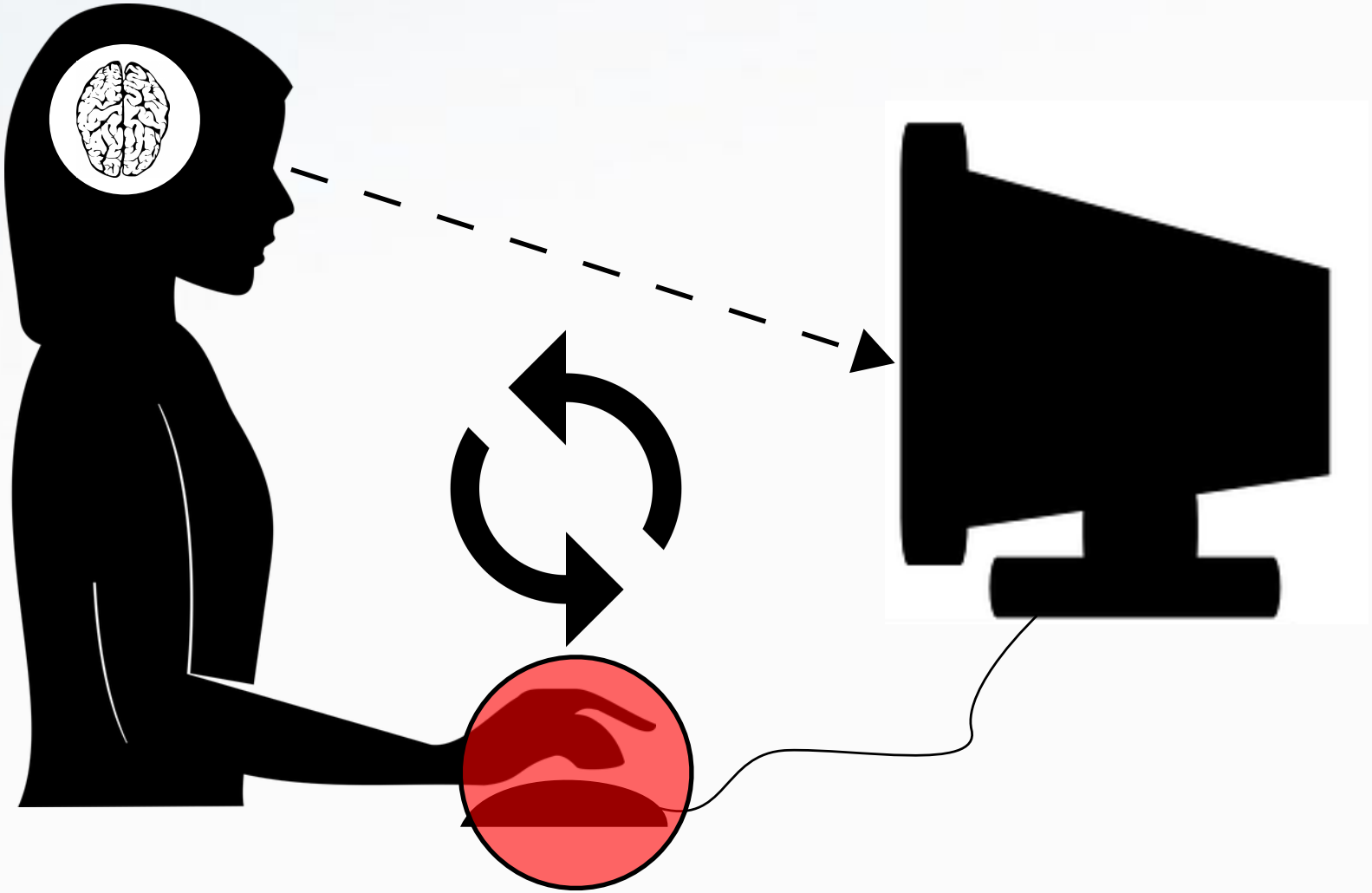
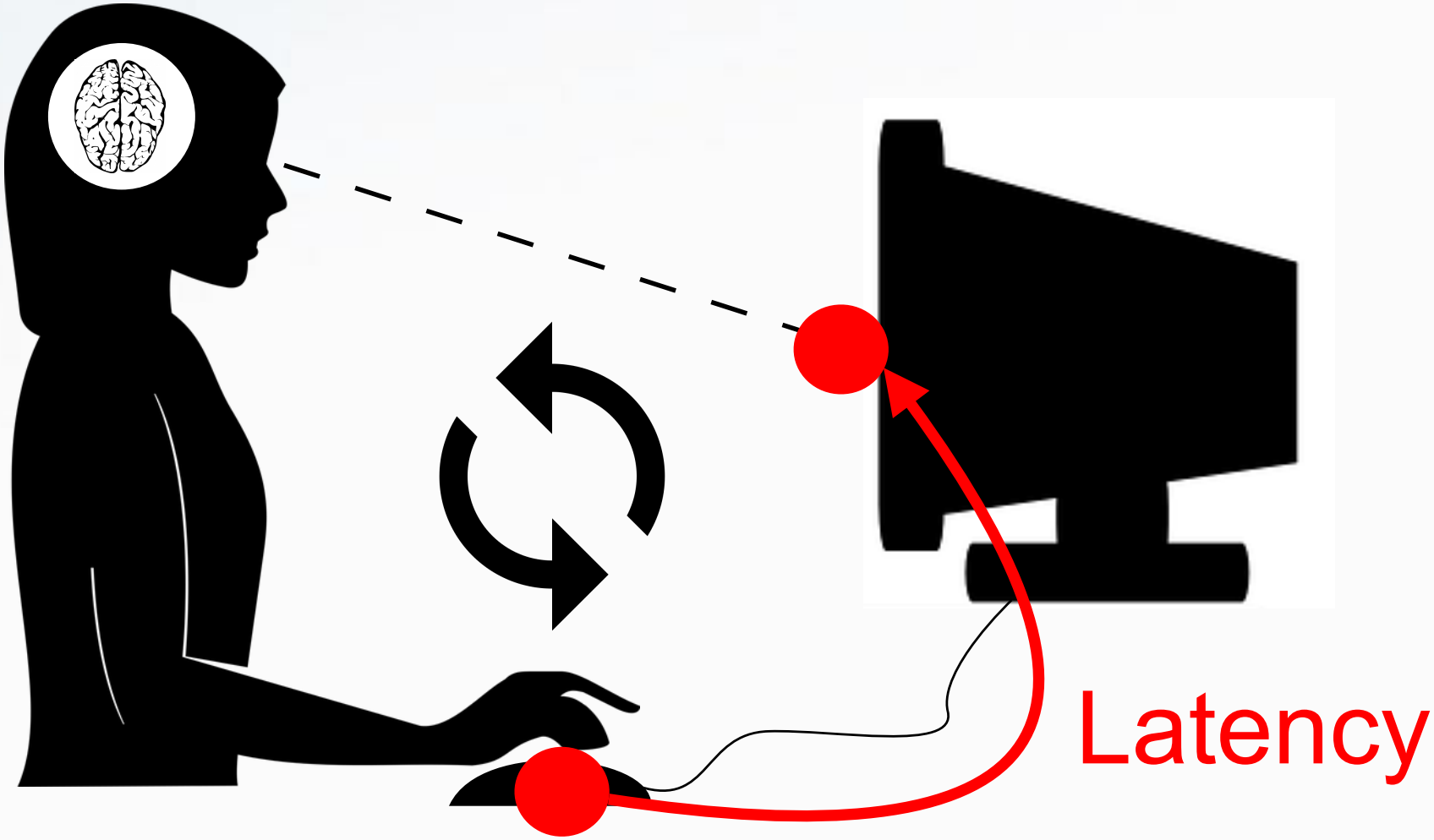
Analysis of the latency and its compensation for direct touch interaction

