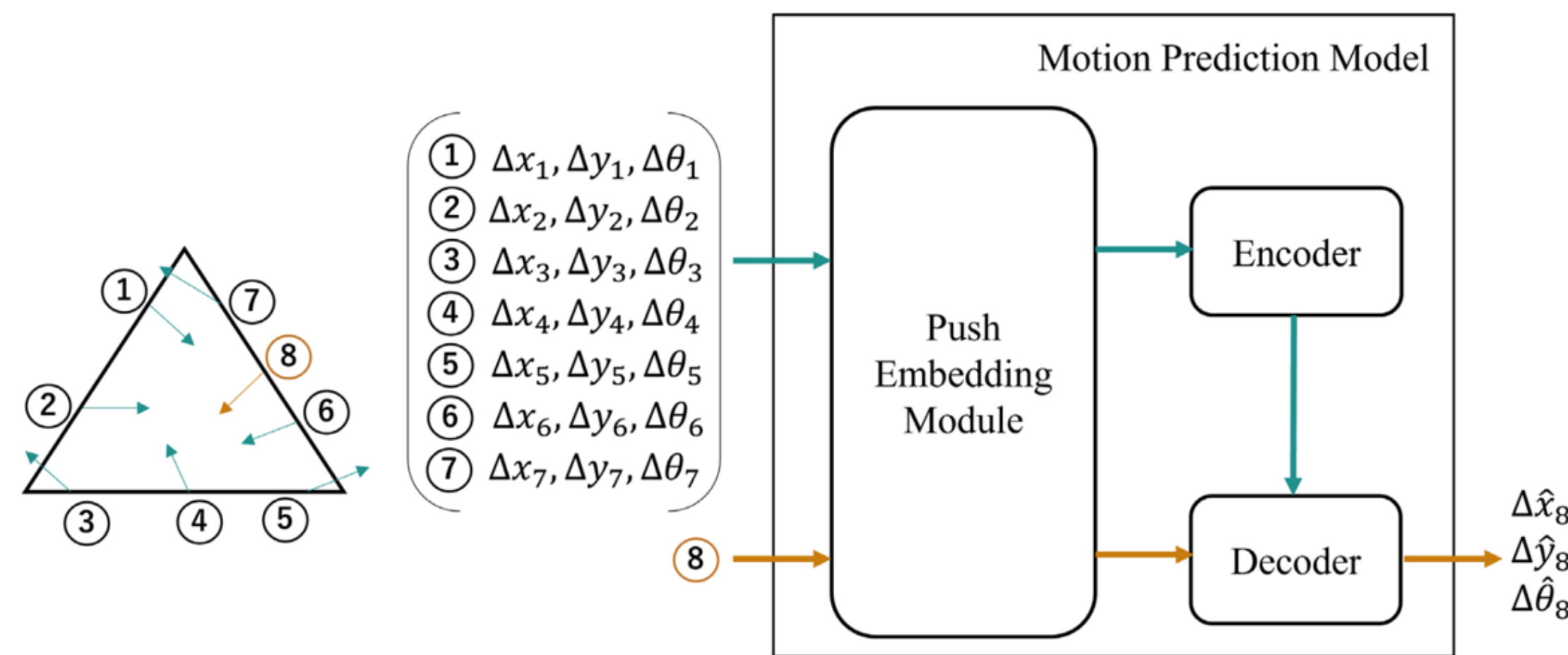
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What's New Here

1. An integrated CoM estimation method combining the motion prediction model and the voting theorem.
2. The two-edge-contact pushing for translating a novel object without rotation.
3. An analysis of tolerance to measurement noise and error-prone CoM estimates.

