

DodecaPen

Accurate 6DoF Tracking of a Passive Stylus

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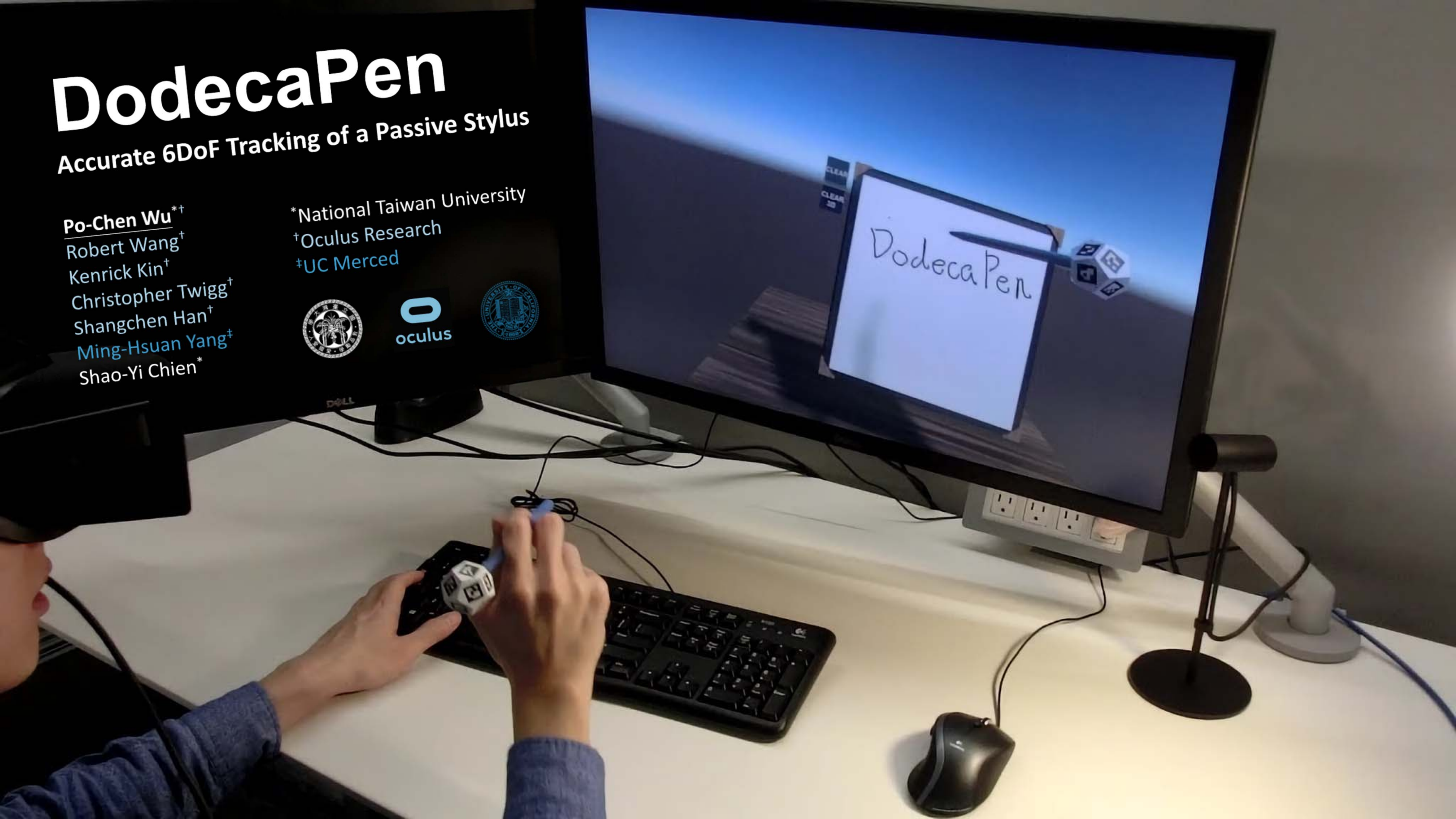
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What's This
Glove?



Oh...





Passive Stylus

- Thick pen-tip

Active Stylus

- Need recharging



Ideal Stylus?



Passive
+
Accurate

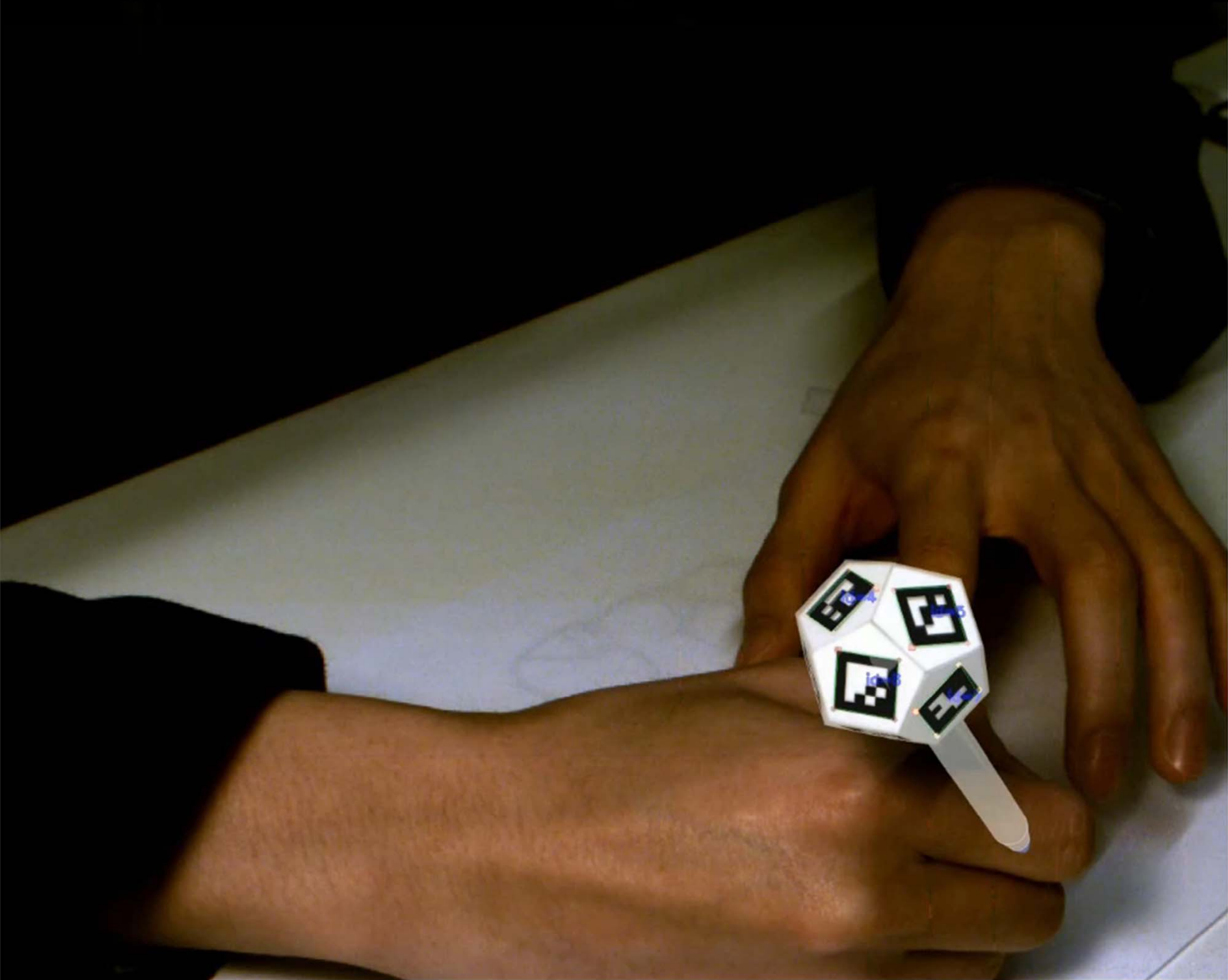
DodecaPen

Dodecahedron + Pen

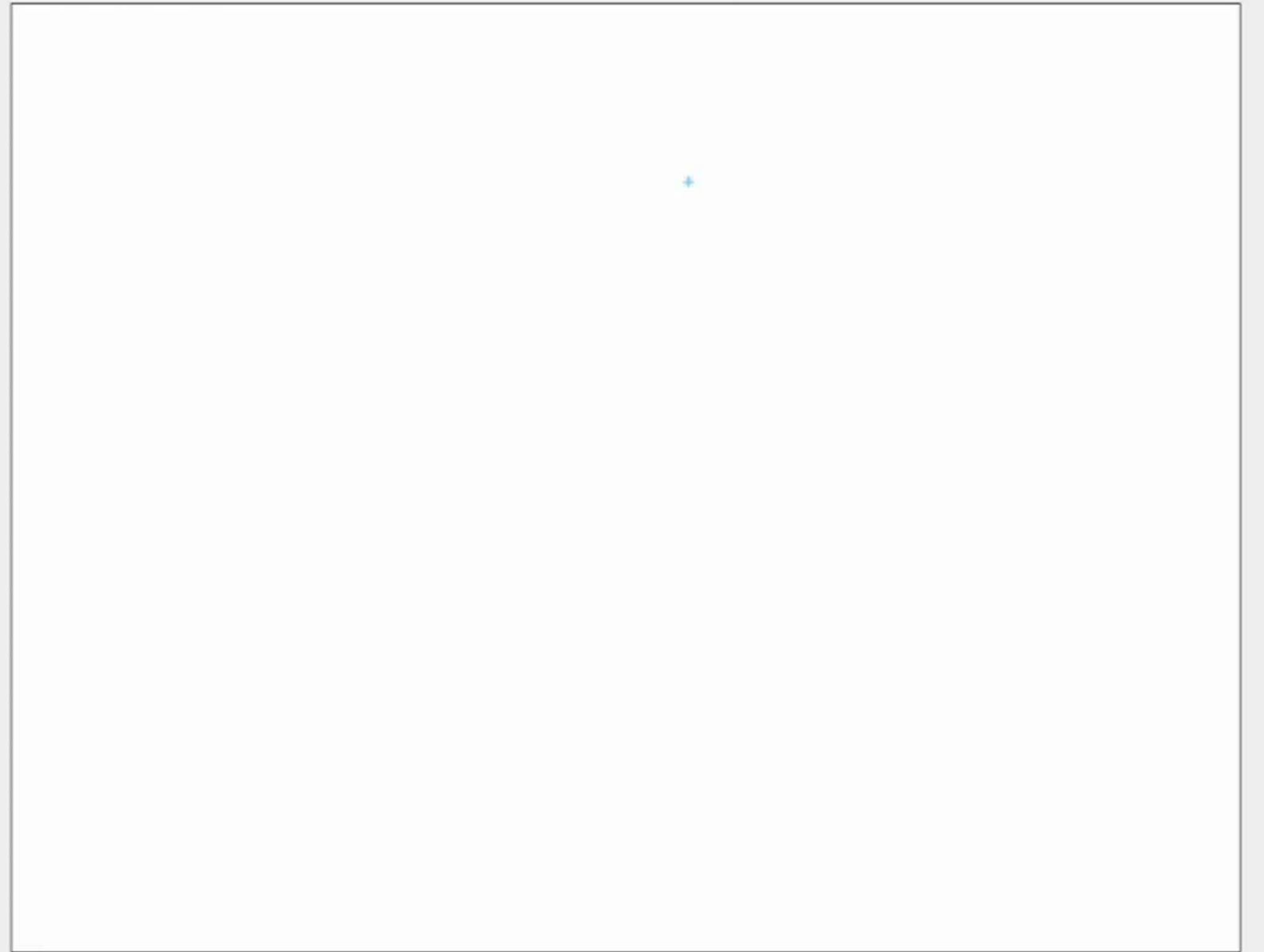
6DoF Tracking



DodecaPen: Puppy

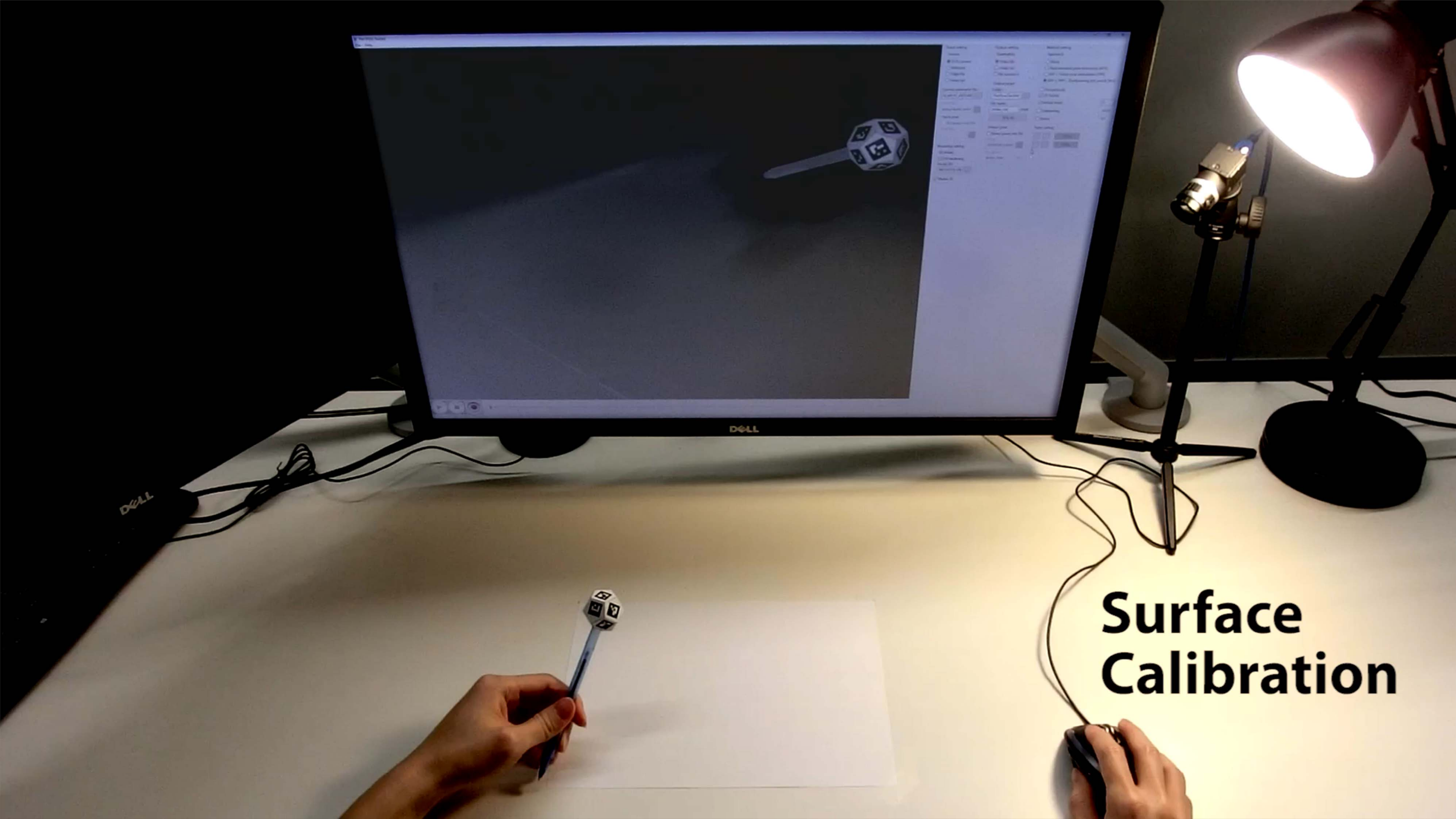


Input Frames

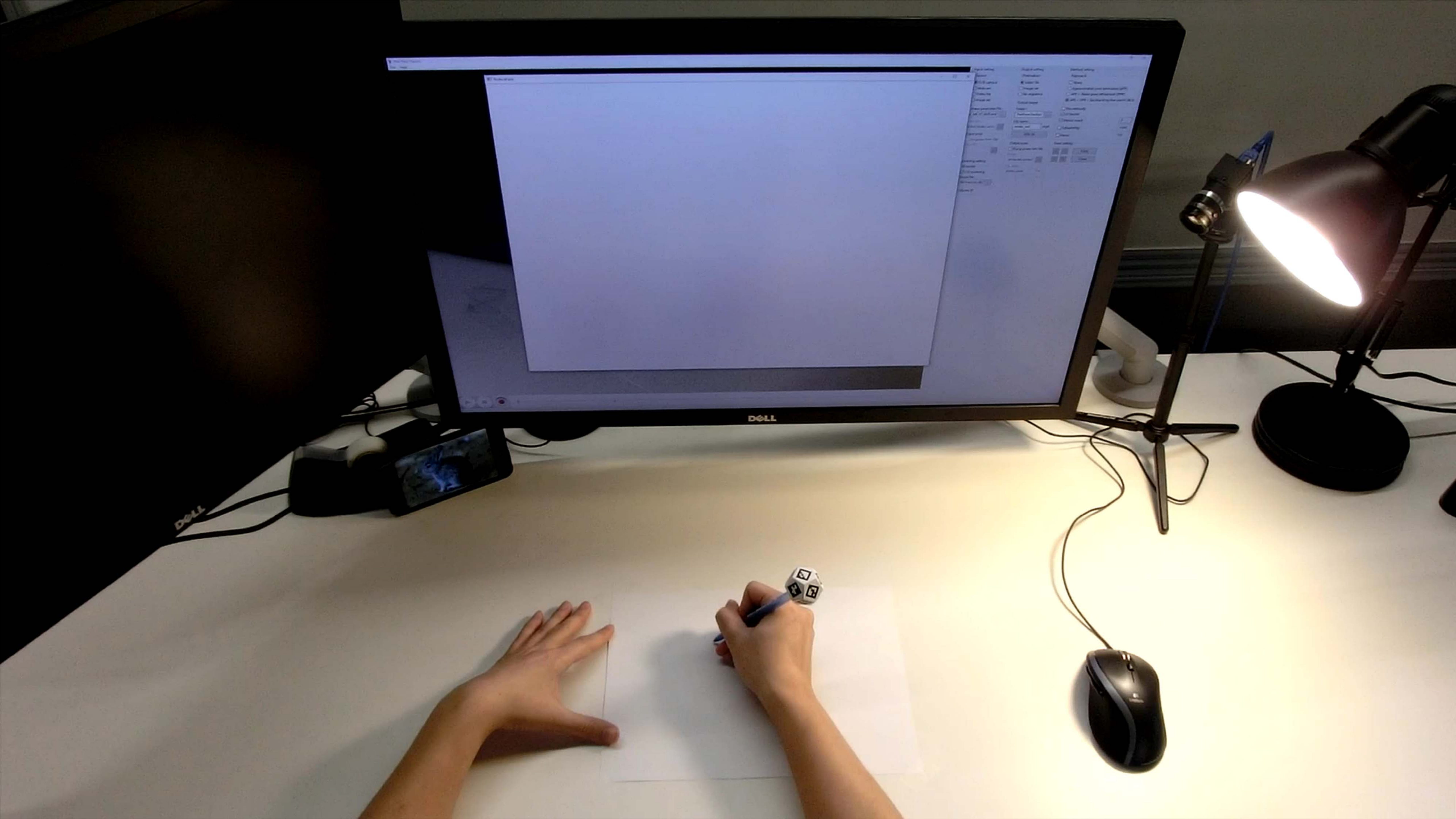


Pen-tip Trajectory

How To Use?