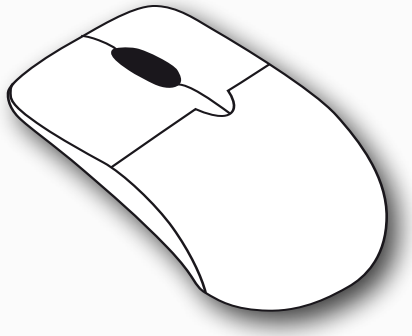
Elie Cattan

François Bérard, Amélie Rochet-Capellan, Pascal Perrier

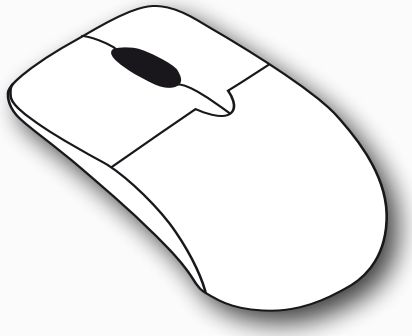



Latency

500 ms

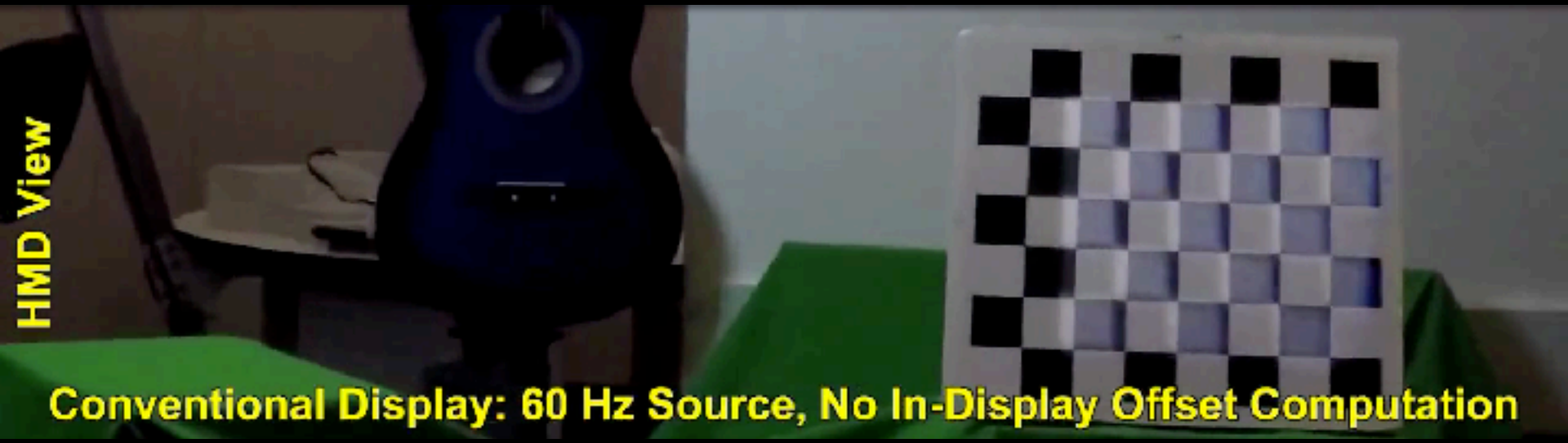


50 ms




Ng et al., 2012
“Designing for Low-Latency
Direct-Touch Input”
iPad
Footage taken at x8 speed

~75 ms



Lincoln et al., 2016

"From Motion to Photons in 80 Microseconds: Towards Minimal Latency for Virtual and Augmented Reality"

Problems due to latency

- Easily perceivable
- Has a negative influence of performances
- Has a negative influence on presence

How to handle touch latency?