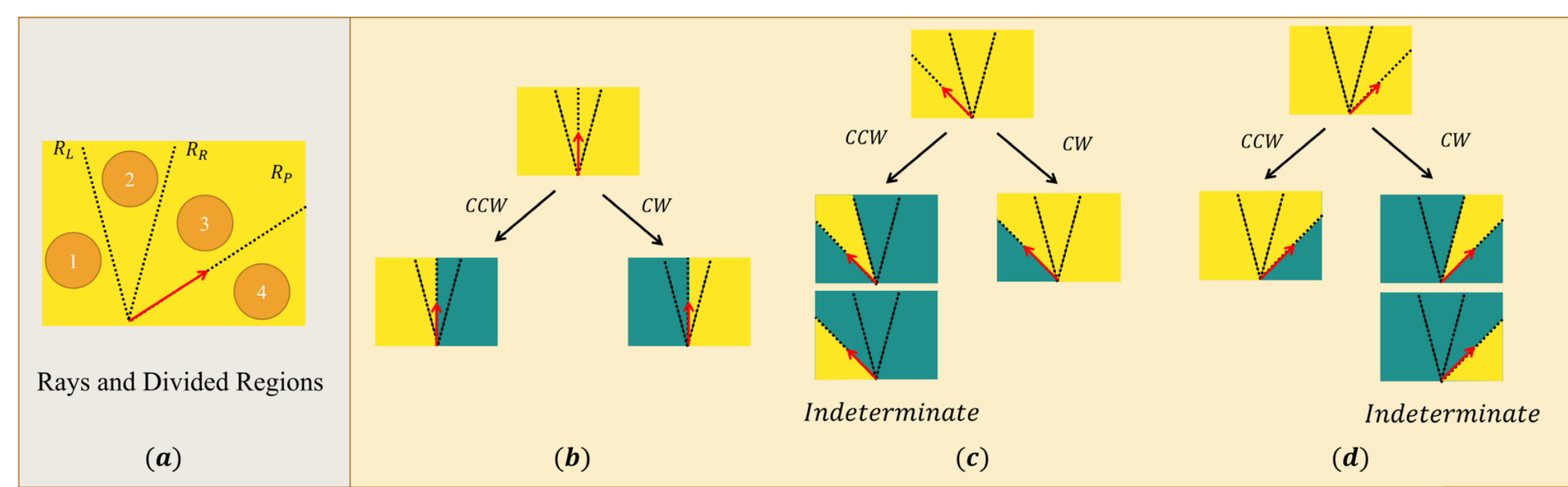
Few Shot Motion Predictor

Basically, the prediction model predicts object motion for a pushing primitive by integrating limited pushing priors.



Voting Driven Region Shrink

We iteratively shrink the CoM region using pushing direction and predicted rotation sense.