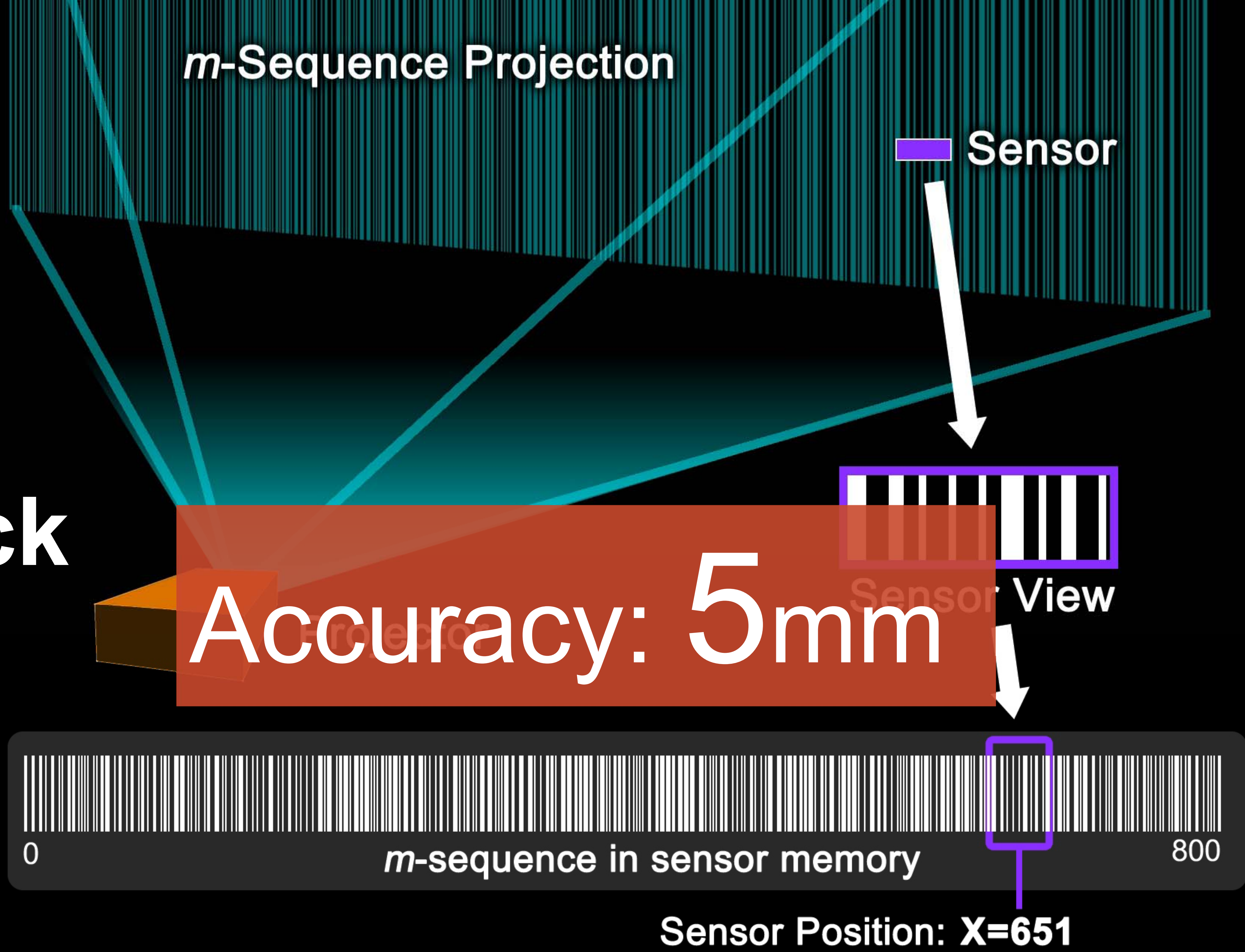
**Surface
Calibration**



Related Work

Lumitrack

(UIST 2013)



IrPen (CGA 2014)

Accuracy: 10mm

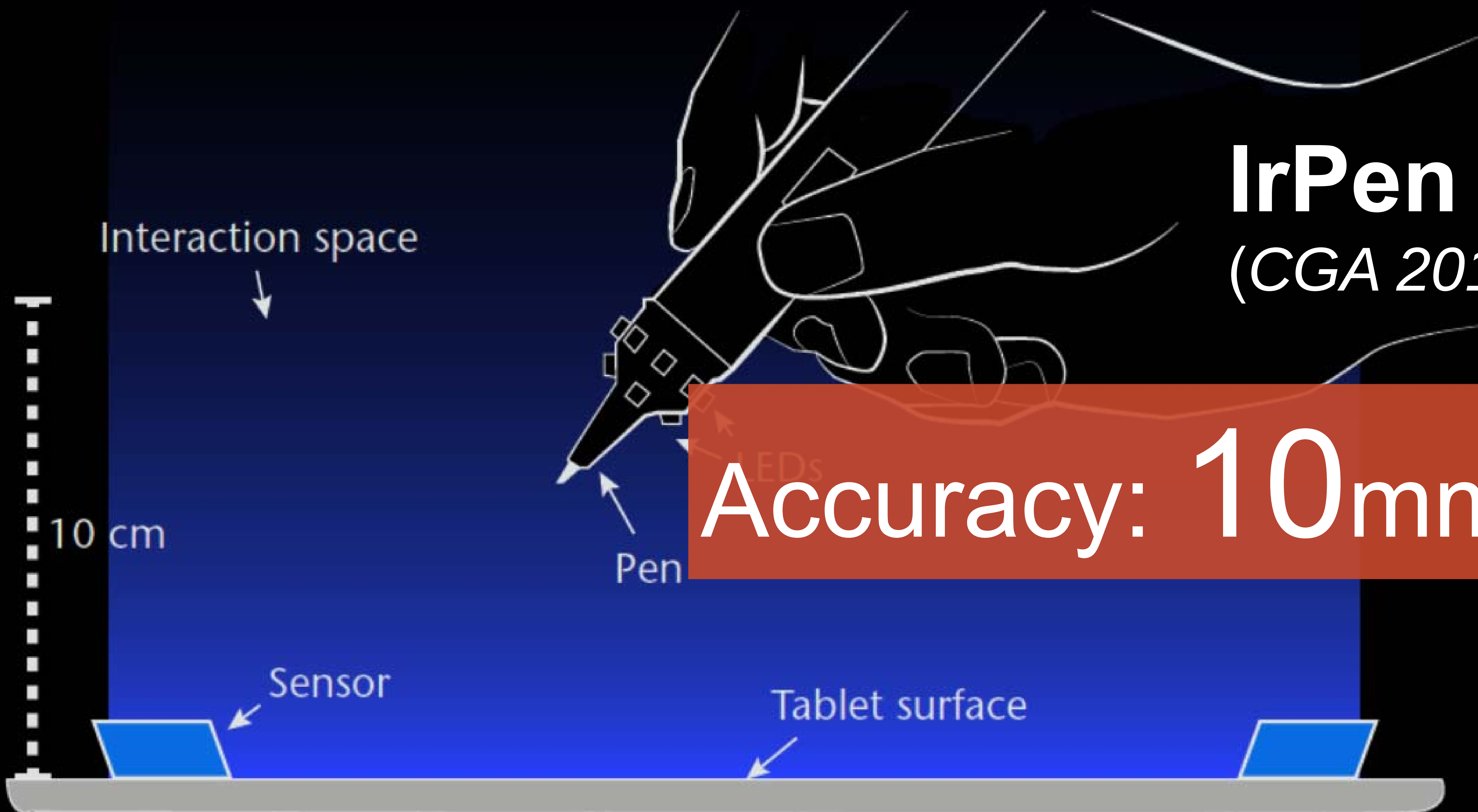
Interaction space

10 cm

Sensor

Pen

Tablet surface

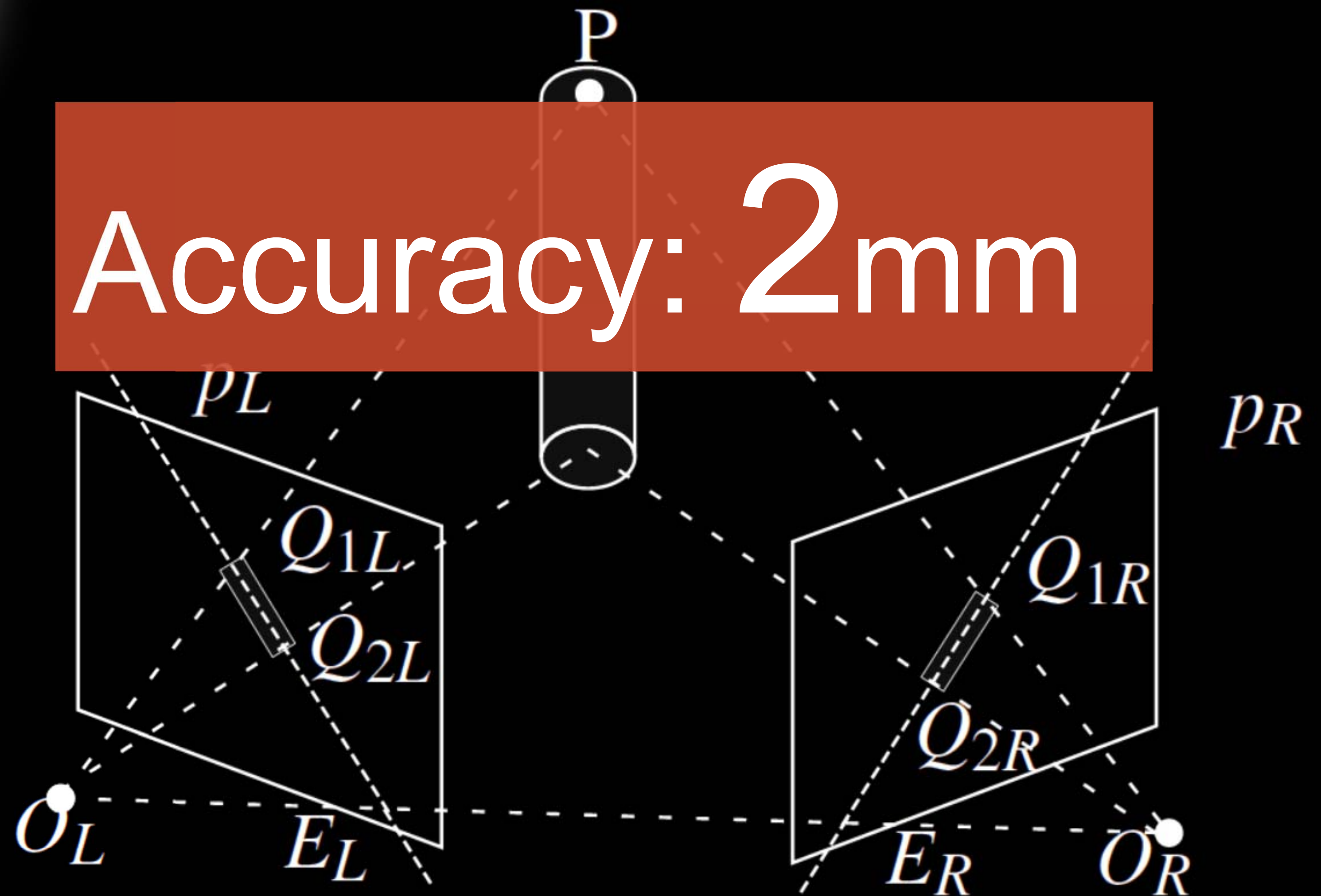


Light Chisel

(PG 2015)



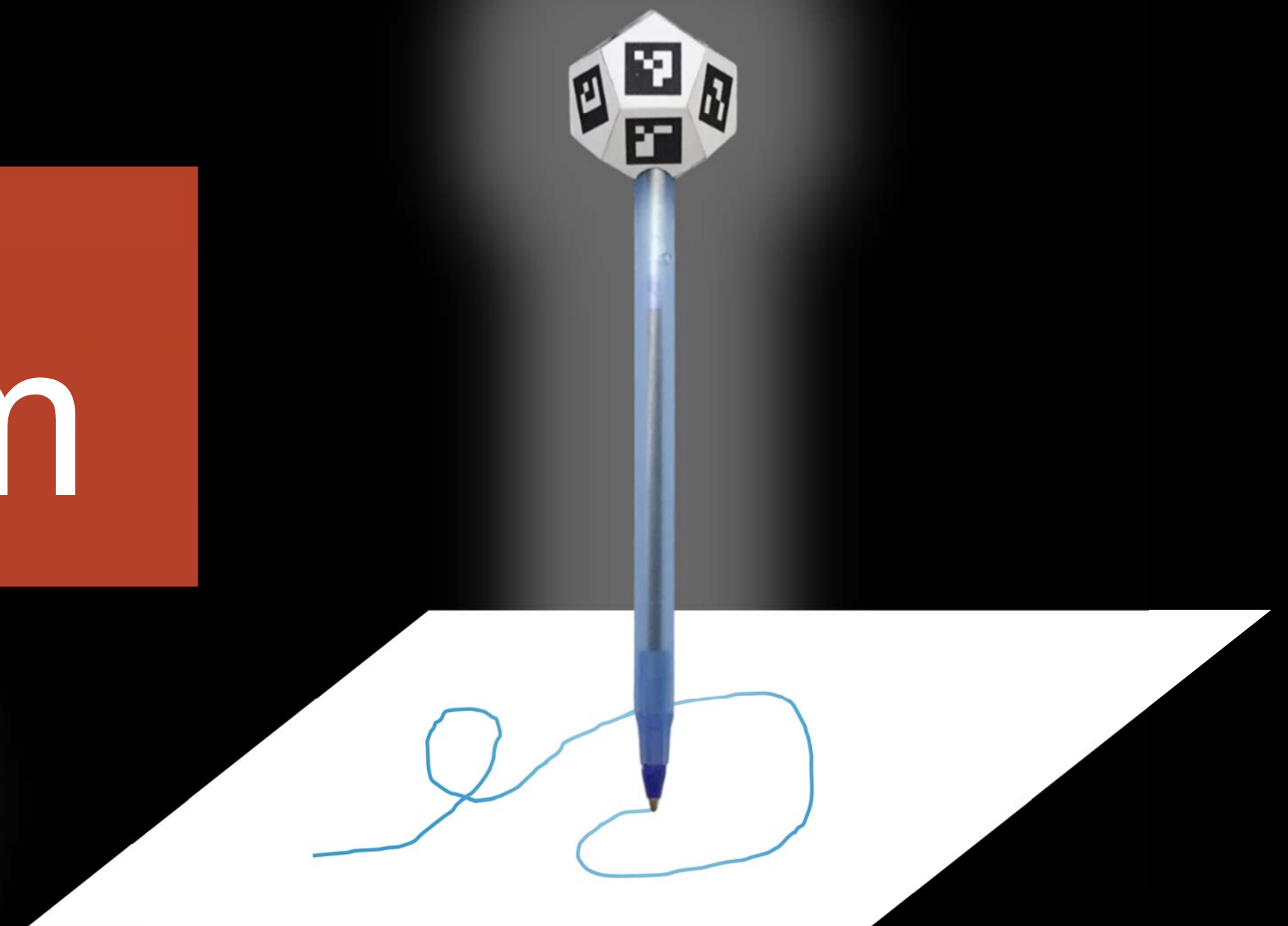
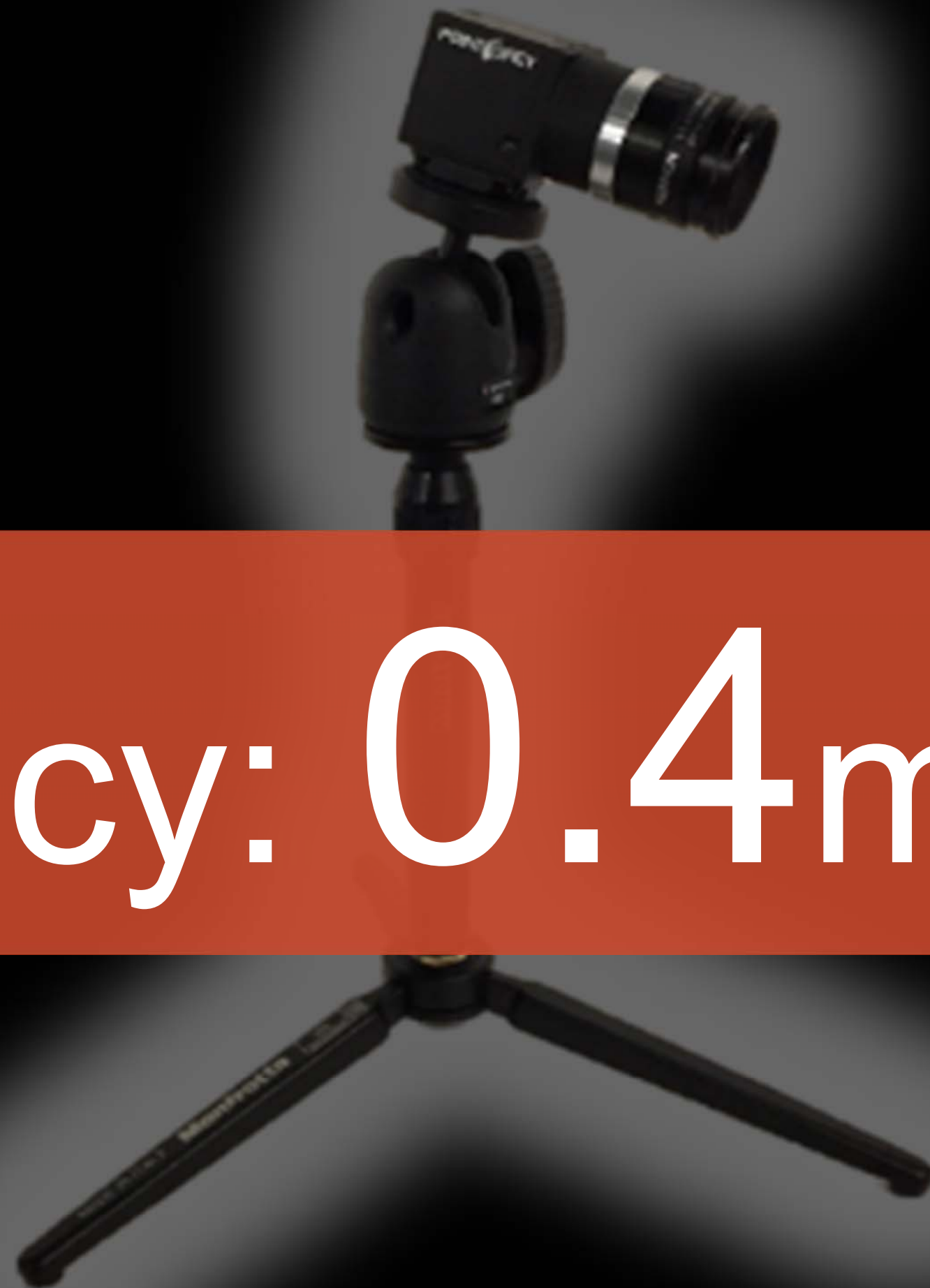
Accuracy: 2mm



DodecaPen

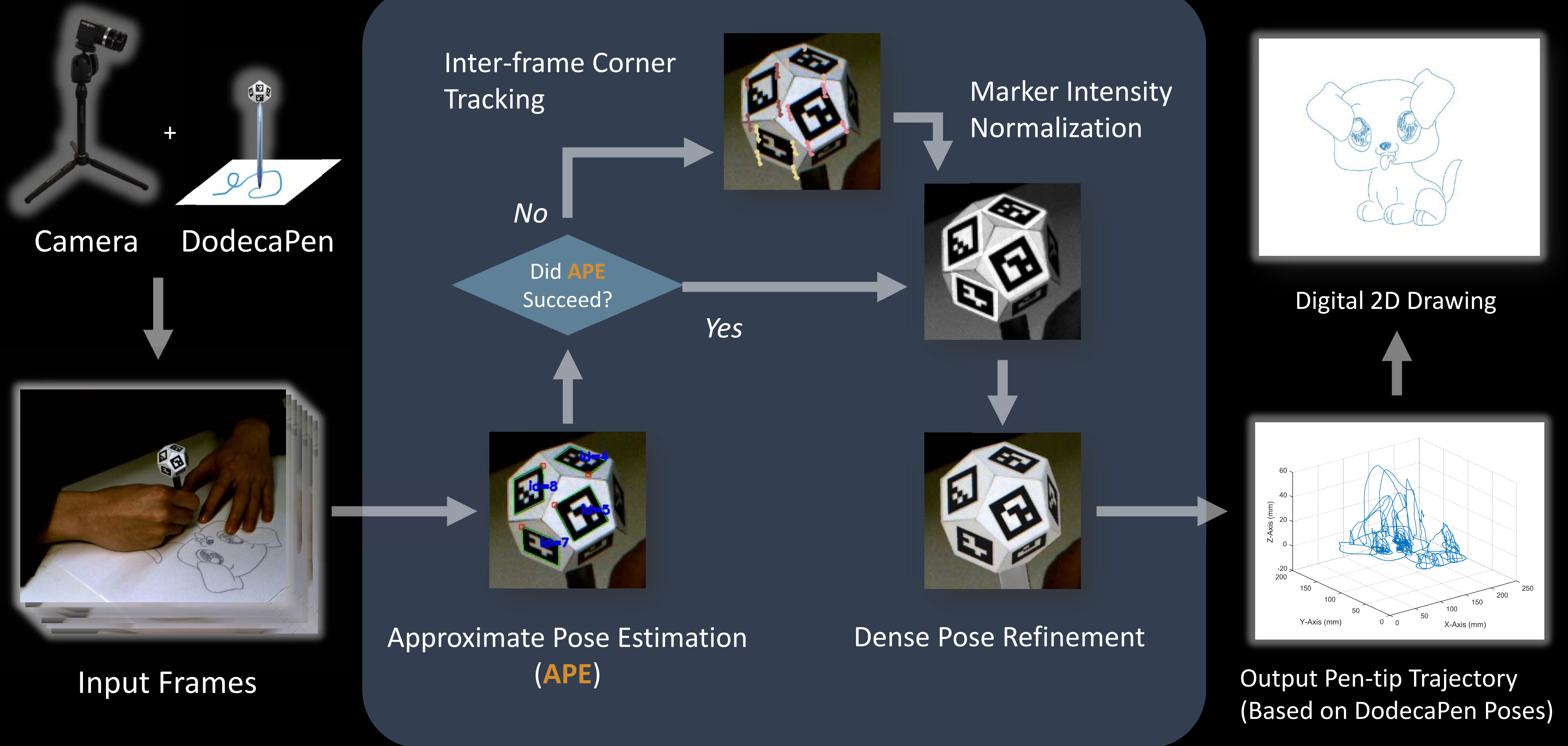
(Proposed)