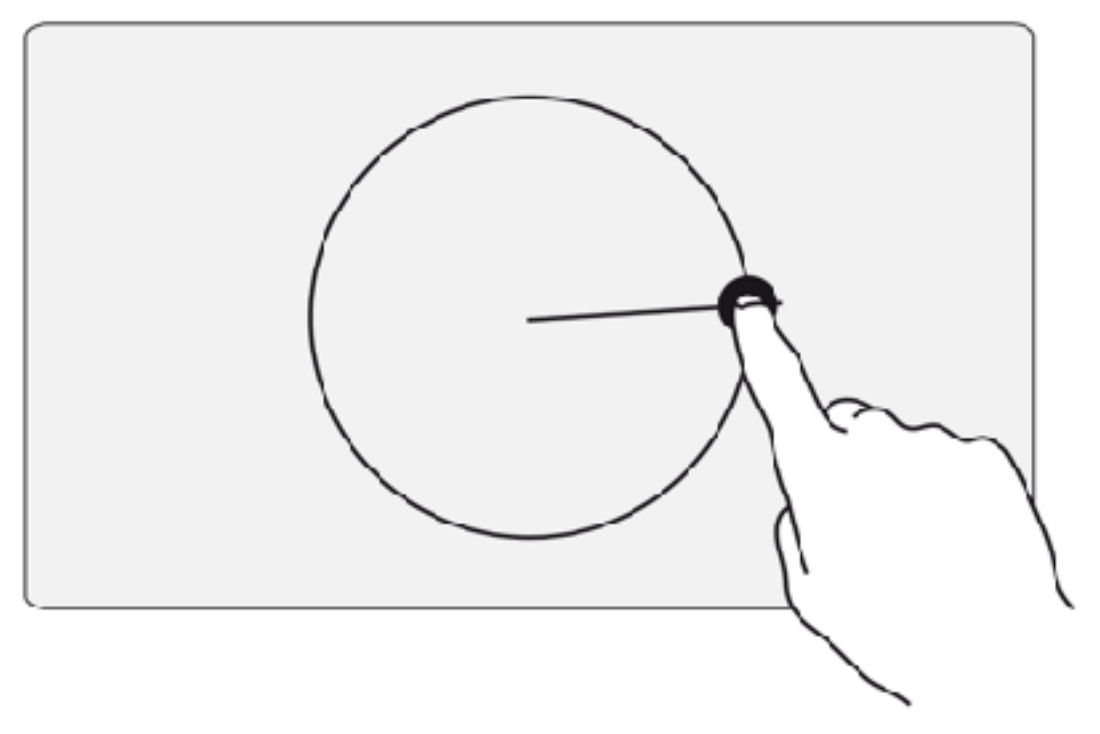
Control

Understand

Counteract

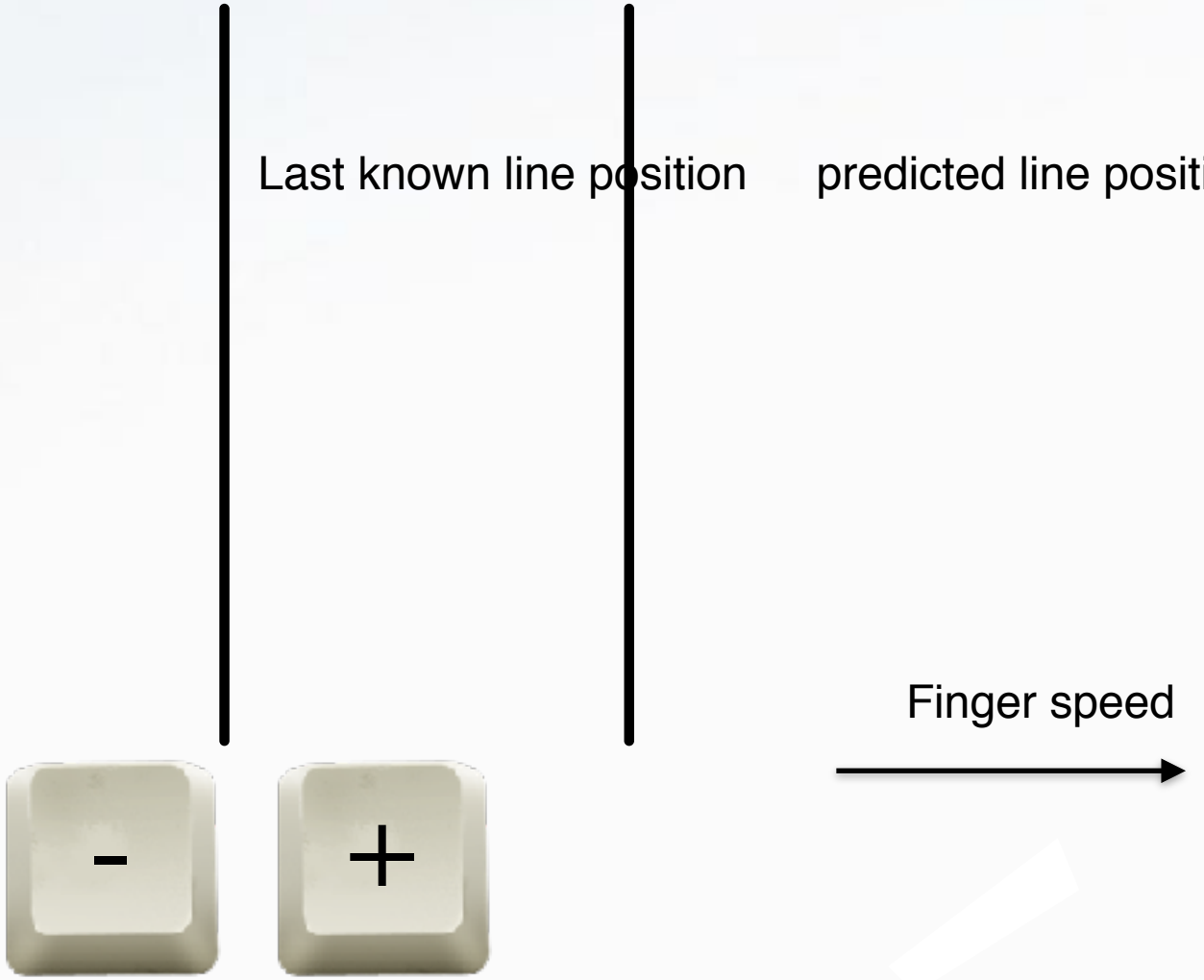
Control

Kaaresoja & Brewster 2010
"Feedback is... Late: Measuring Multimodal Delays in Mobile Device Touchscreen Interaction"



The wheel

Bérard & Blanch 2013
"Two Touch System Latency Estimators: High Accuracy and Low Overhead"