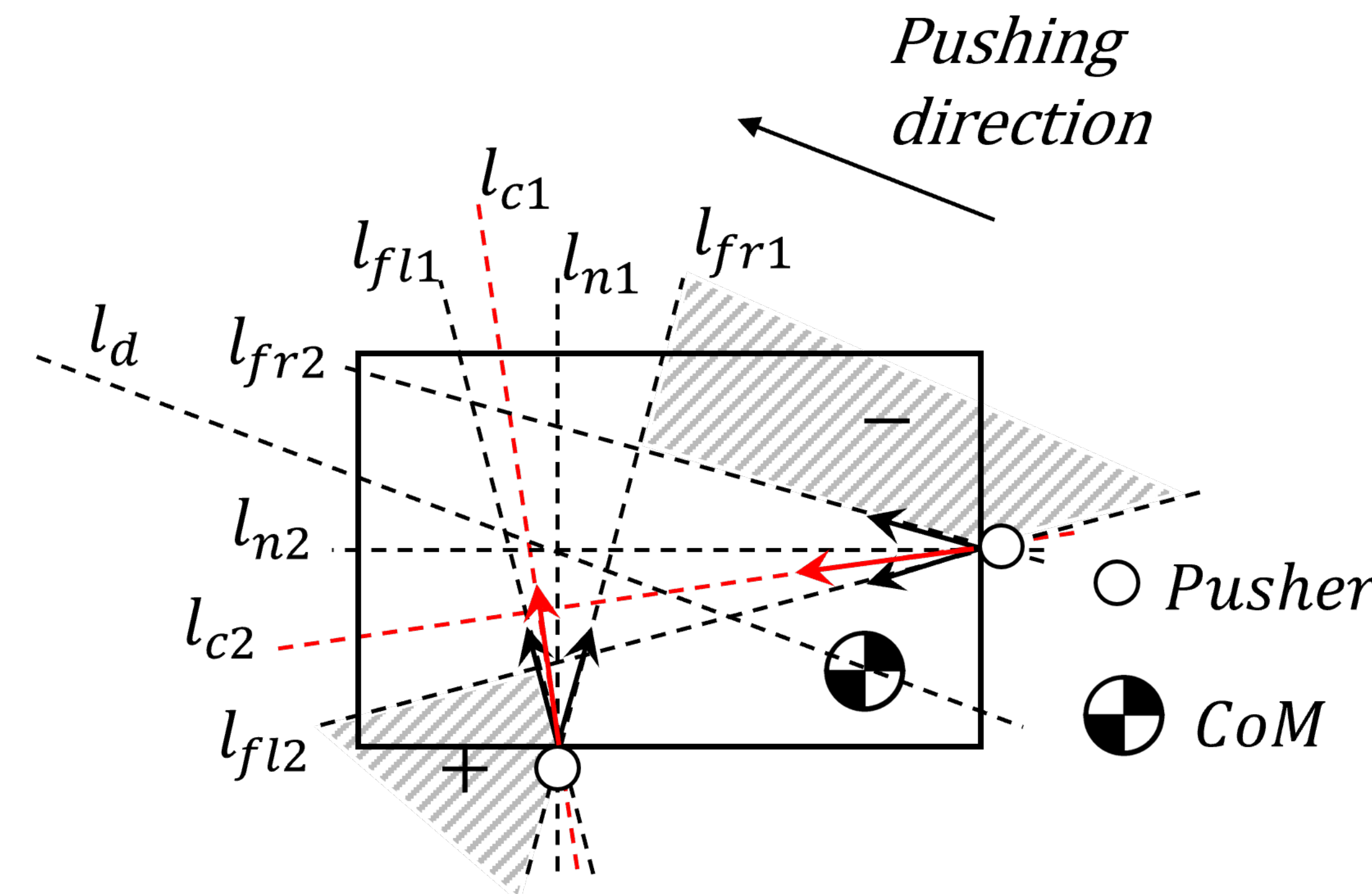


CoM region updating rules

Zero Moment Two Edge Pushing (ZMTEP)

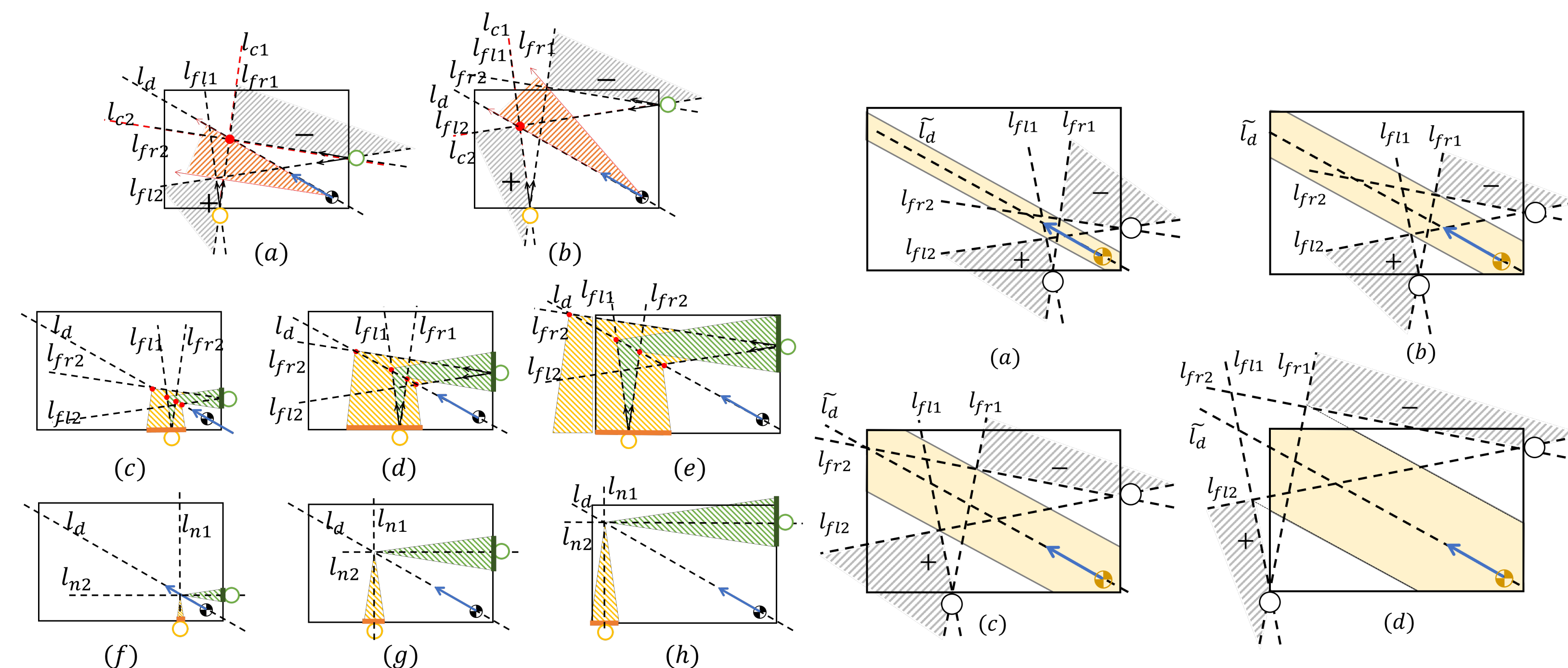
Theorem (Pure Translation Condition)

- Positive span: $l_d \in \text{POS}\{l_{n1}, l_{n2}\}$
- l_{n1}, l_{n2}, l_d intersect at a single point.