Accuracy: 0.4mm

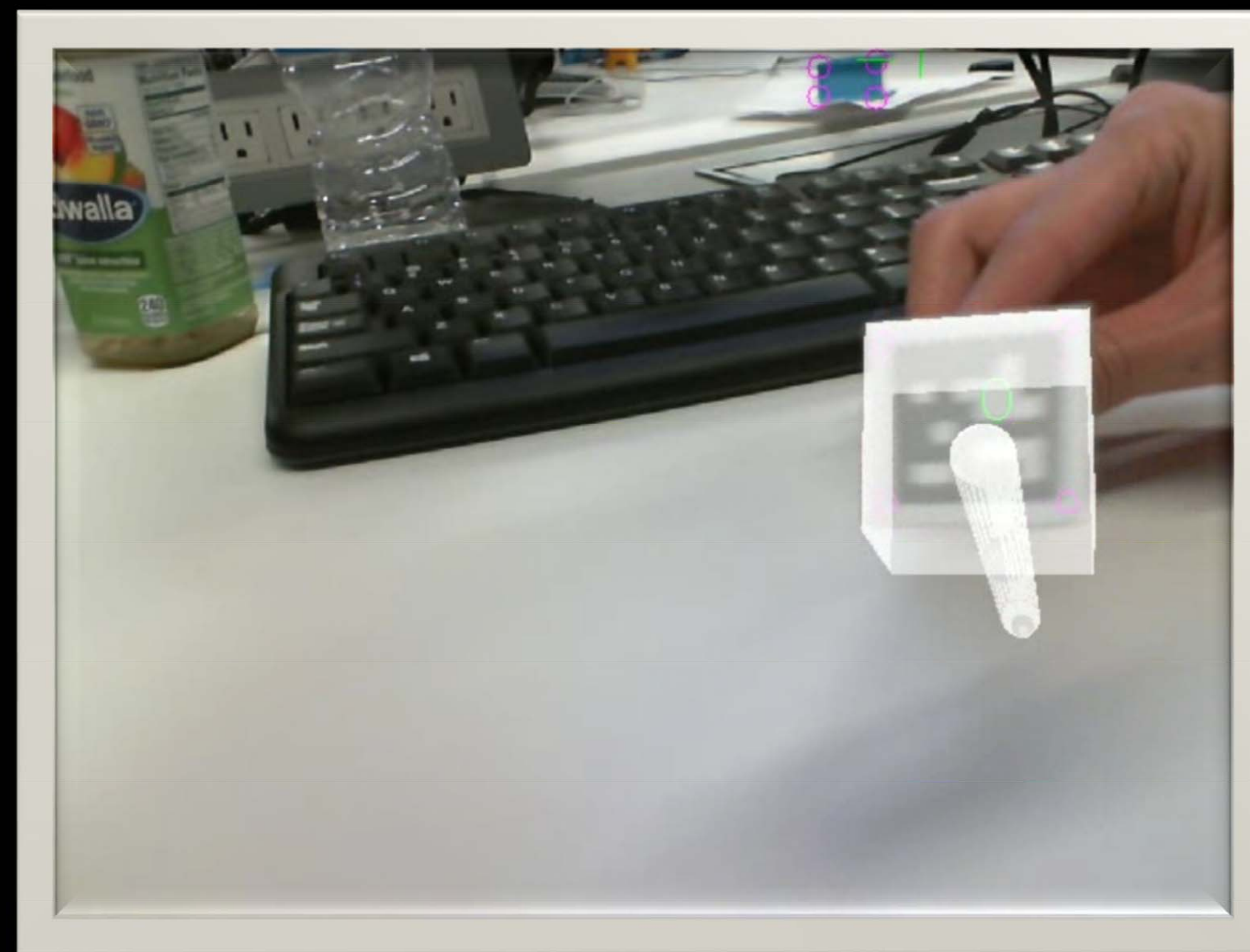


How To Implement?

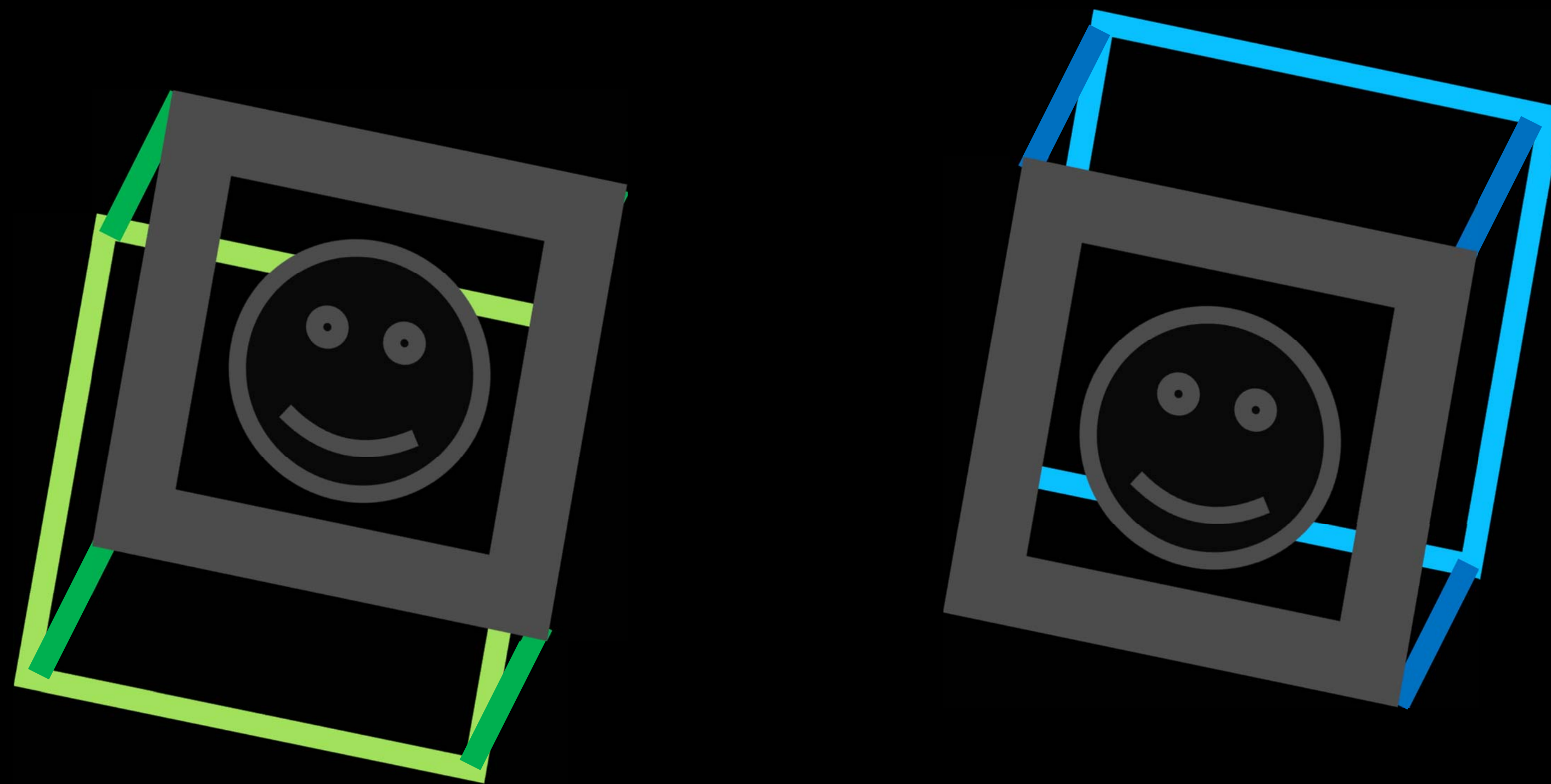
Proposed 6DoF Pose Tracking System



Why Dodecahedron?



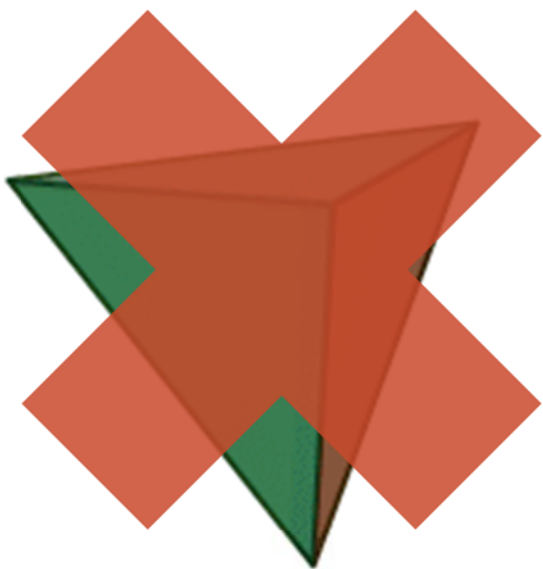
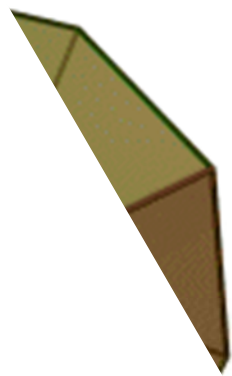
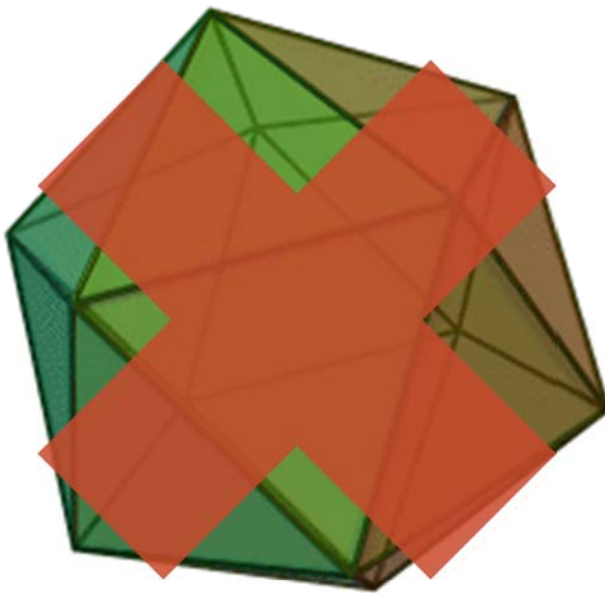
Pose Jumping!



Multiple Candidates due to Coplanar Points

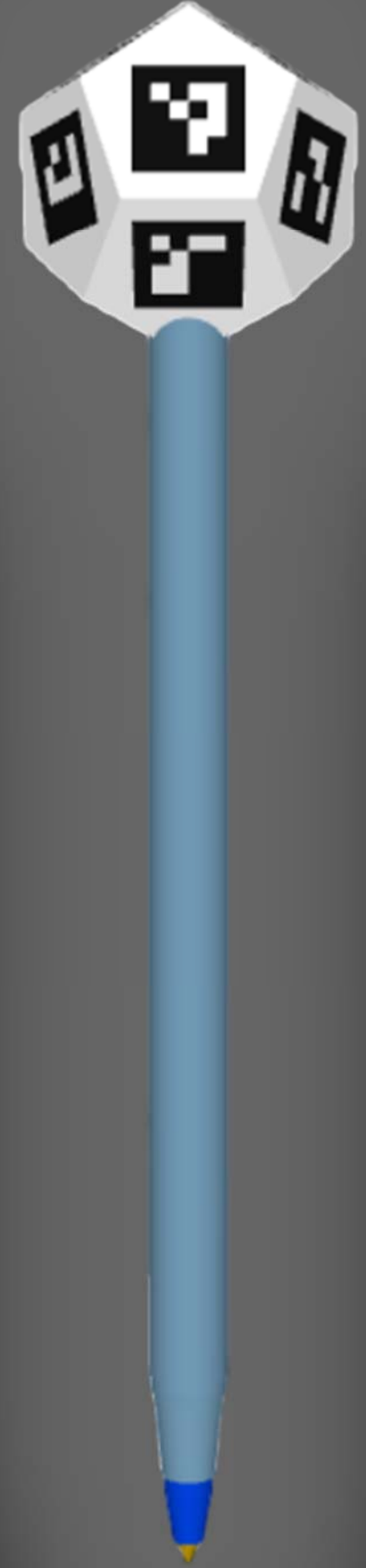
Platonic Solid

A Regular Polyhedron

Tetrahedron	Cube	Dodecahedron	Icosahedron
Four faces	Six faces	Twelve faces	Twenty faces
			



The Chosen One



Ideal $\leftrightarrow$ Real





Fail





Dodecahedron Calibration



Pen-tip Calibration



6 DoF Pose Tracking

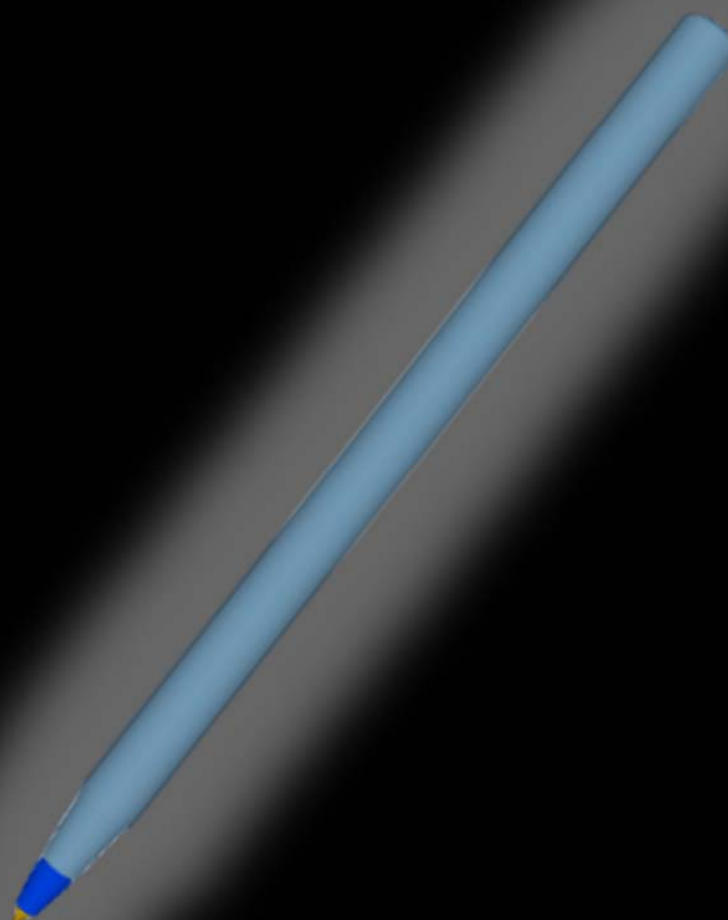




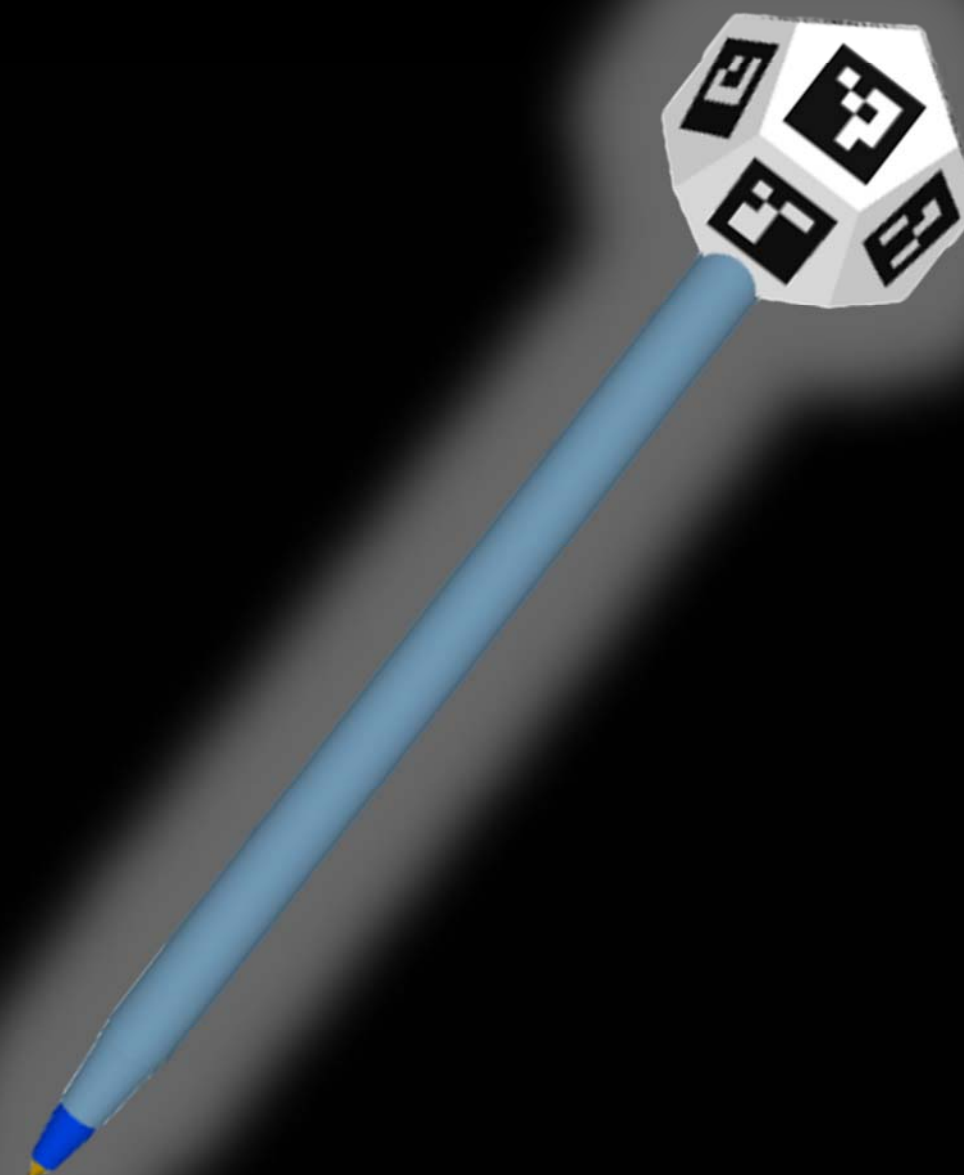




+



=



+



= ?