Last known line position
predicted line position
Finger speed
-
+

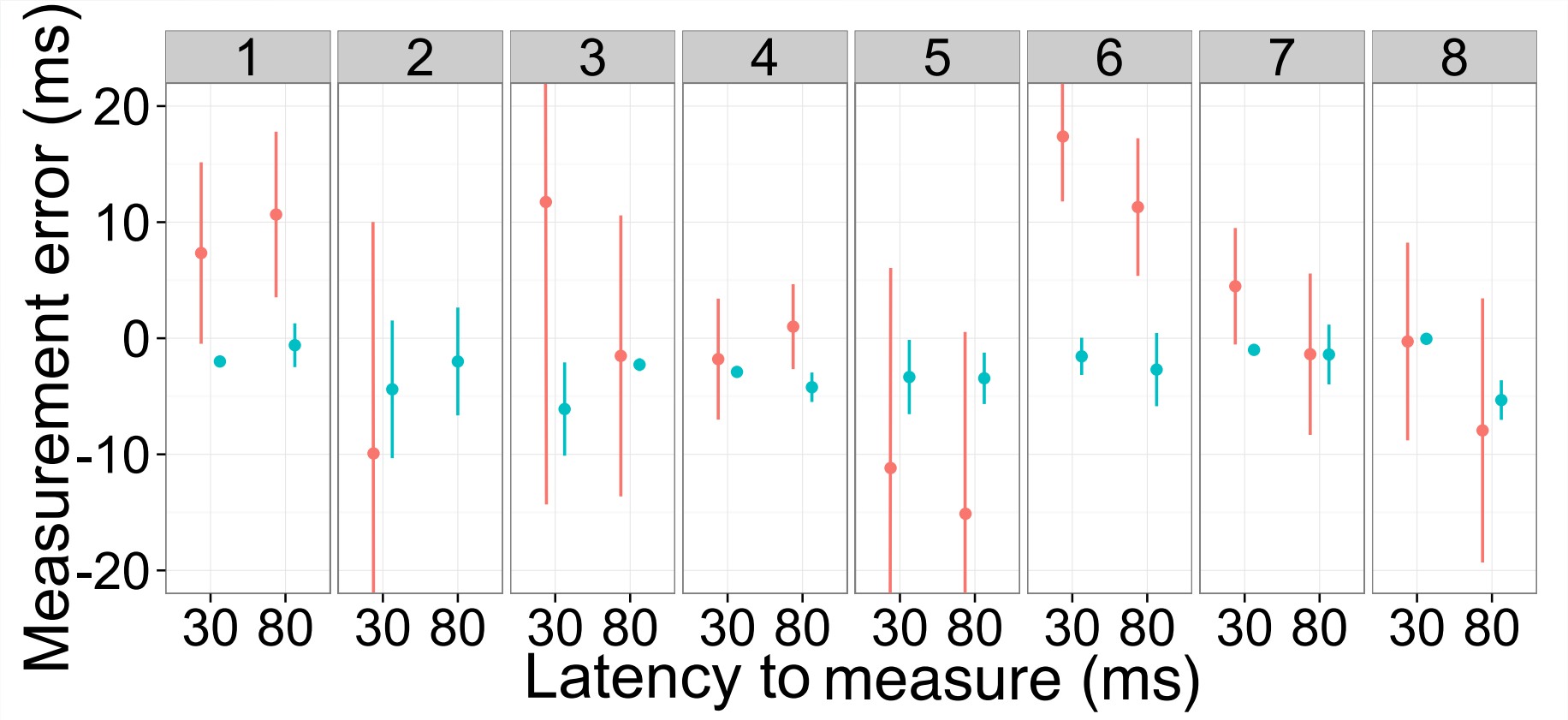
Prediction = 0ms

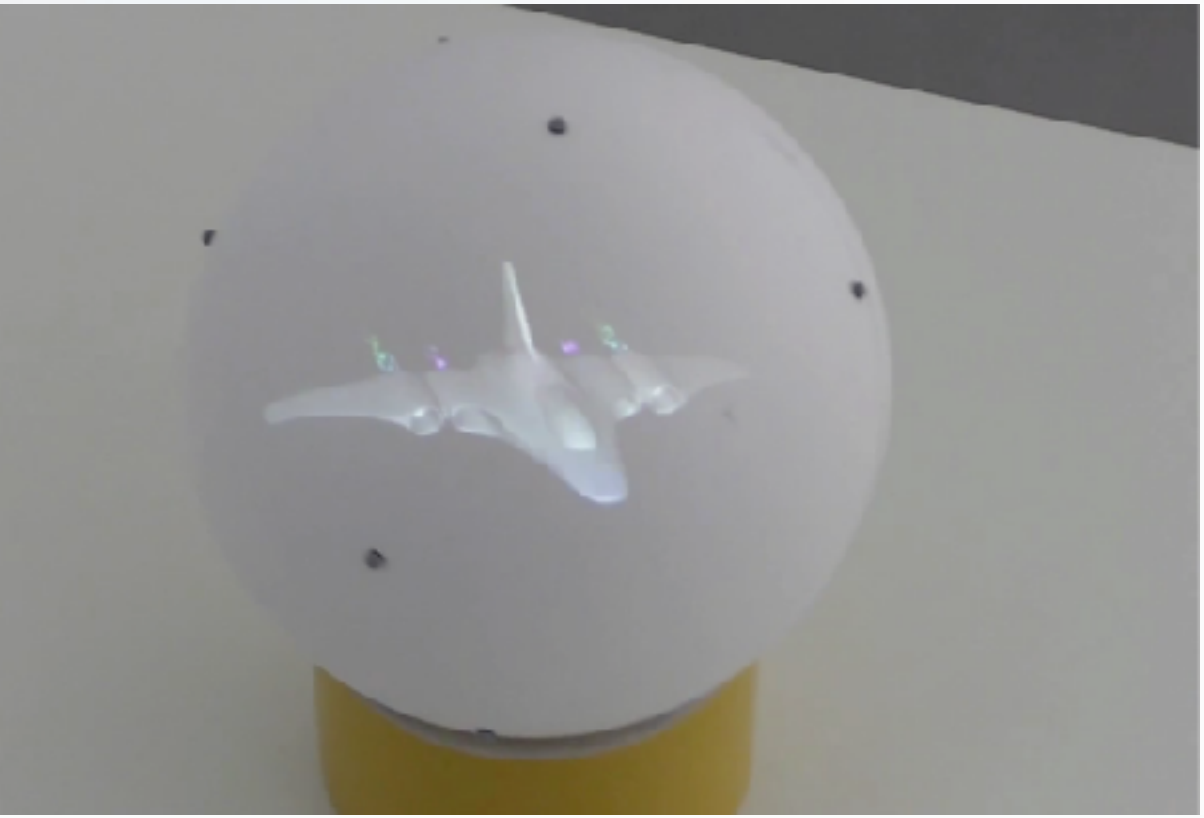
Prediction = 50ms

Prediction = 100ms

Prediction = 80ms

Our predictive technique Wheel technique





Bérard et al. 2017
"The Object Inside: Assessing 3D Examination with a Spherical Handheld Perspective-Corrected Display"