Tolerance Insights

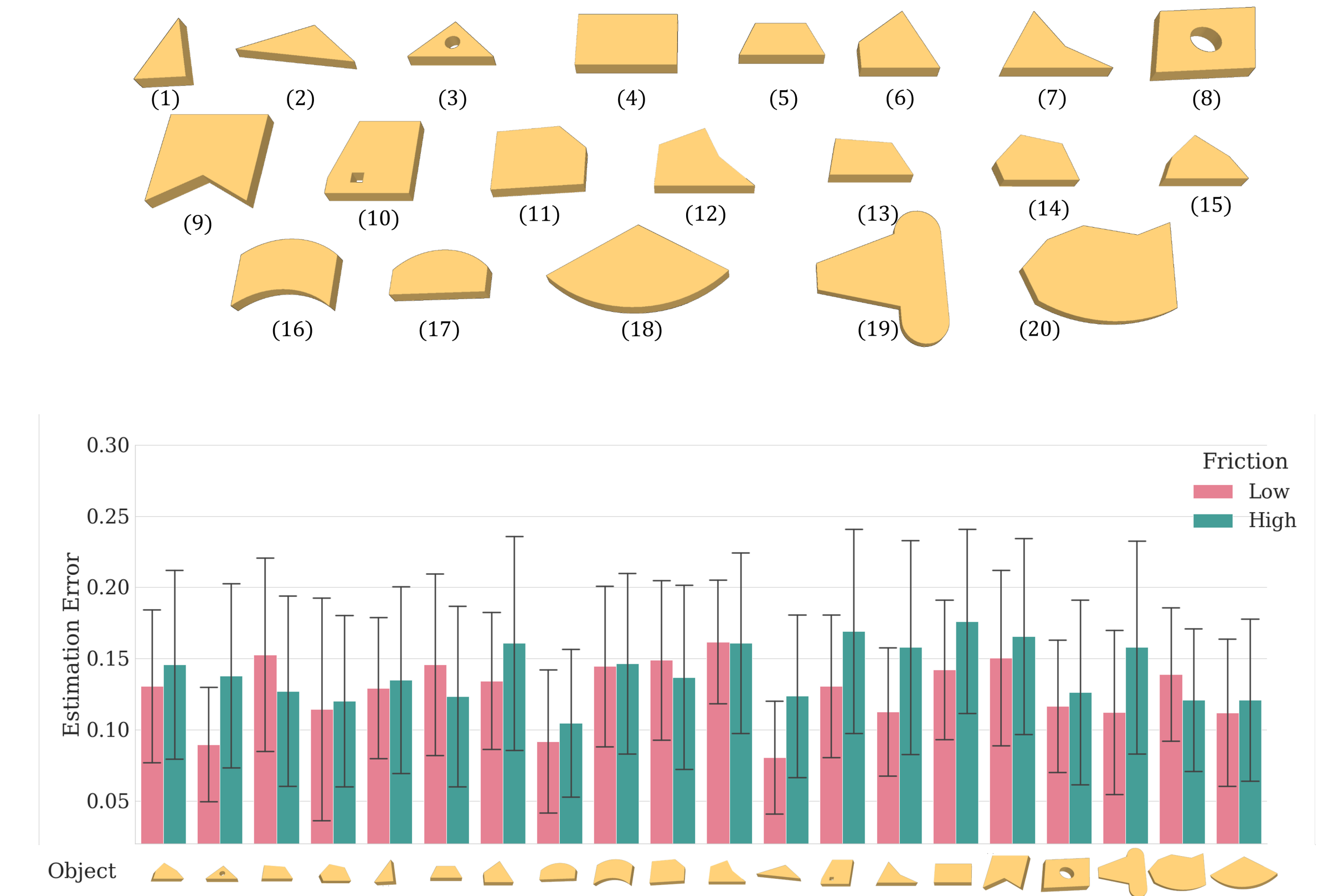
In real settings, robot may not be able to achieve the required two-edge-contact configuration precisely, and the error-prone CoM estimation causes incorrect contact configurations. Therefore, we analyse the tolerance range for given the contact configuration.



Contact position tolerance range

CoM tolerance range

CoM Estimation Experiment



Empirical Evidence for ZMTEP