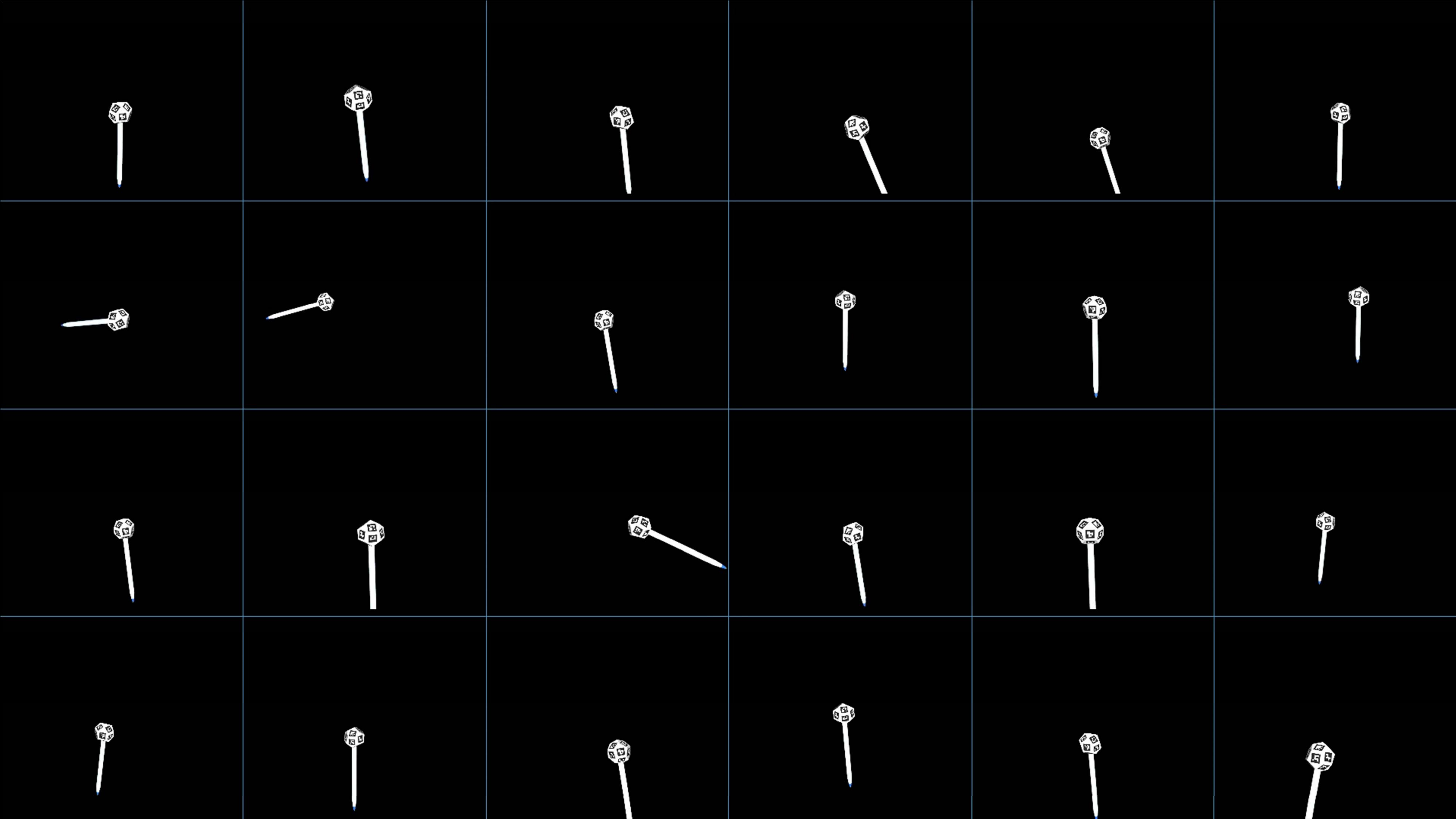


Performance Analysis

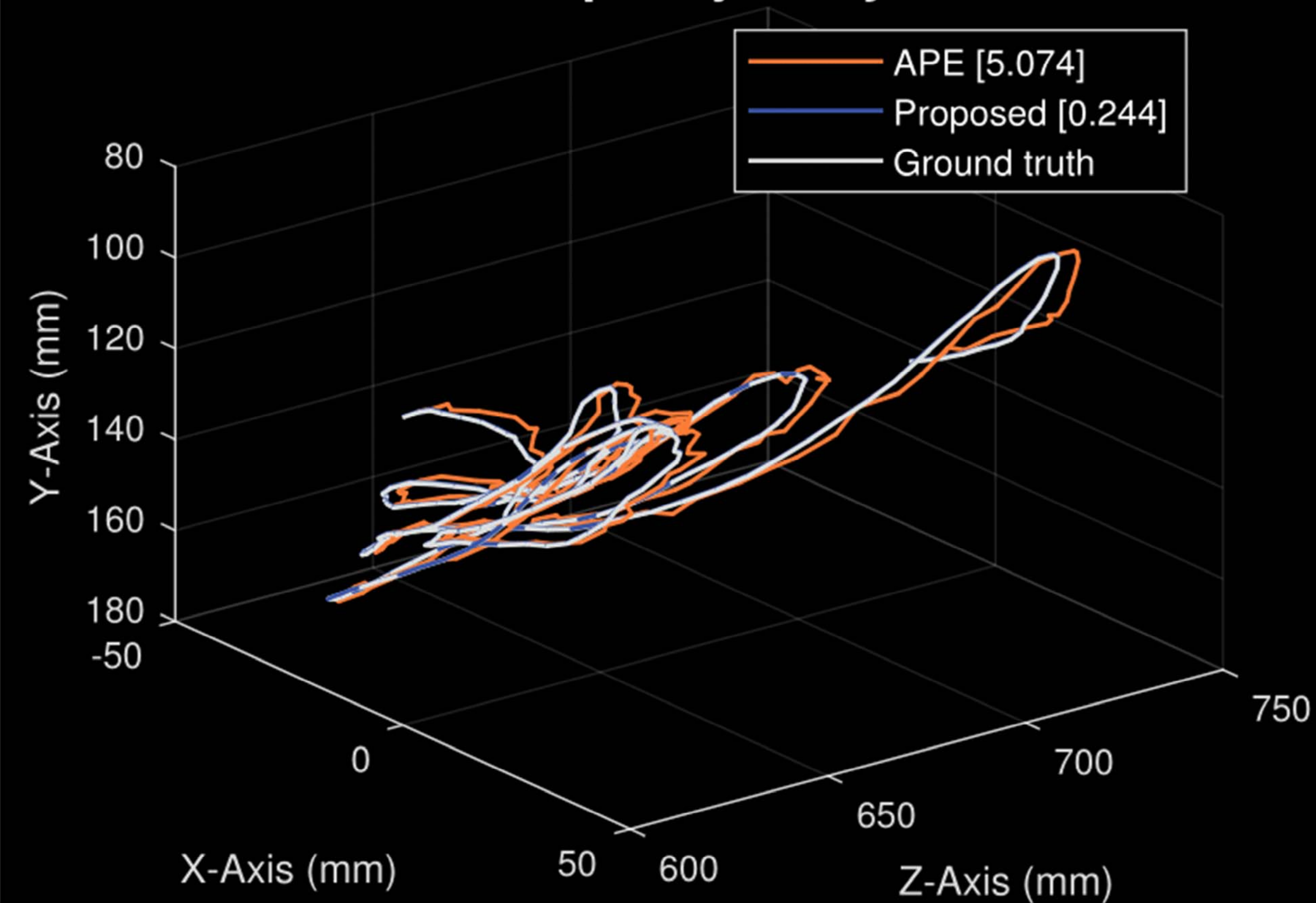
Evaluation with Synthetic Data

24 Motion Patterns

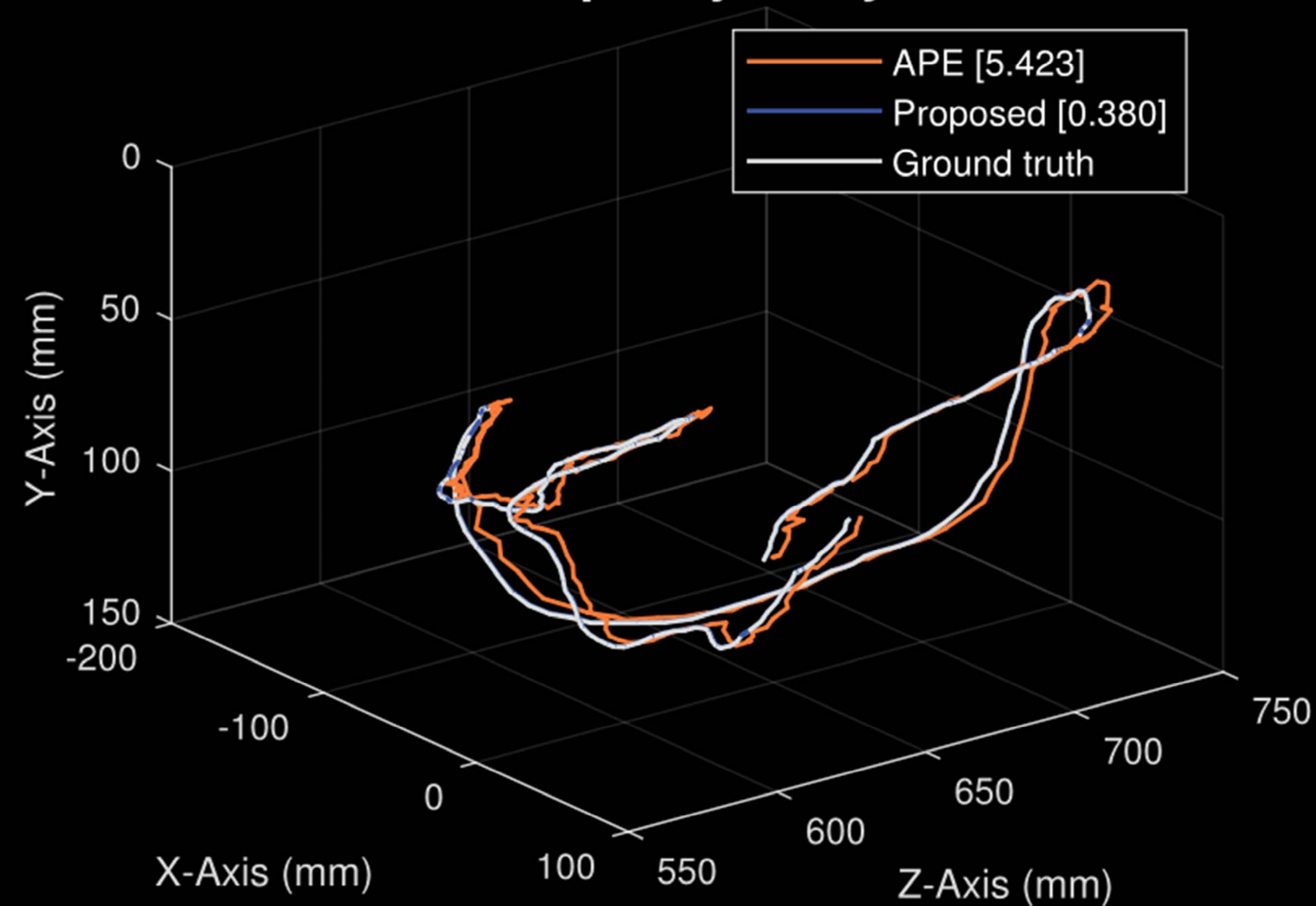
4 Varying Conditions



Pen-tip Trajectory 01

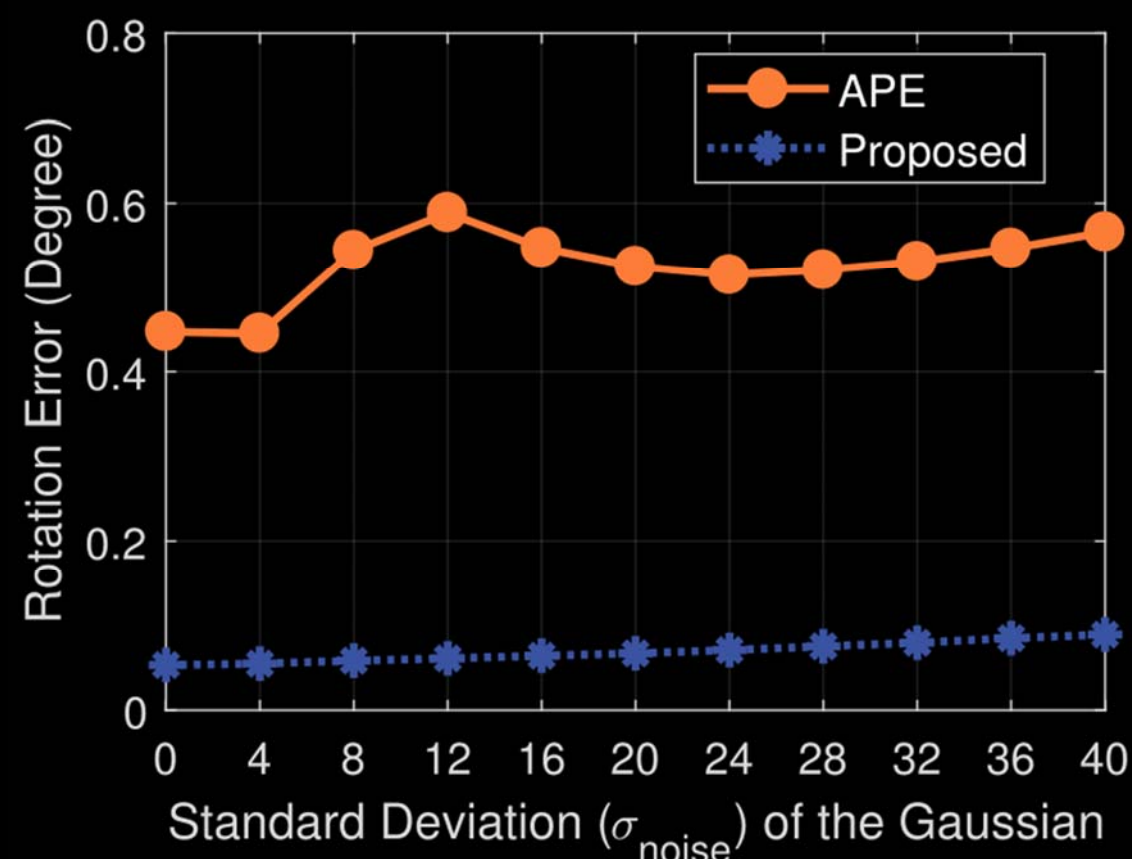


Pen-tip Trajectory 02

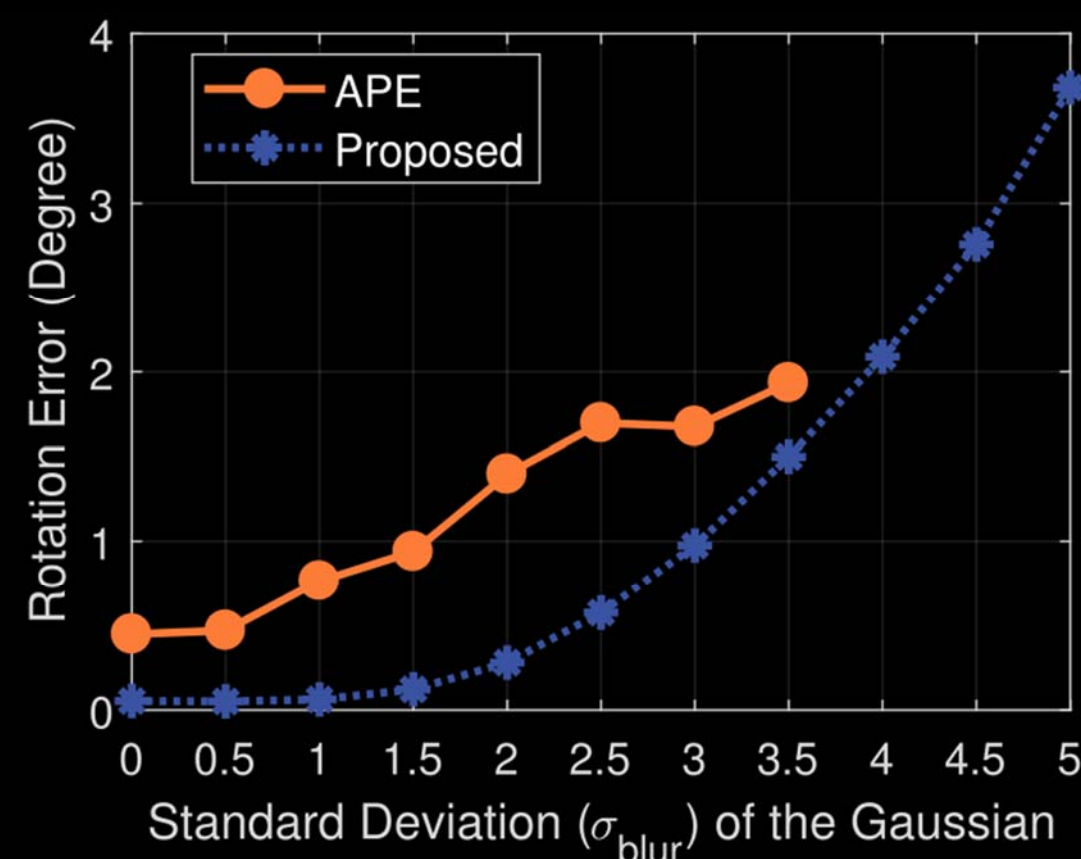


Rotation Error

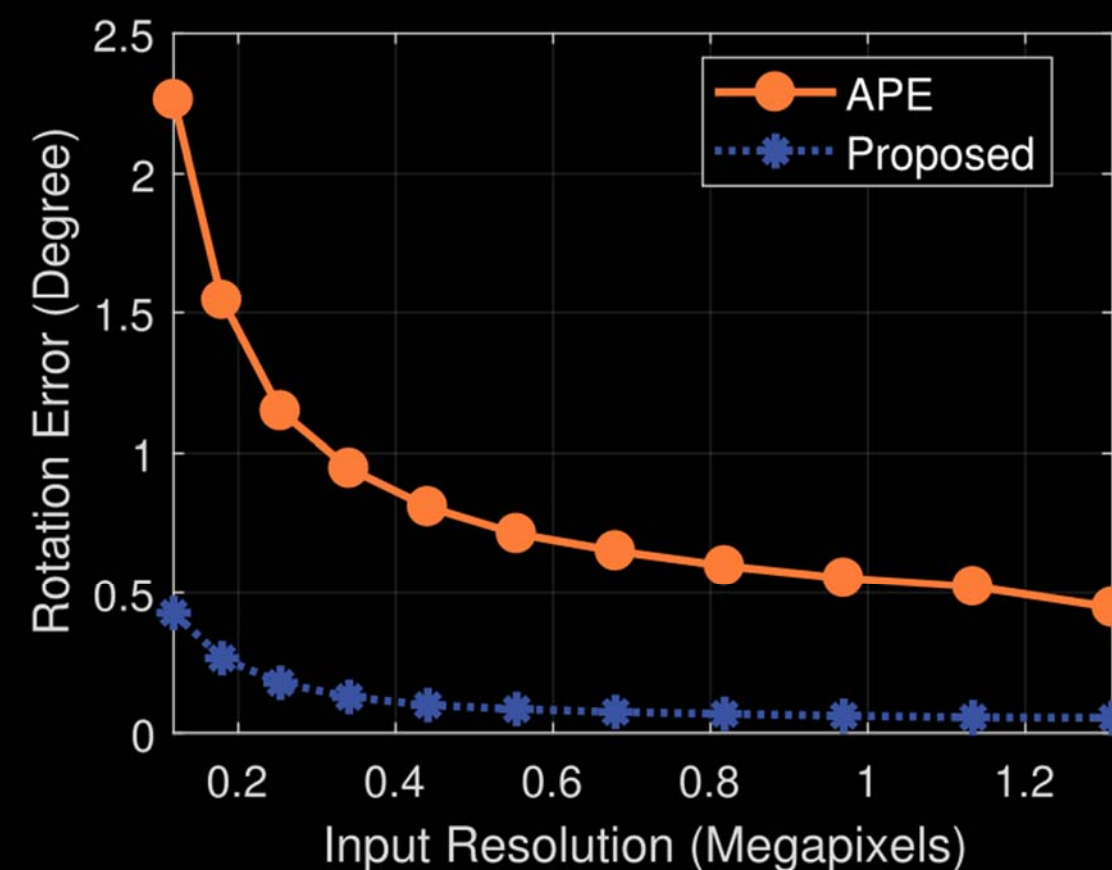
Shot Noise