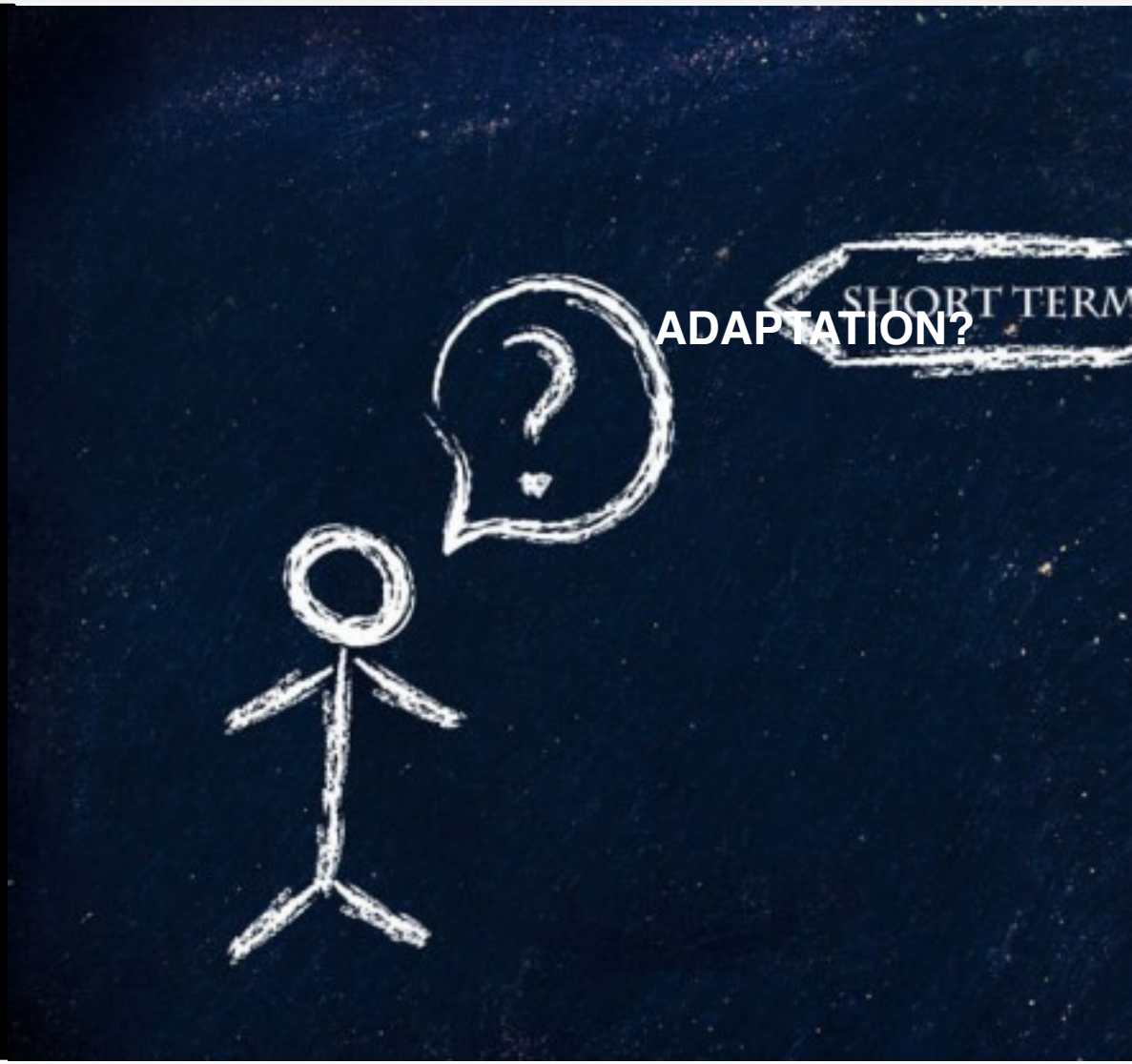
Understand

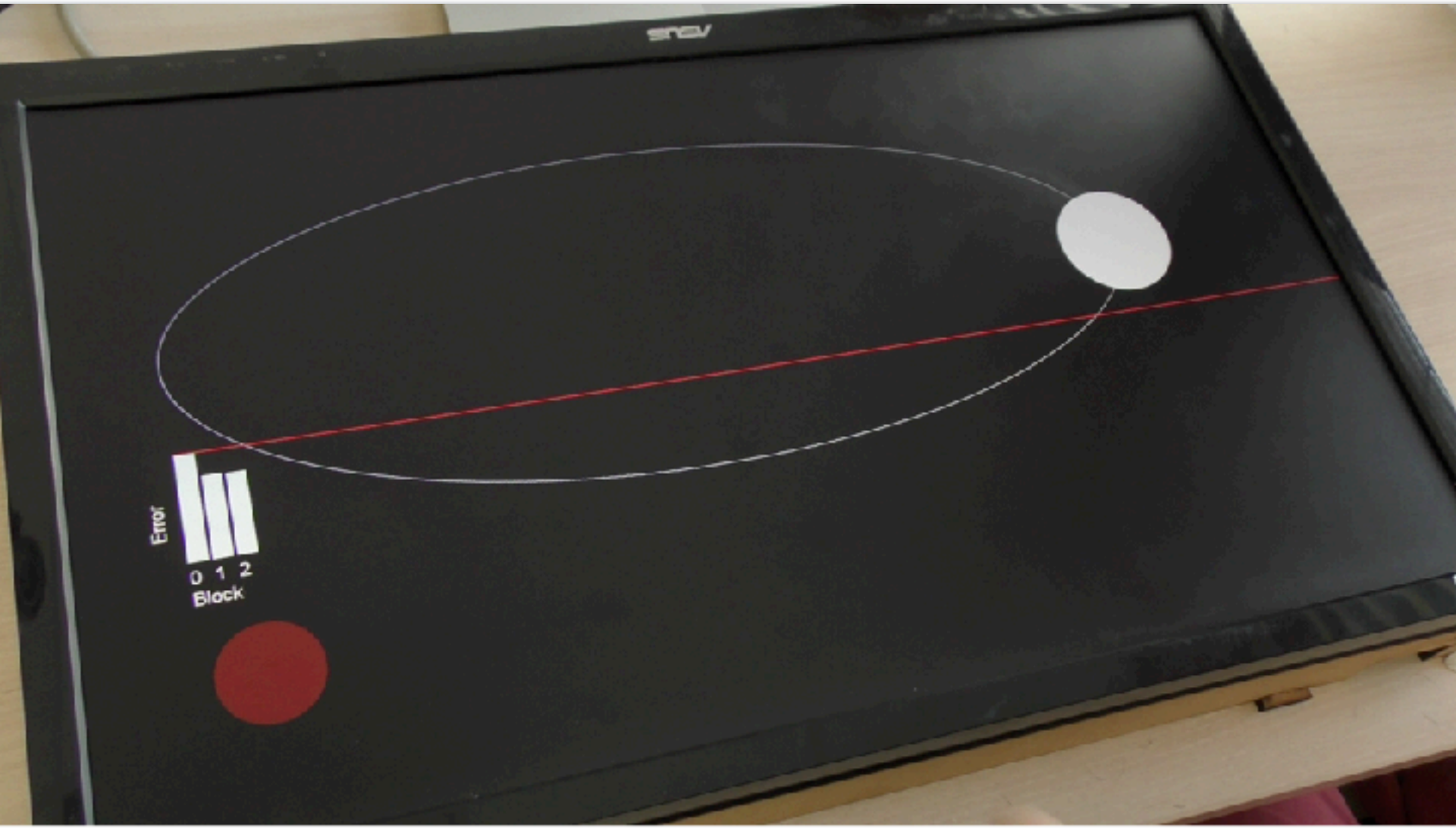
Users' performance

Jota et al. 2013
"How Fast is Fast Enough? A Study of the Effects of Latency in Direct-Touch Pointing Tasks"