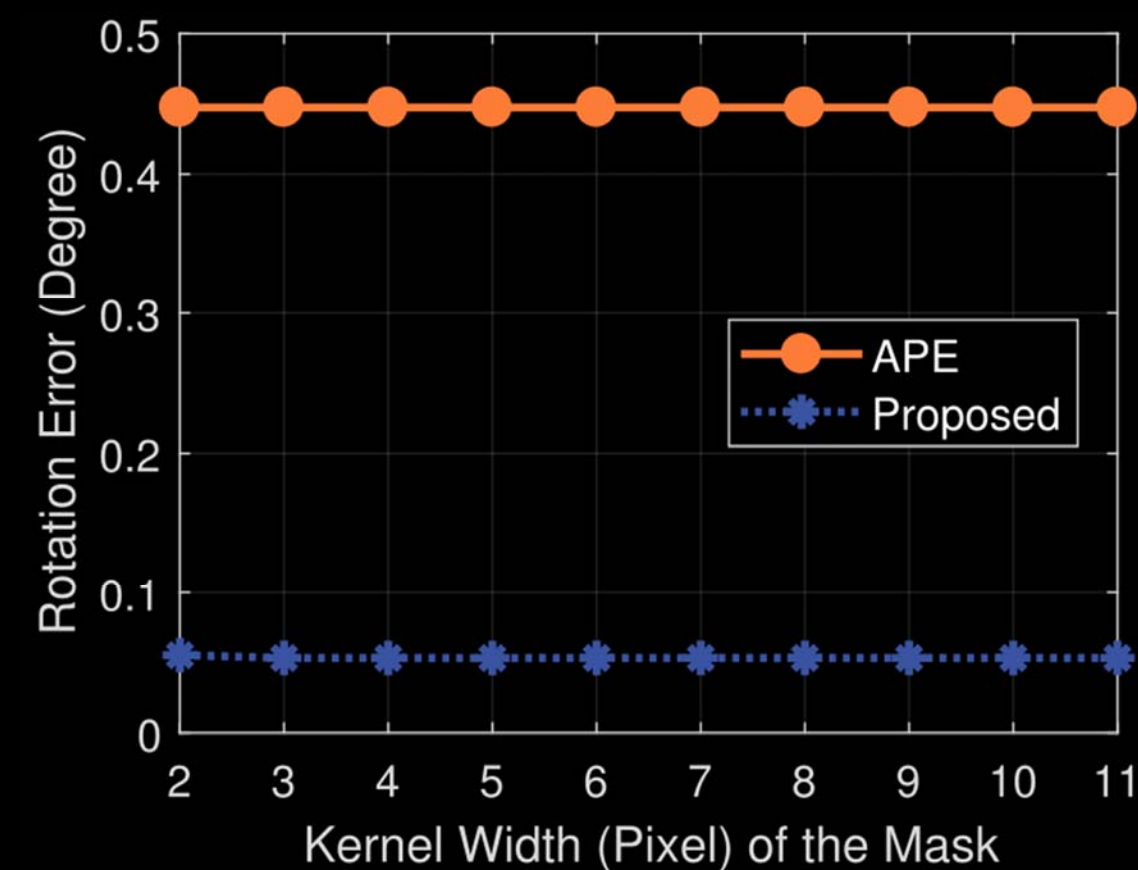
Spatial Blur



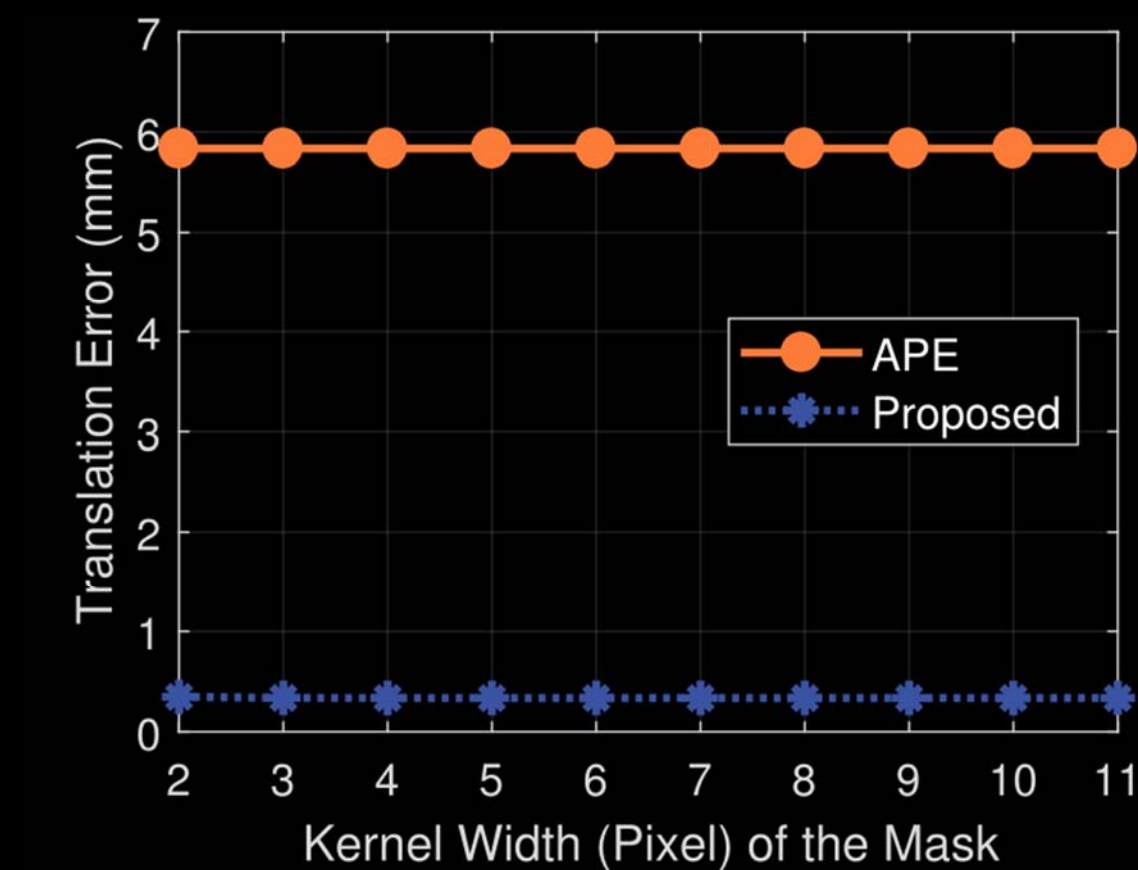
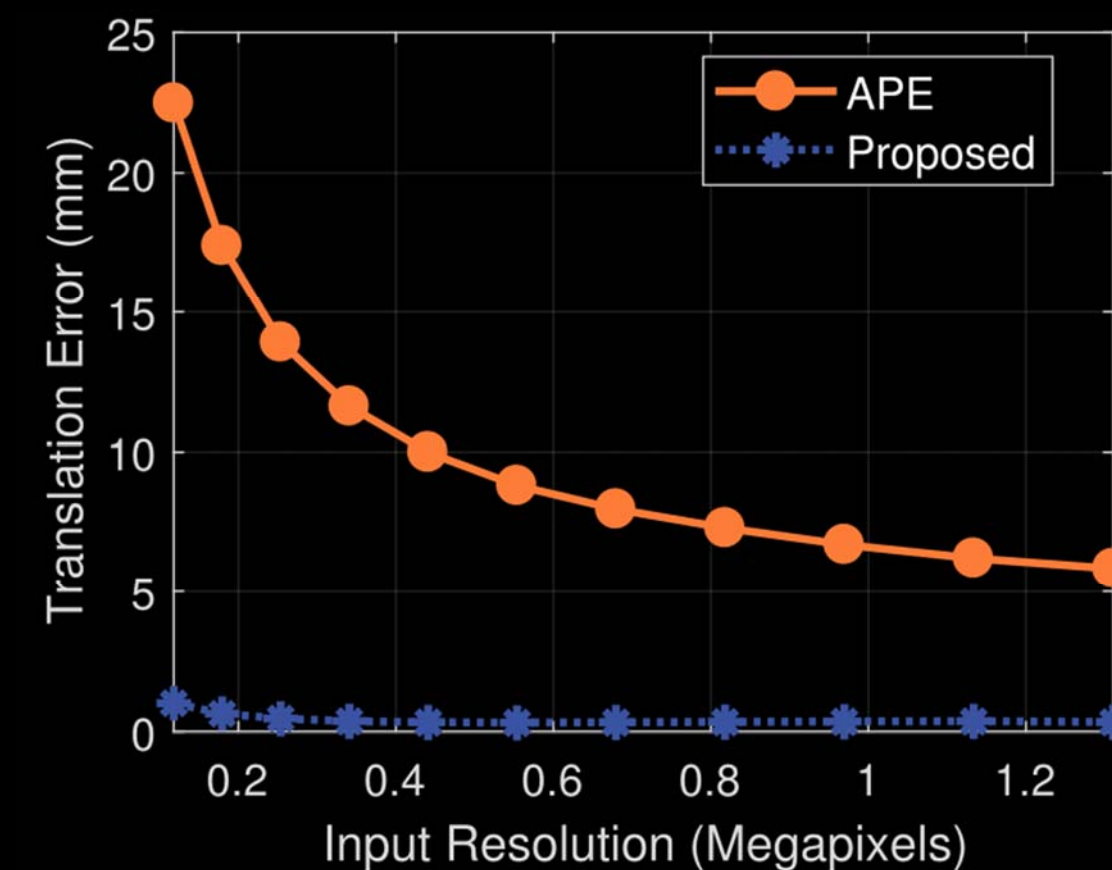
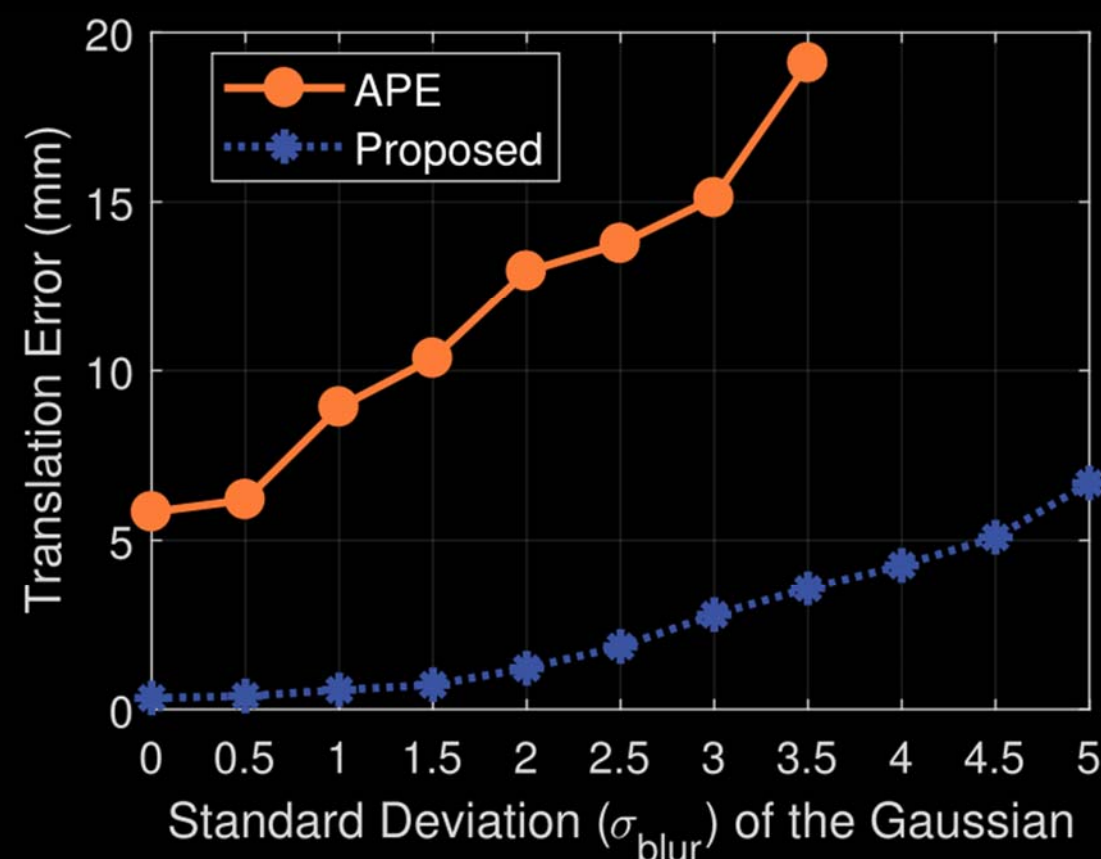
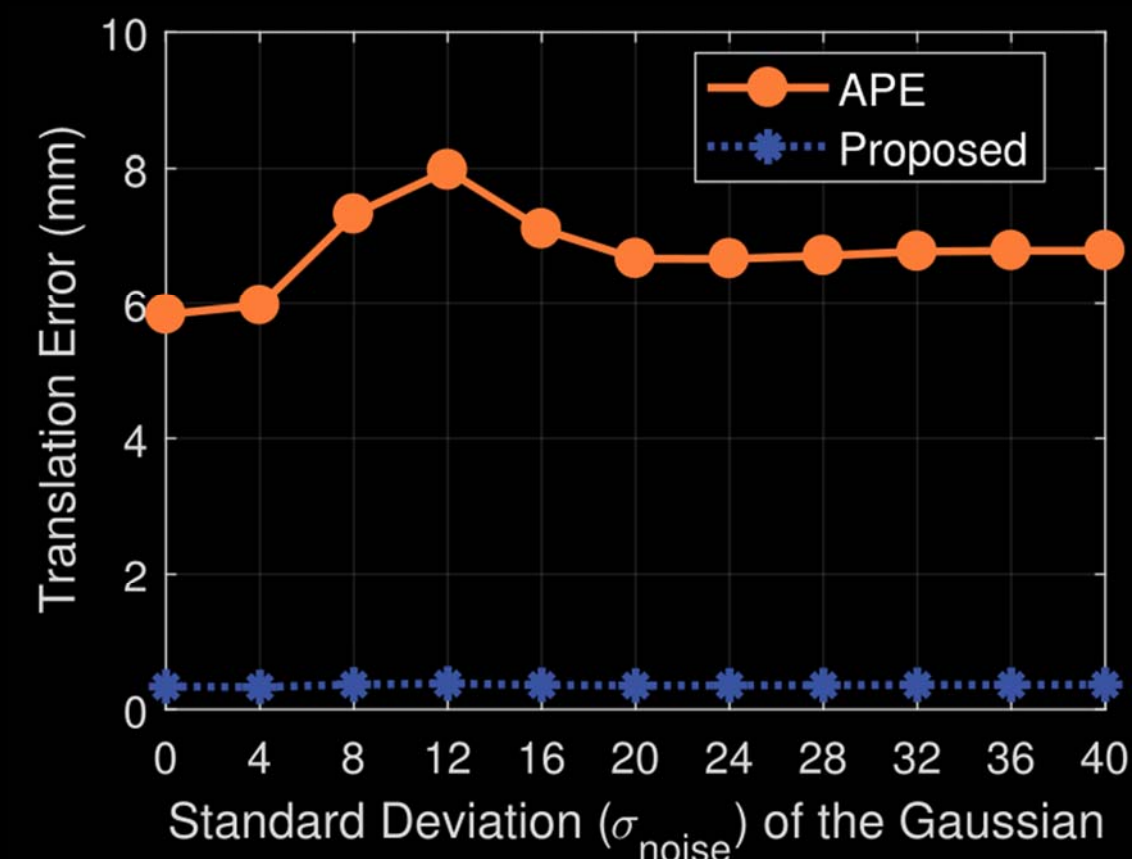
Camera Resolution



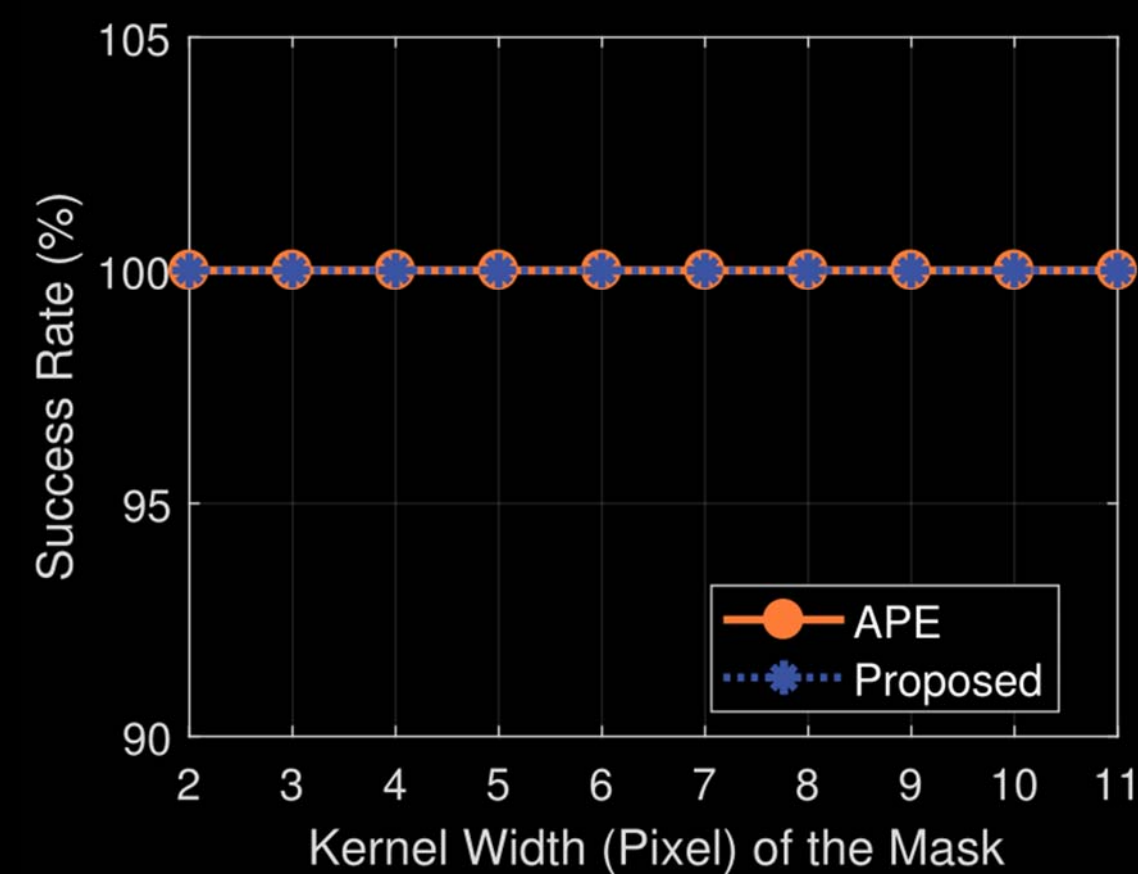
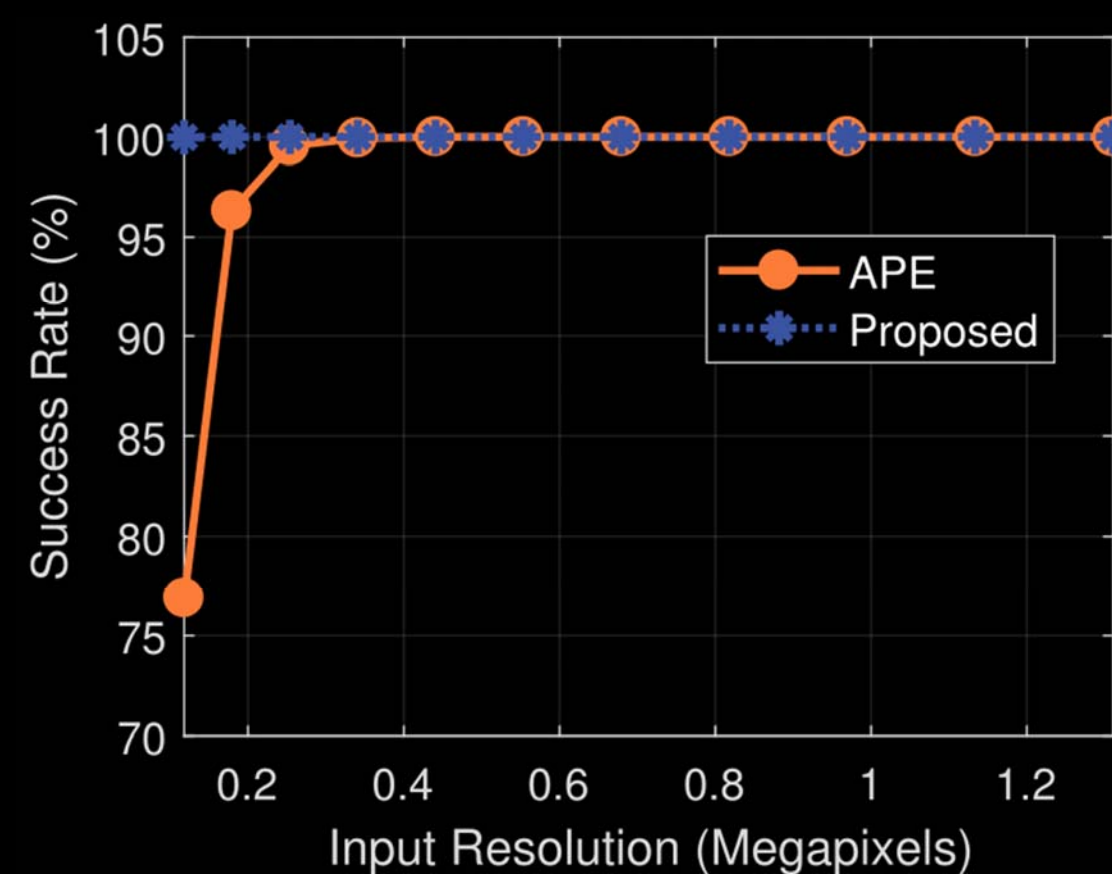
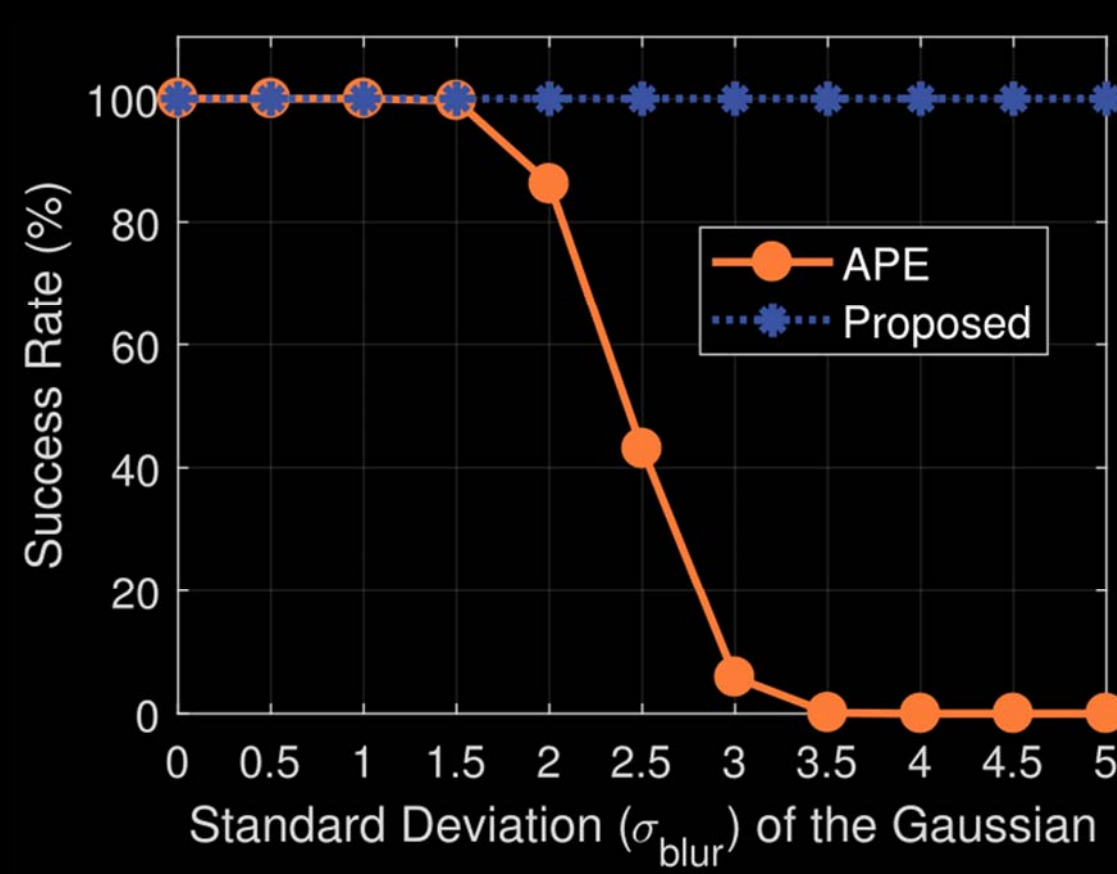
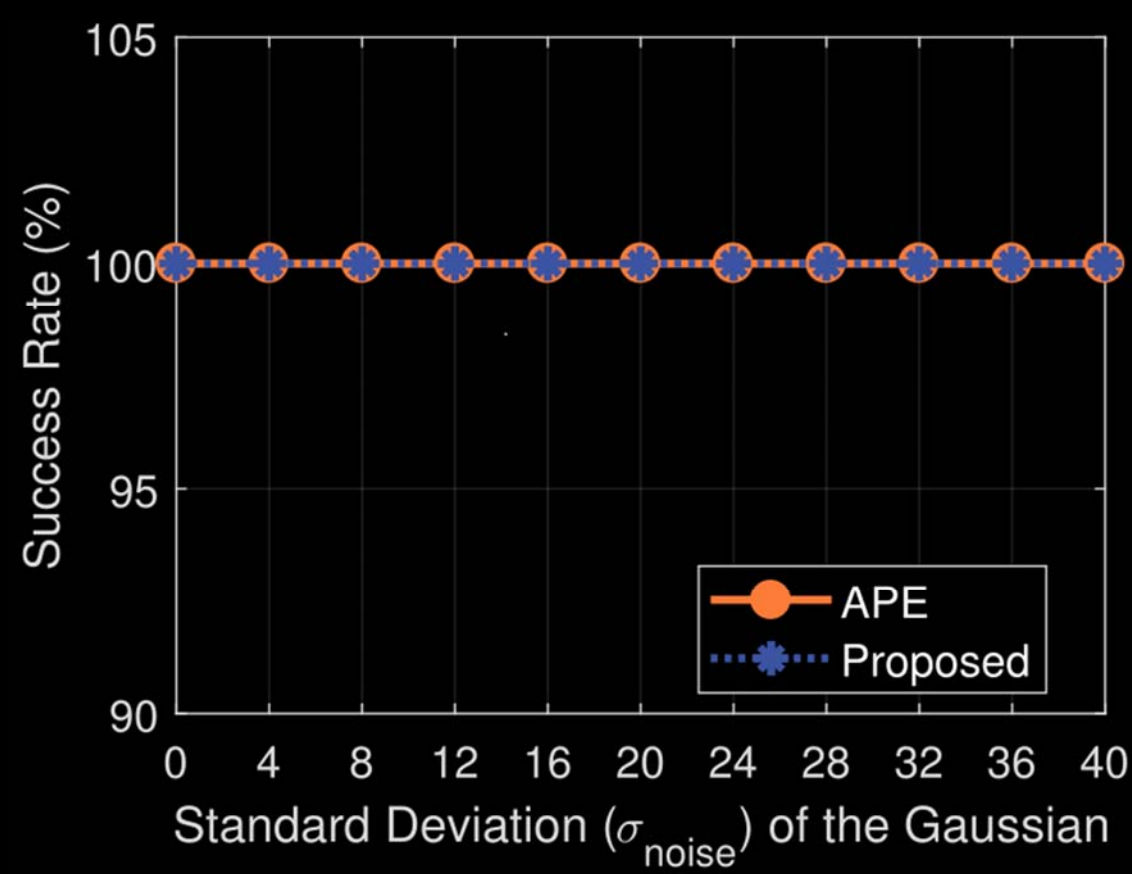
Mask Kernel Width



Translation Error



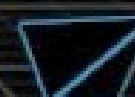
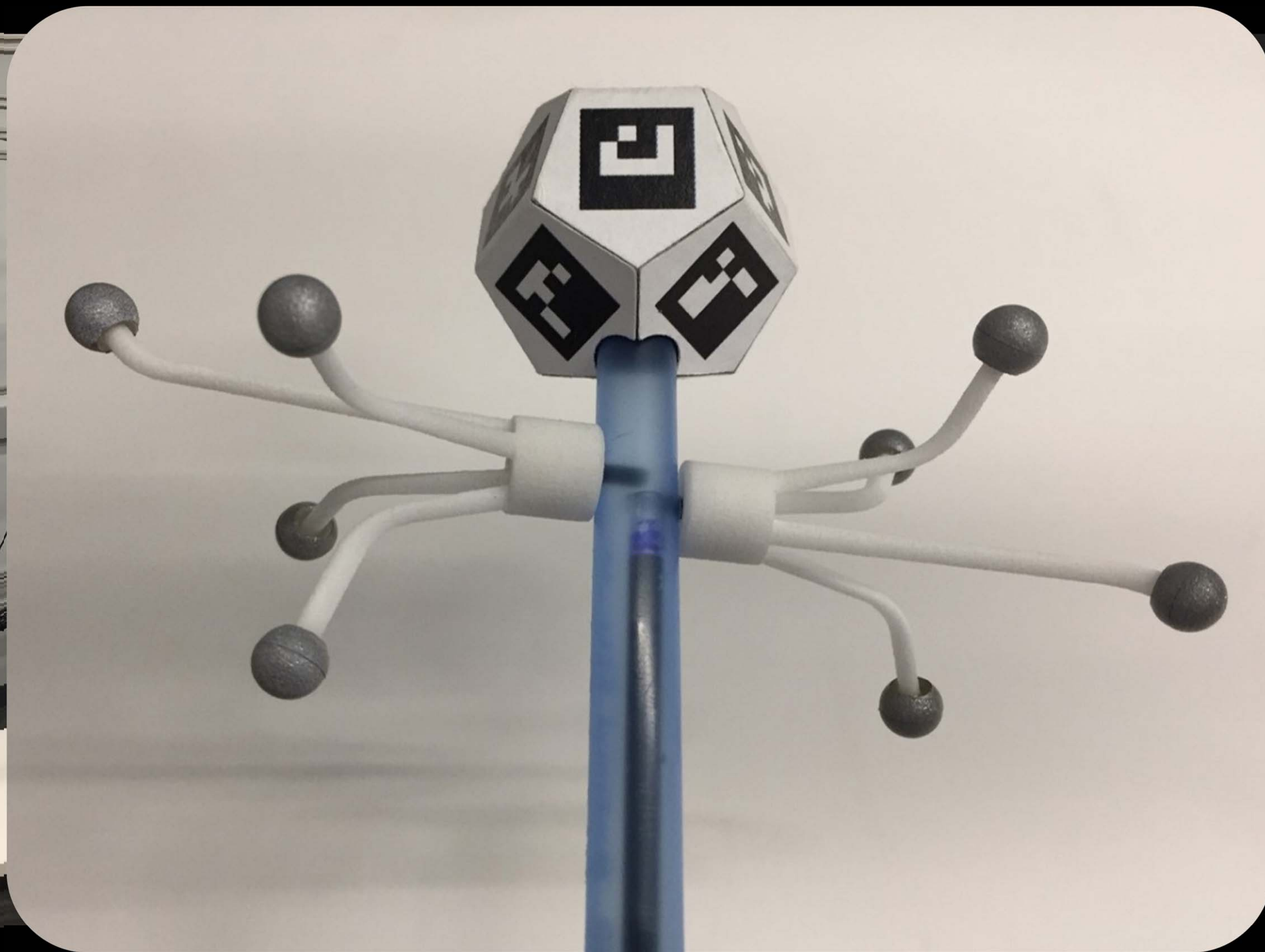
Success Rate

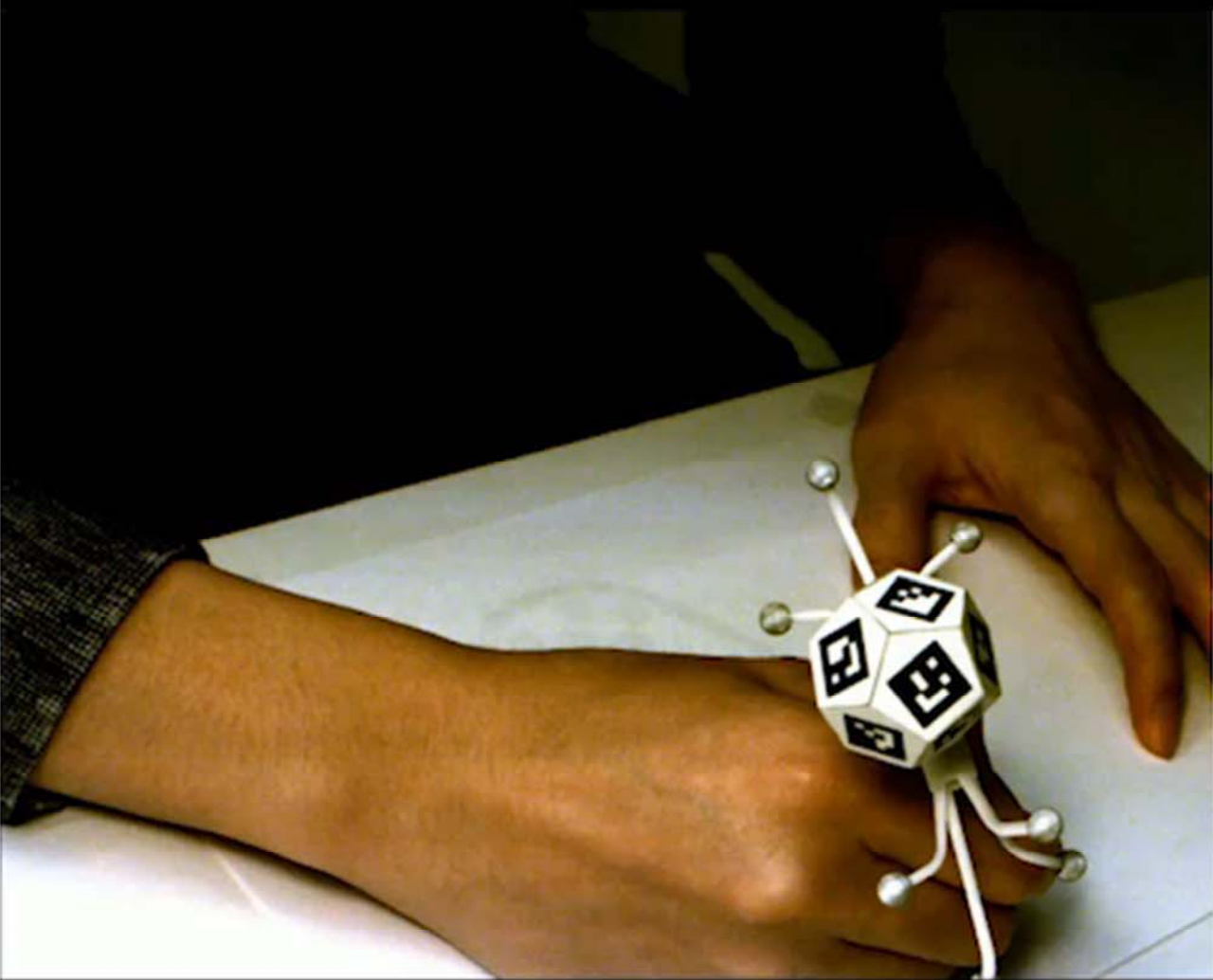


Evaluation with Real Data

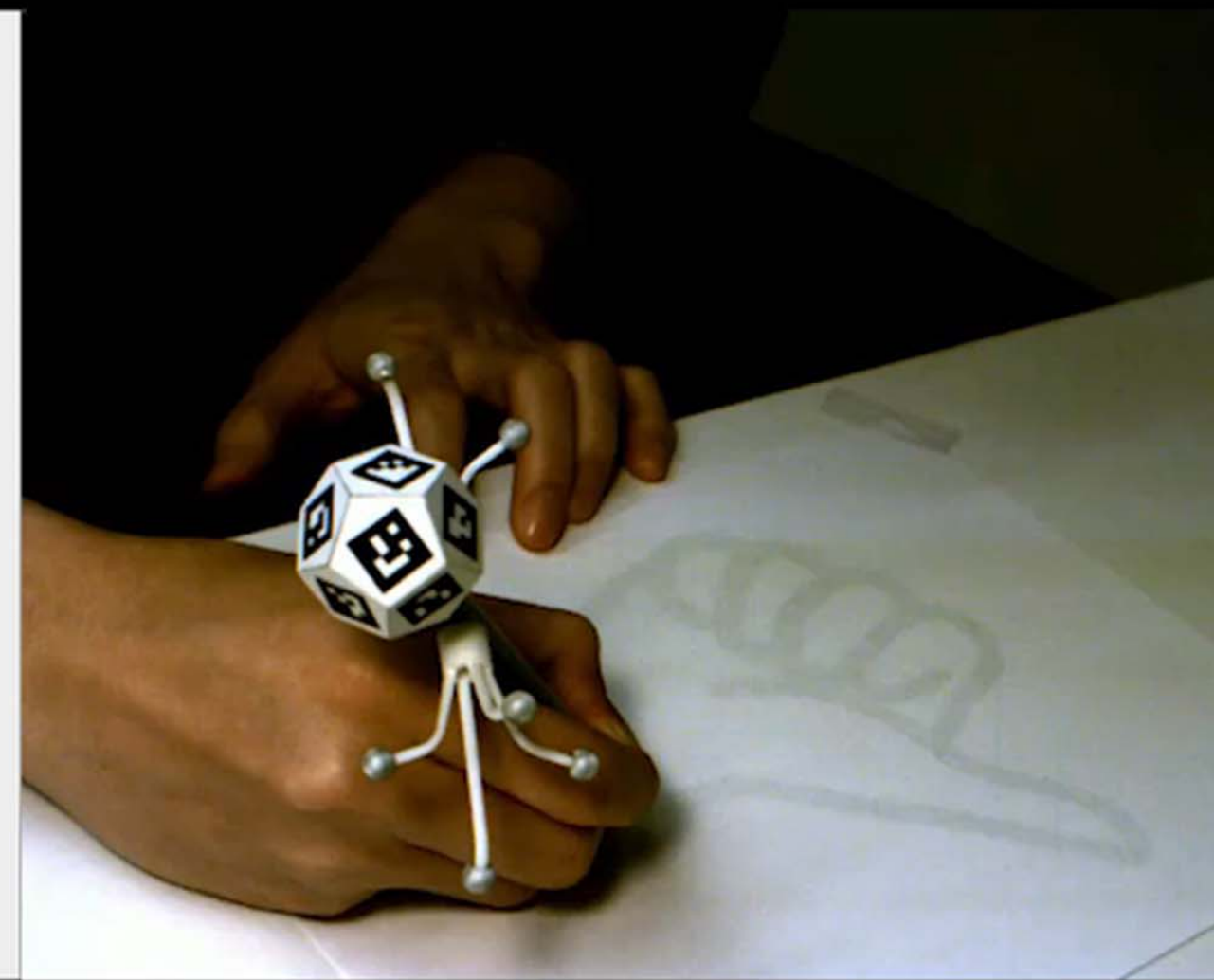
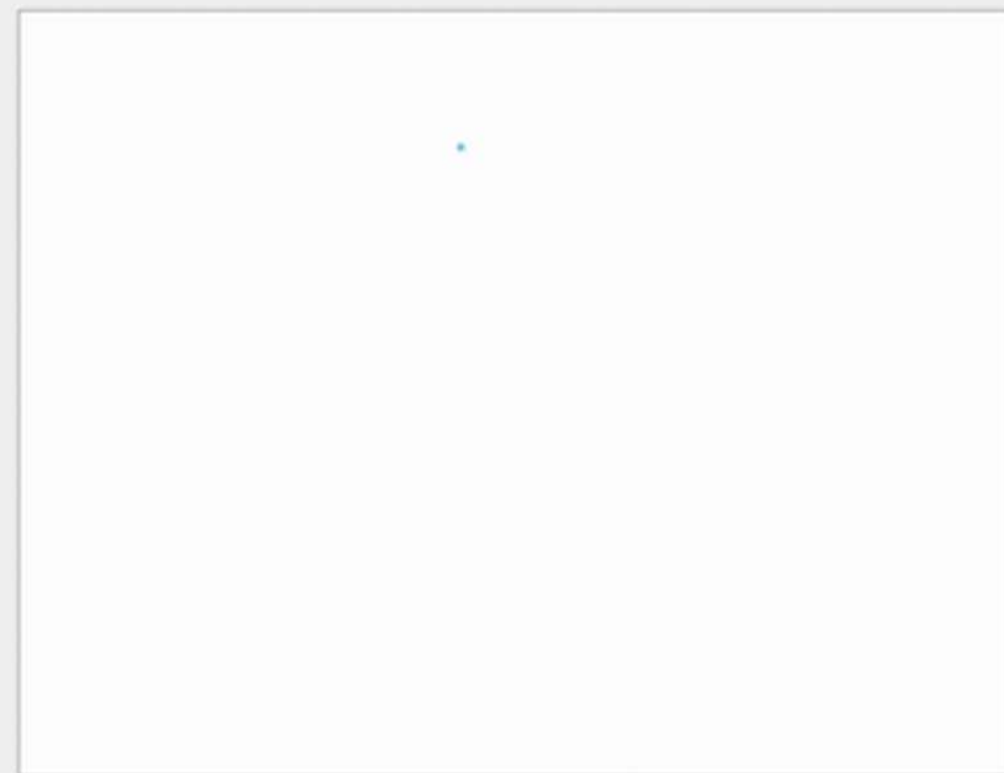
4 Real Drawings

VS. Mocap System (16 Cameras)