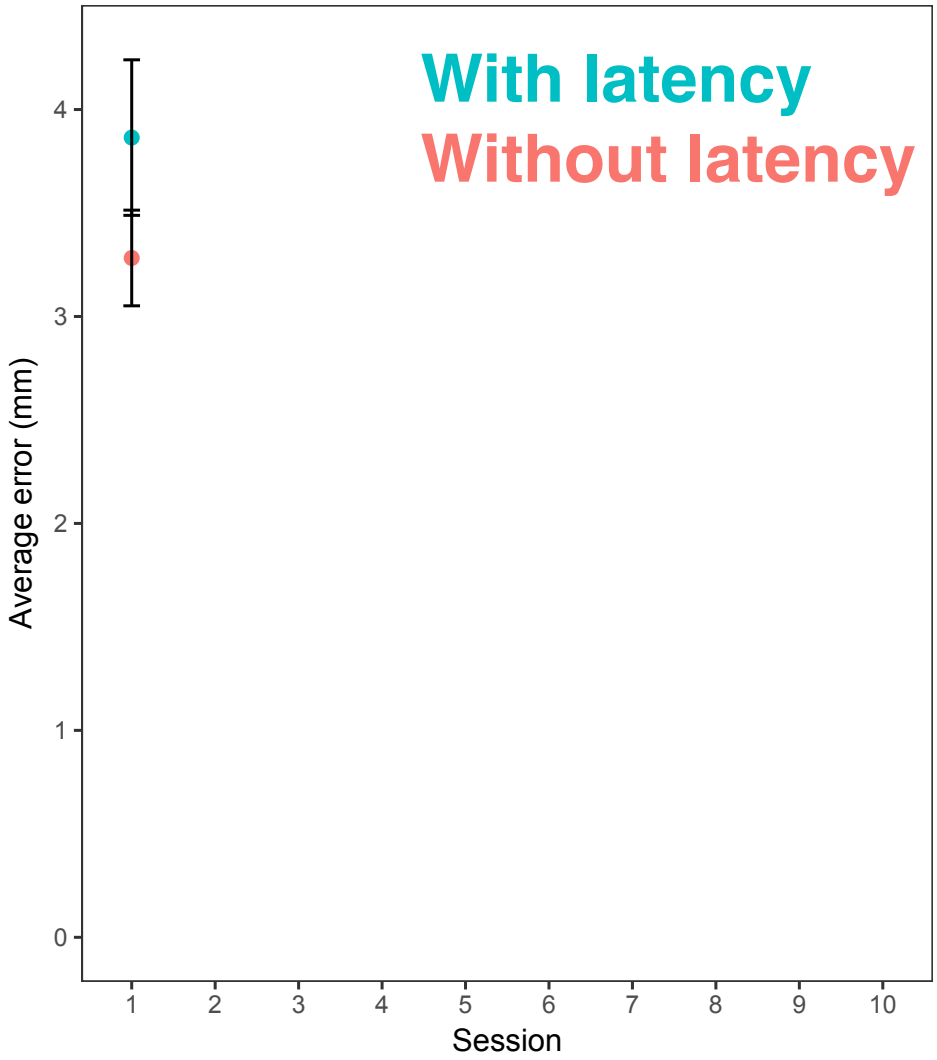
Cattan et al. 2015
"Reducing Latency with a Continuous Prediction: Effects on Users' Performance in Direct-Touch Target Acquisitions"

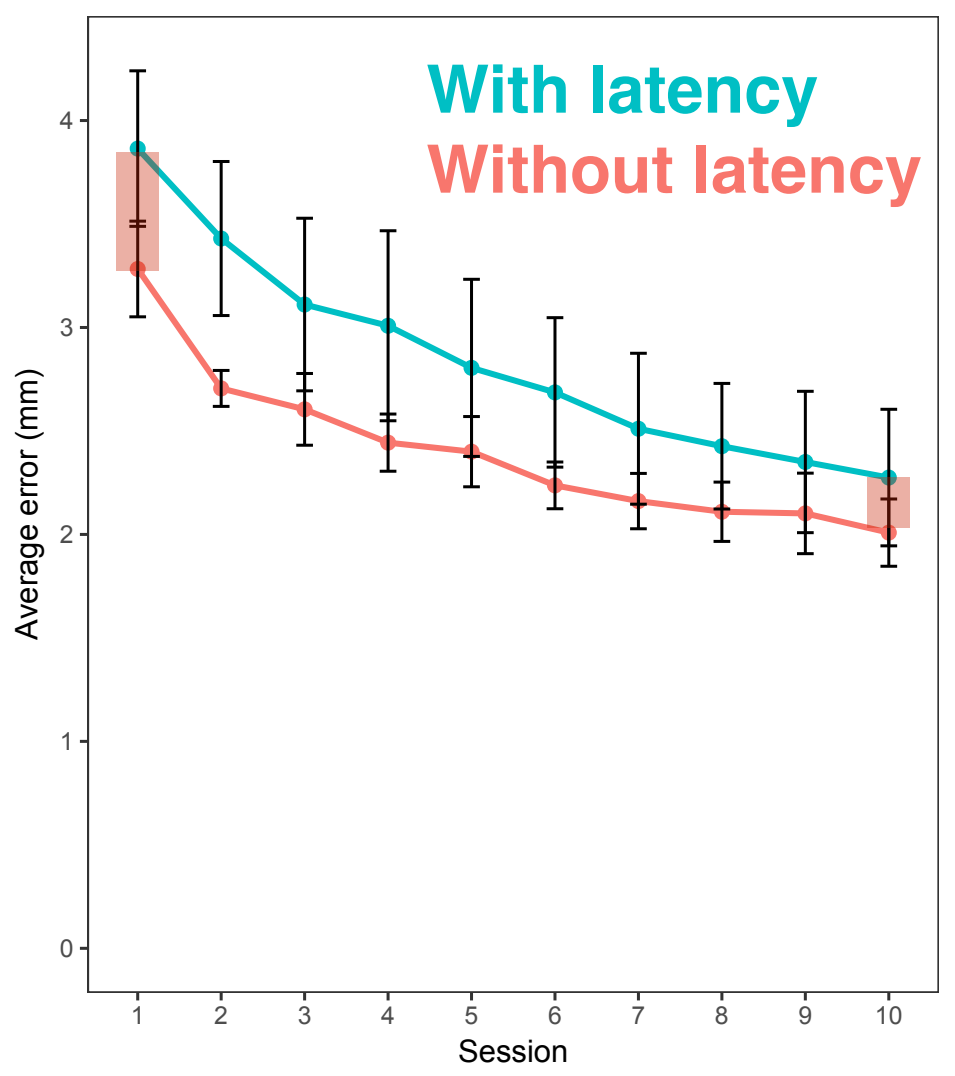
Cattan et al. 2016
"Effect of Touch Latency on Elementary vs. Bimanual Composite Tasks"


SHORT TERM
ADAPTATION?