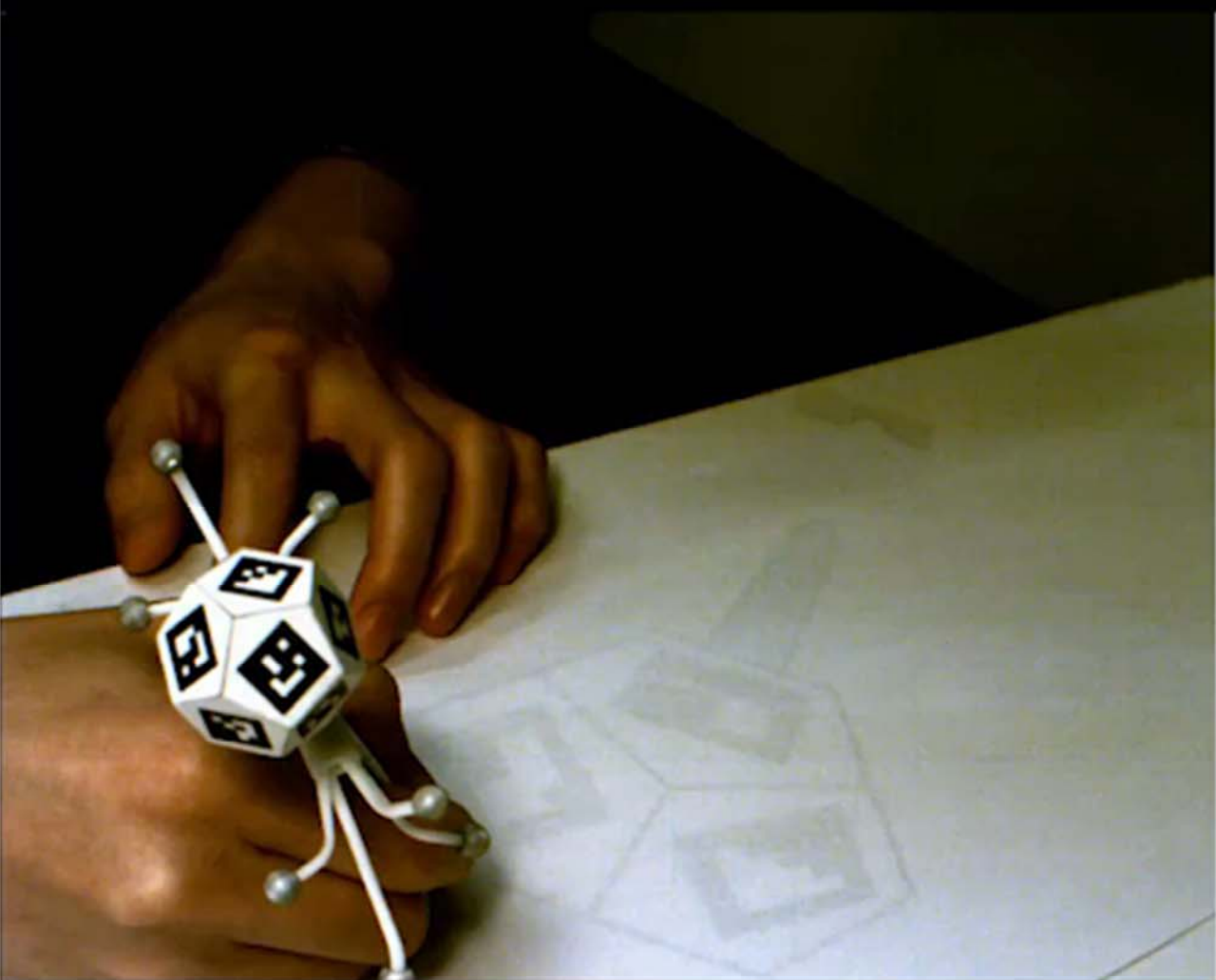
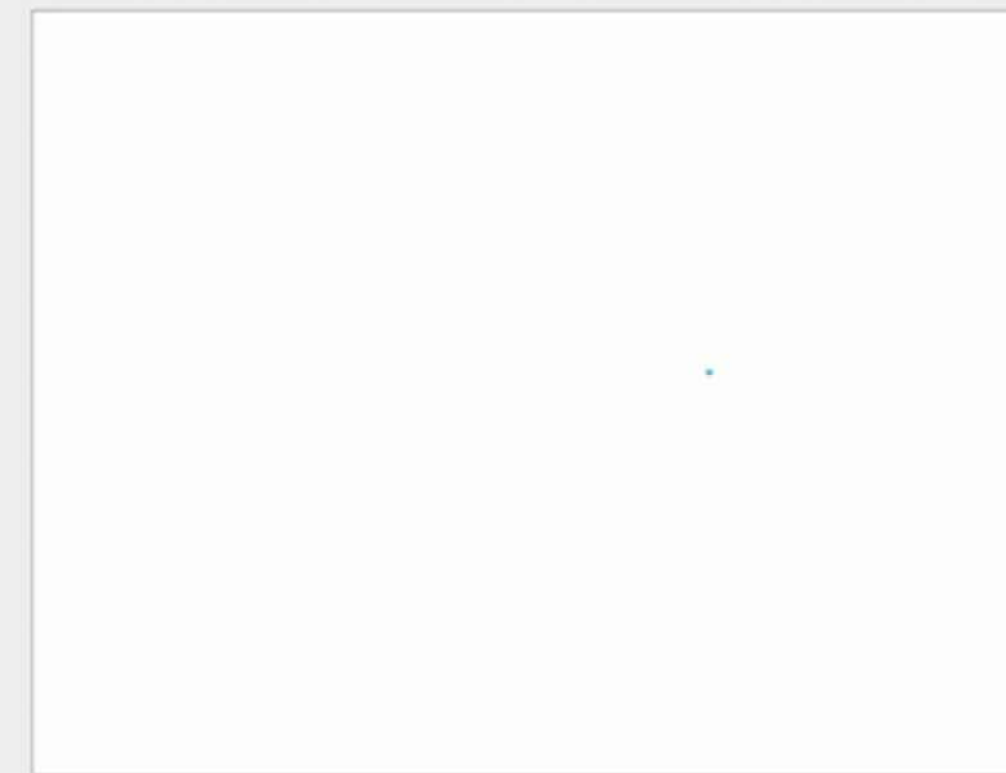




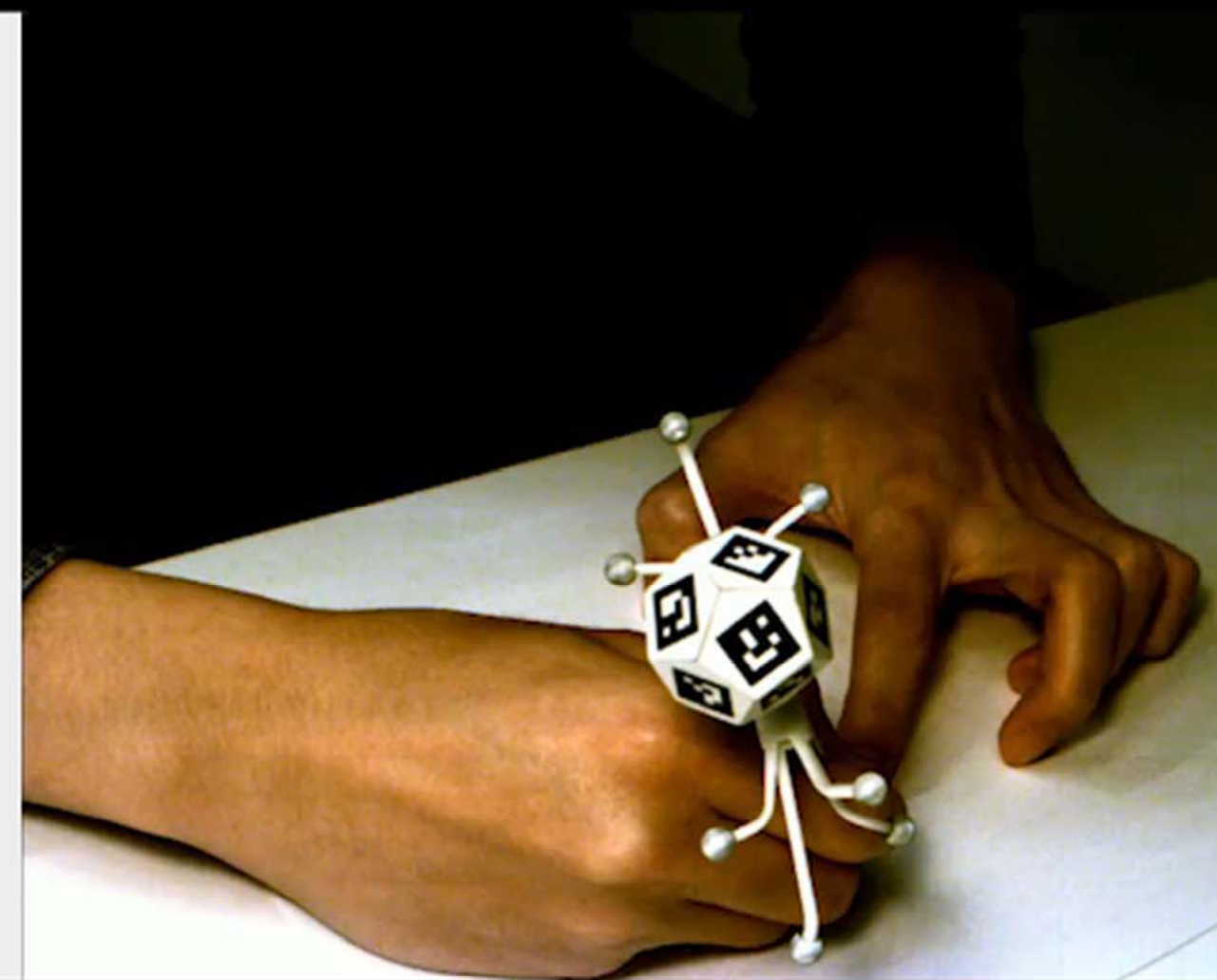
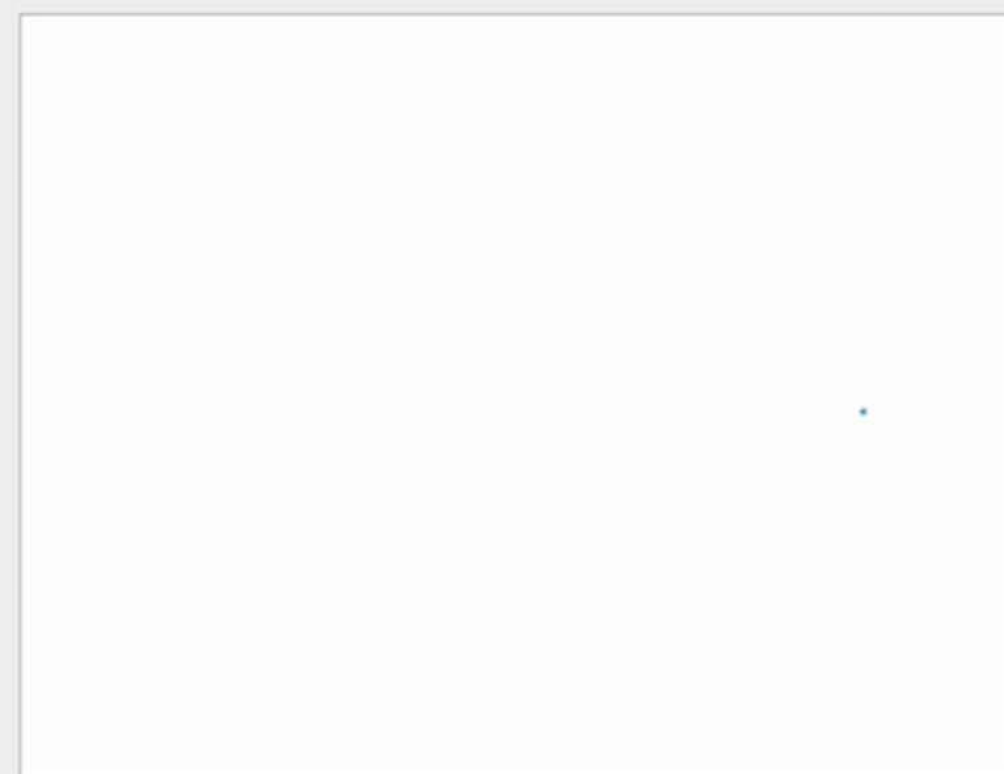
Boba