Error
0 1 2
Block

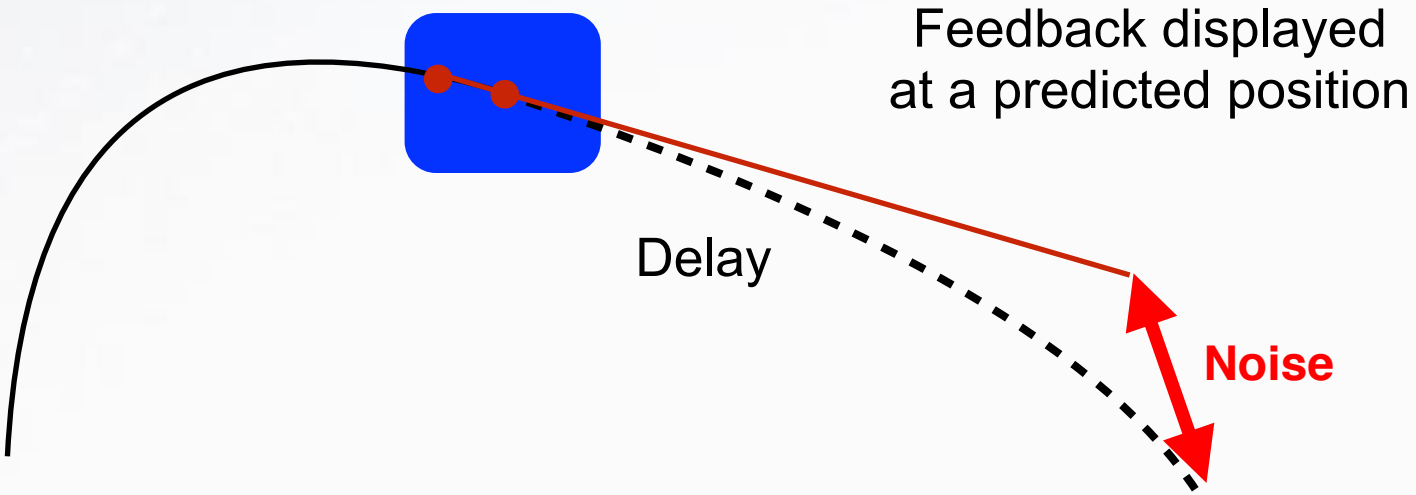
Latency vs. No latency


With latency
Without latency
Average error (mm)
0
1
2
3
4
1
2
3
4
5
6
7
8
9
10
Session


With latency
Without latency
Average error (mm)
0
1
2
3
4
1
2
3
4
5
6
7
8
9
10
Session

Counteract

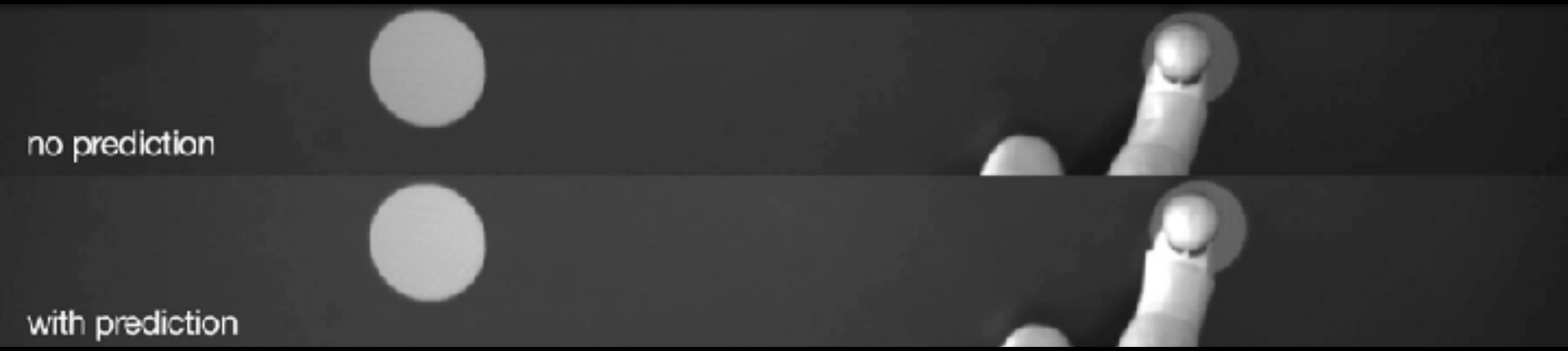
Two data points



Users' performance on pointing tasks
with X ms of latency corrected by X ms of prediction

OK, if prediction length ≤ 25 ms

25 ms latency



1/35th speed

We proposed solutions to

Control

New measurement technique

Understand

Users can adapt to the latency

Counteract

Prediction technique to compensate

List of publications:

Cattan, E., Rochet-Capellan, A., Perrier, P., & Bérard, F. (2015, November). Reducing latency with a continuous prediction: Effects on users' performance in direct-touch target acquisitions. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces* (pp. 205-214). ACM.

Cattan, E., Rochet-Capellan, A., & Bérard, F. (2015, November). A predictive approach for an end-to-end touch-latency measurement. In *Proceedings of the 2015 International Conference on Interactive Tabletops & Surfaces* (pp. 215-218). ACM.

Cattan, E., Rochet-Capellan, A., & Bérard, F. (2016, November). Effect of Touch Latency on Elementary vs. Bimanual Composite Tasks. In *Proceedings of the 2016 ACM on Interactive Surfaces and Spaces* (pp. 103-108). ACM.

Cattan, E., Rochet-Capellan, A., Perrier, P., & Bérard, F. (2017, May). Does Practice Make Perfect?. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 5619-5629). ACM.