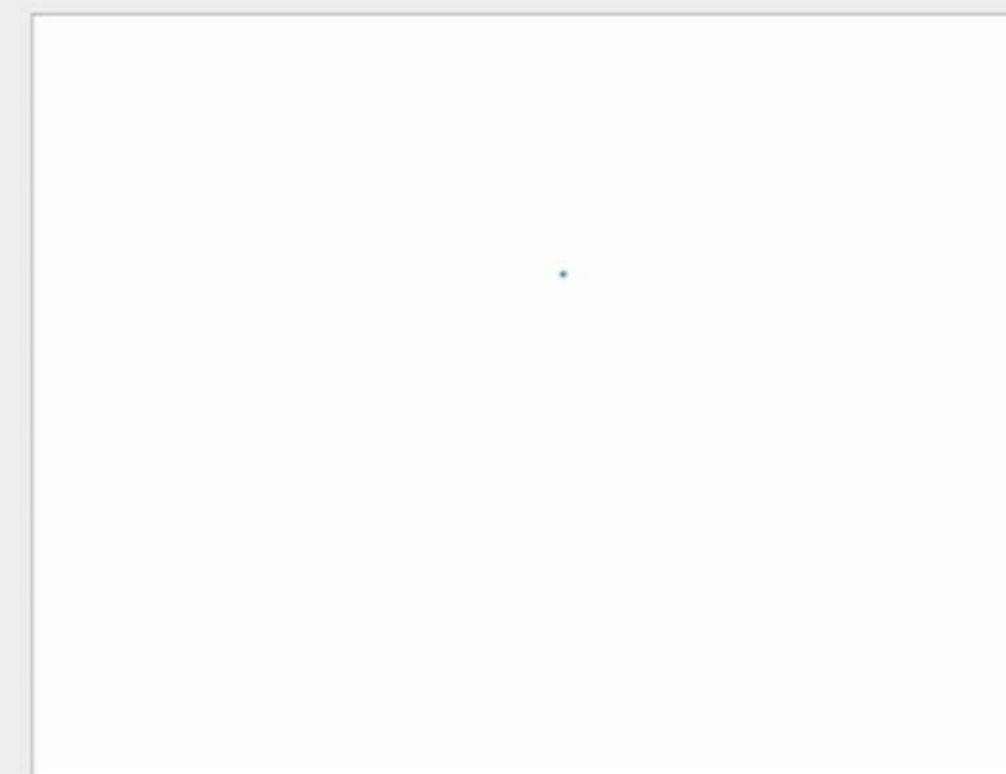
Thumb



DodecaPen



UIST2017



Boba

Thumb

DodecaPen

UIST2017

APE

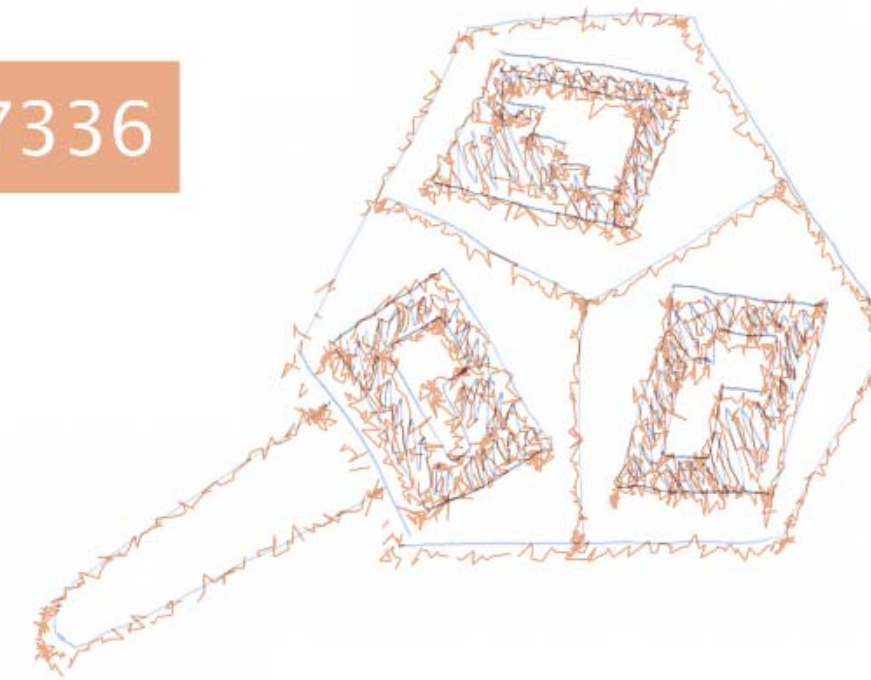
0.9197



1.0769



0.7336

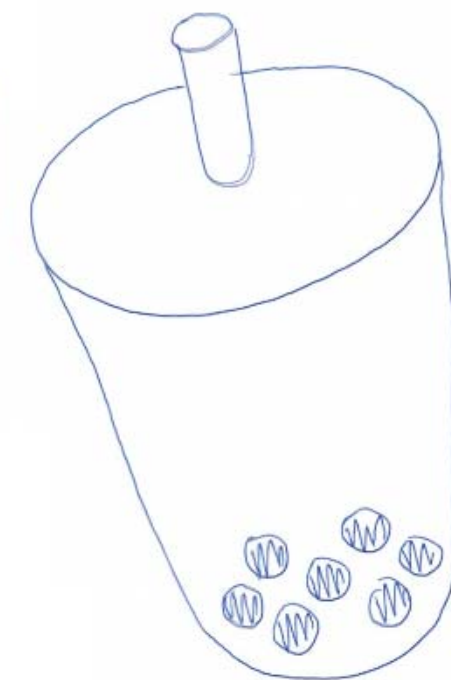


0.7585



Proposed

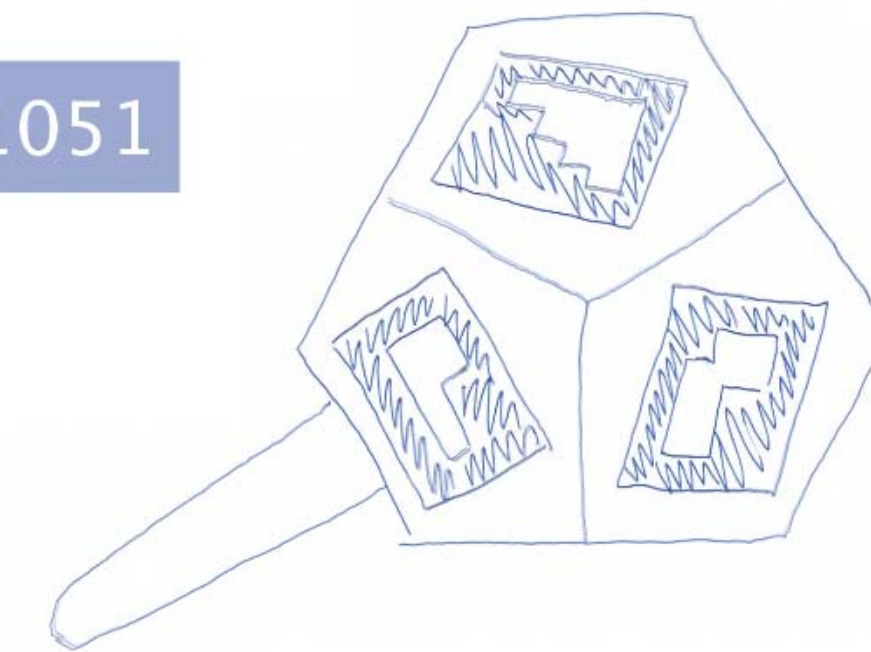
0.0595



0.0443



0.1051

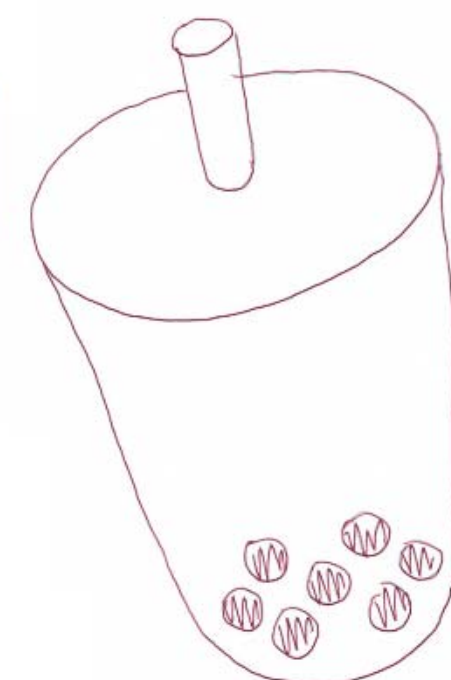


0.0929

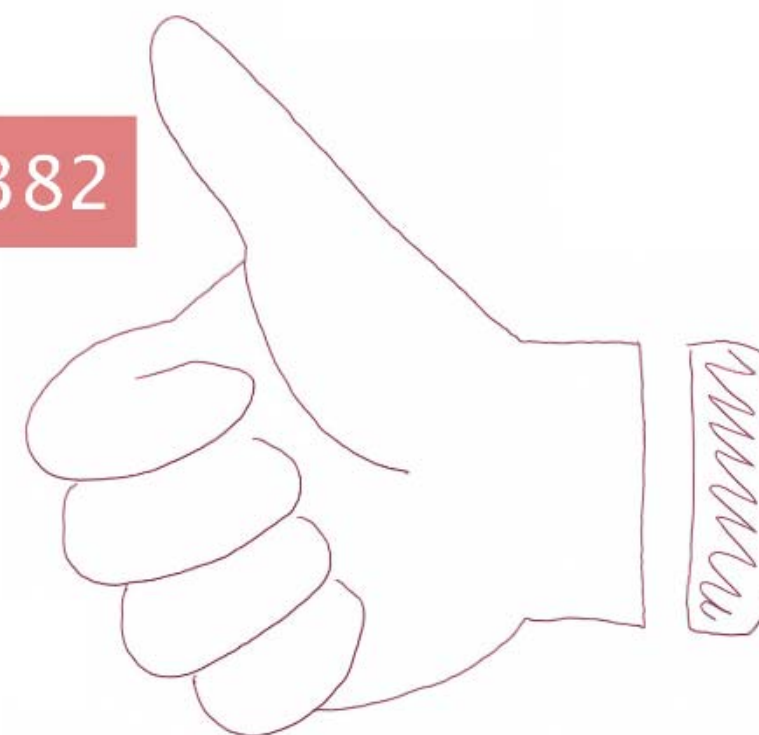


Mocap

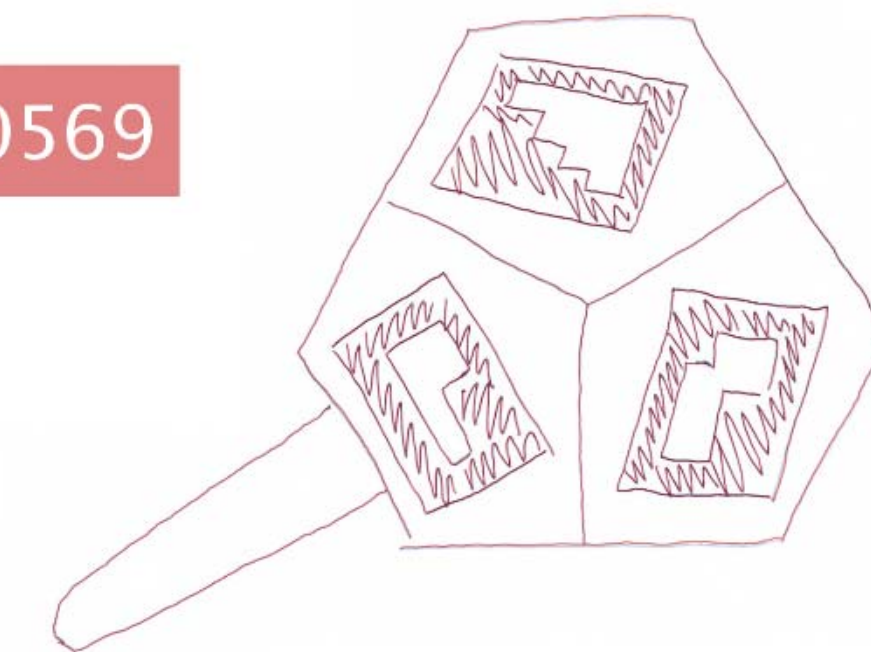
0.0398



0.0382



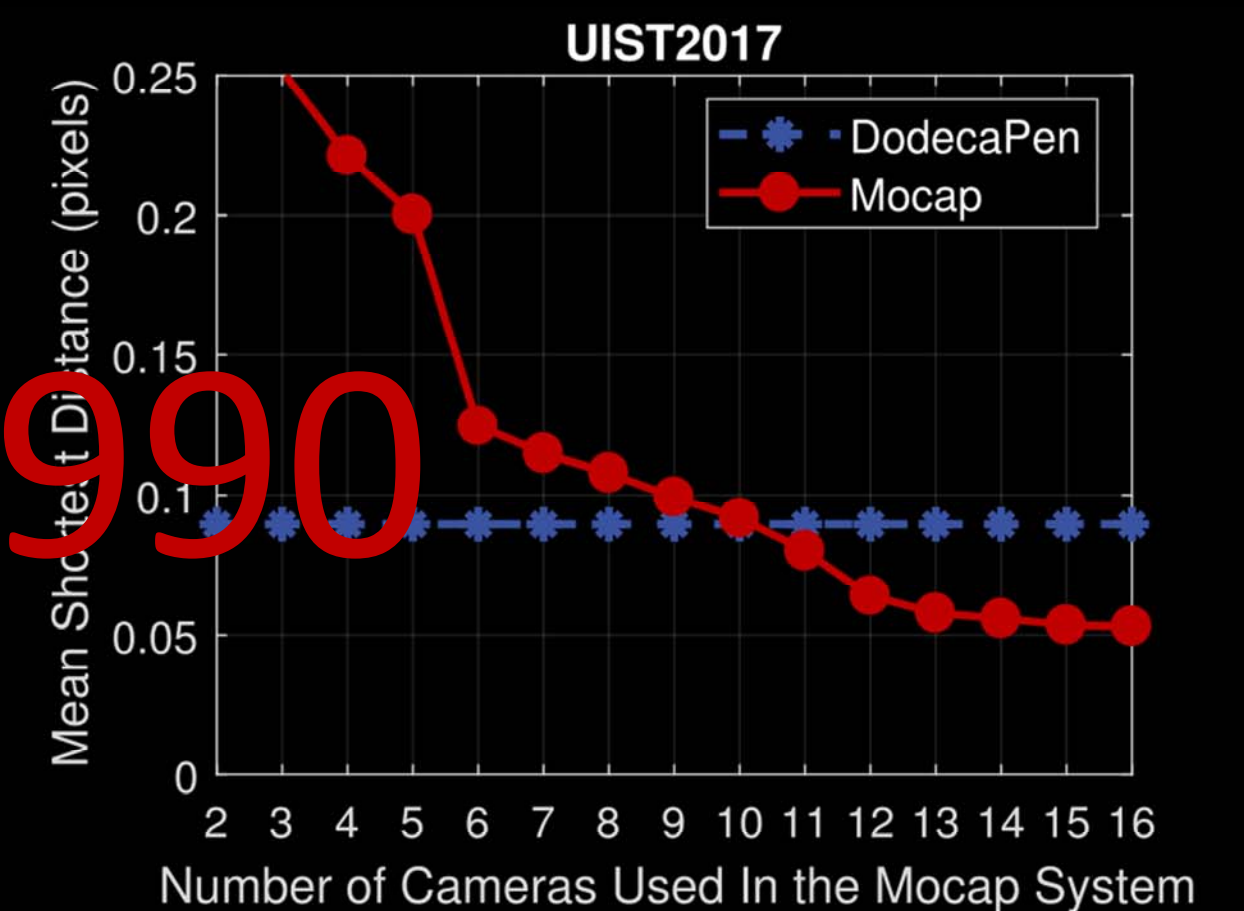
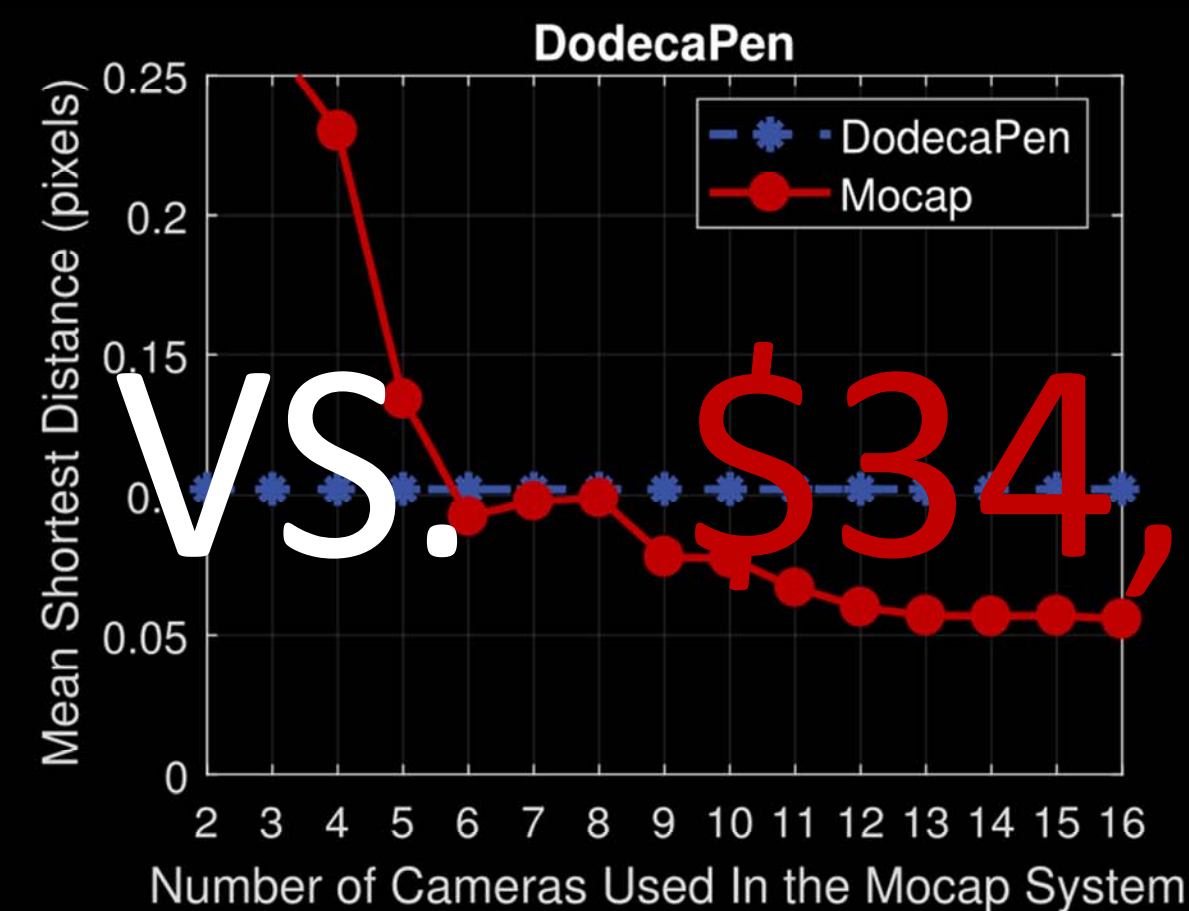
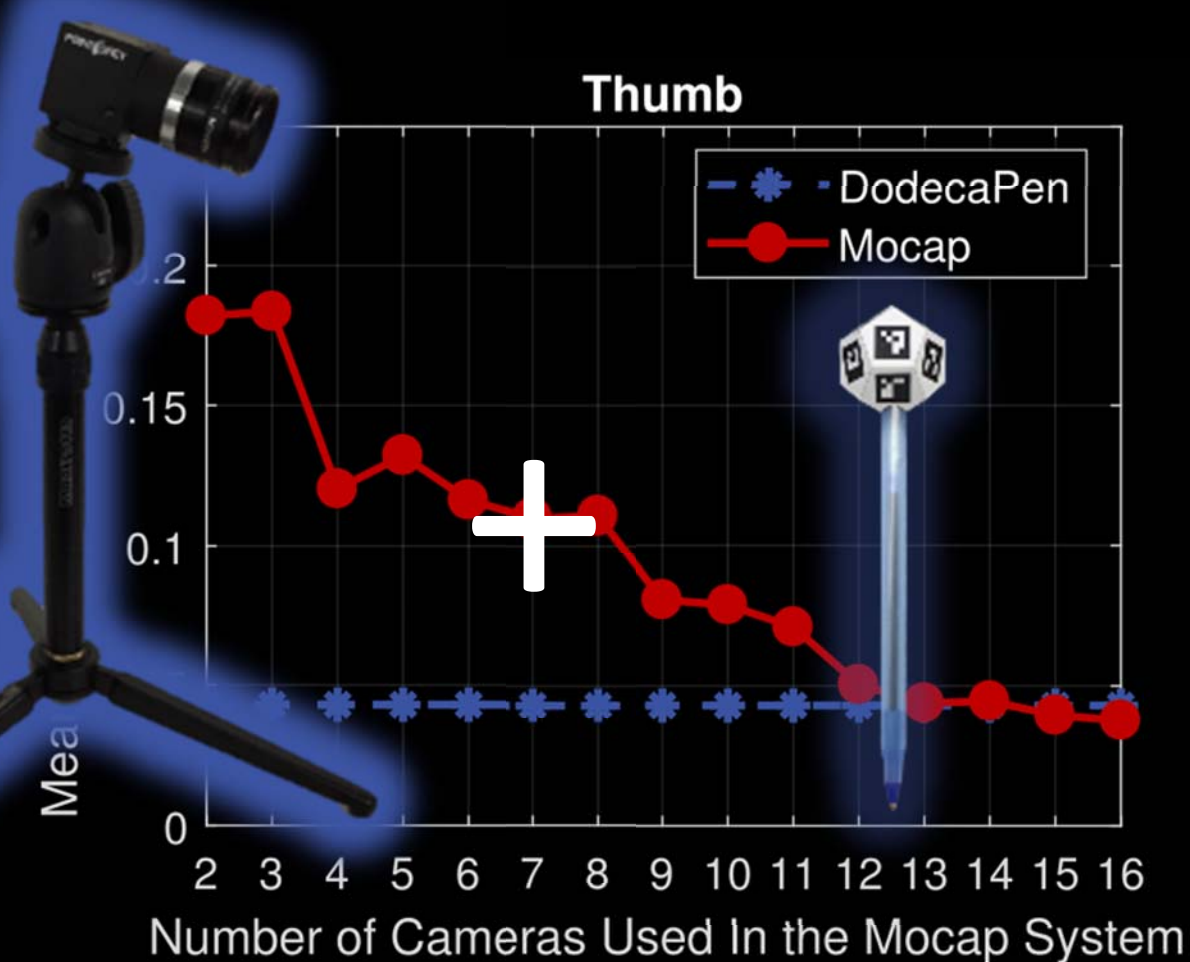
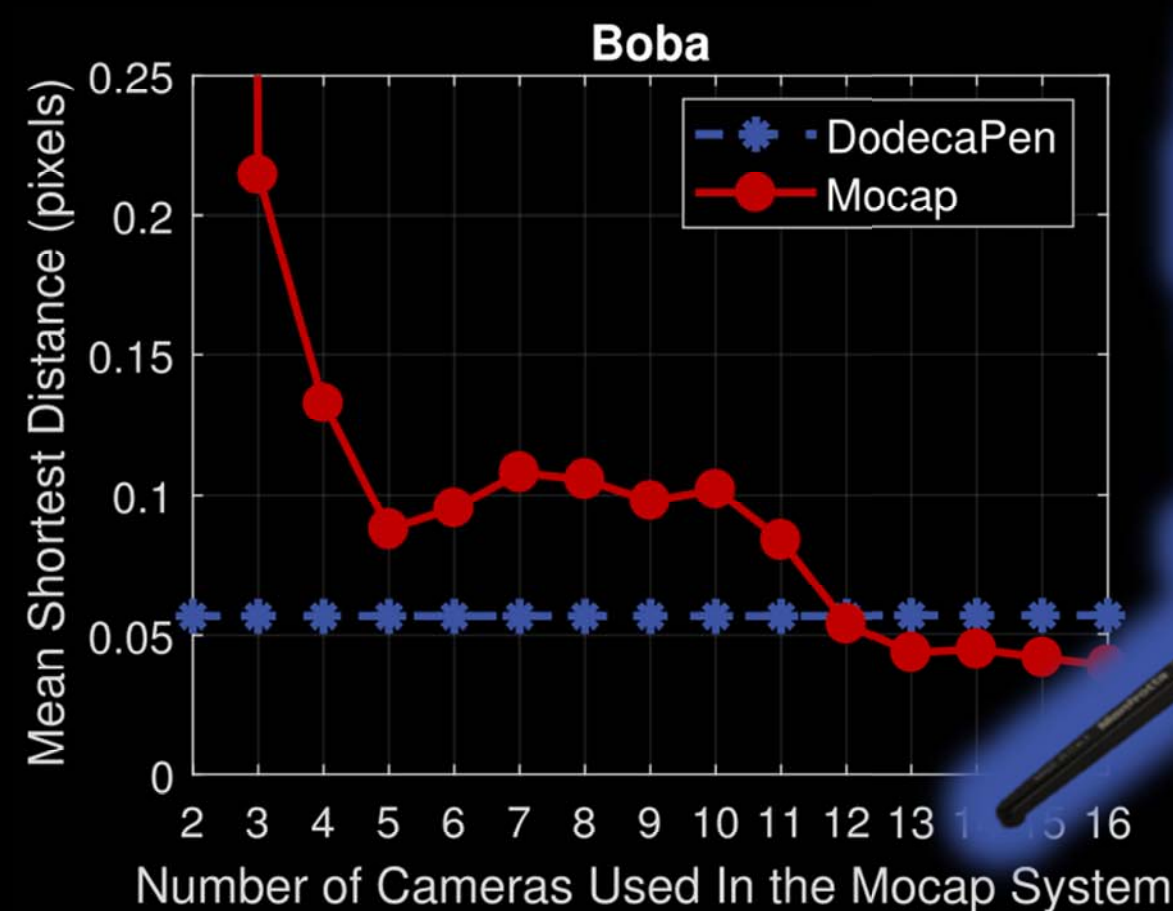
0.0569



0.0555



DodecaPen VS. Mocap



Comparable to a mocap system
with 10 active cameras

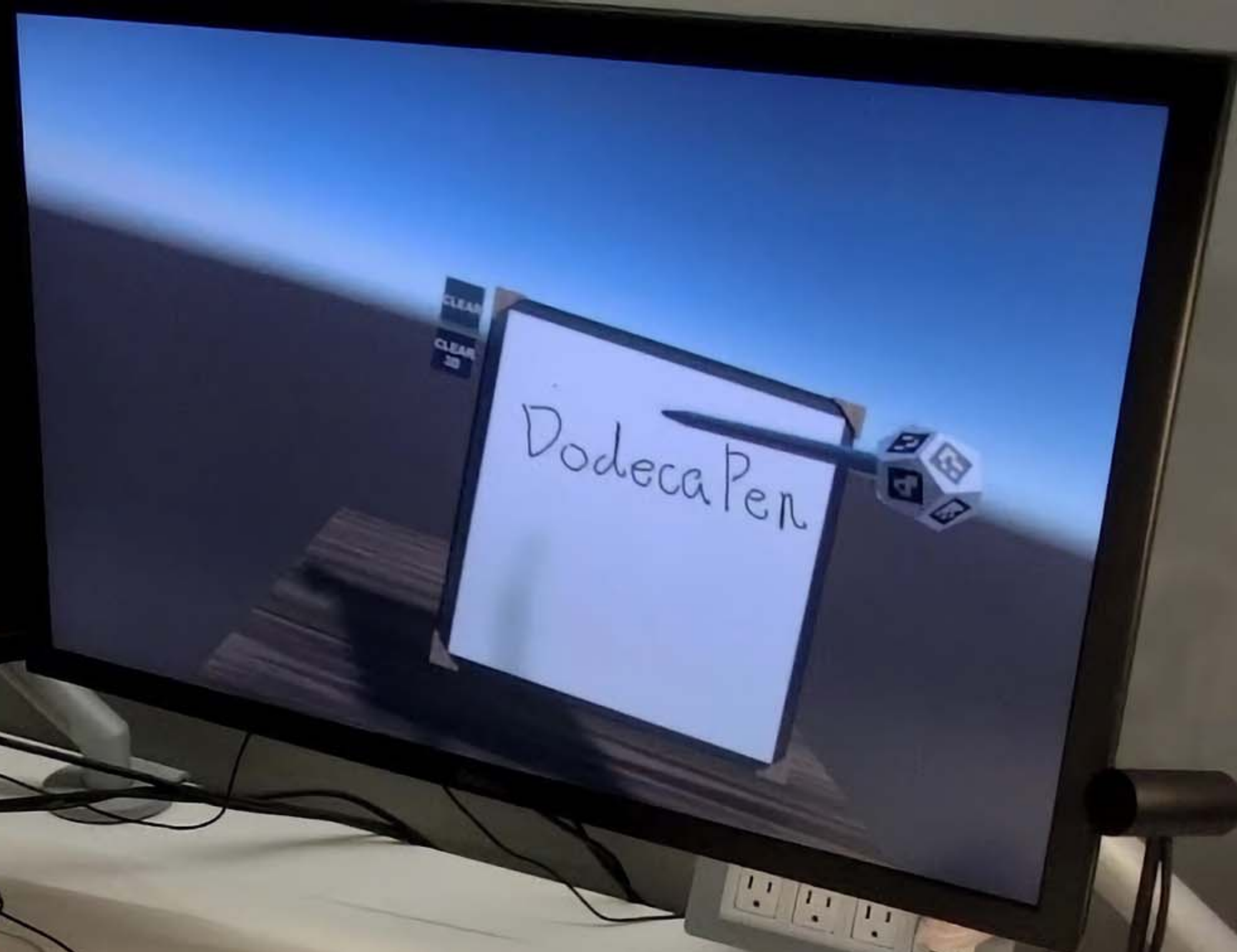
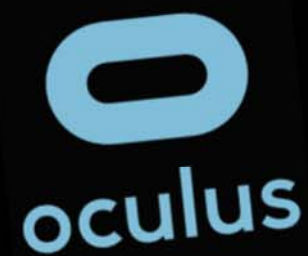
Take Home Message

1. Sub-millimeter accurate 6DoF tracking using a set of readily available and easy-to-assemble components.
2. Single camera pose estimation can be fast and robust enough for drawing in 2D, 3D and in VR.



Thank You

For Your Attention 😊



DodecaPen: Accurate 6DoF Tracking of a Passive Stylus

