Reach Target neural control network intended velocity \( (u_k) \) primary motor cortex neuroprosthetic device cursor kinematics \( (x_k) \) ensemble action potentials \( (n_k) \)

Figure 1

1A

1B

1A

1B

starting Points

Ideal Path
Open Loop Trajectory
Closed Loop Trajectory

Reach Target

8cm
4cm

Ideal Path
Open Loop Trajectory
Closed Loop Trajectory

Starting Points

Reach Target

8cm
4cm
Figure 2

2A
- 25 ms binwidth
- 300 ms binwidth

2B
- Open Loop
- Closed Loop

Mean Integrated Distance To Target (mm)

Decoded Integration Bin Width (ms)

2C
Kalman Filter Decoding

2D
- Bin Width
  - 25 ms
  - 100 ms
  - 300 ms

2E
Firing rate (spikes/s)

2F
Noiseless Decoding

2G
Distance (cm)

2H
RMSE in position (cm)
Figure 3

3A Poisson neuronal output

3B Gaussian neuronal output

3C Gaussian neuronal output with low control cost
Figure 4

4A
10 Neurons with low control cost

4B
10 Neurons with control cost

4C
96 Neurons with control cost

4D
96 Neurons with OLE Decoding
Figure 5

5A

Time to Target (ms)

Decoded Integration Bin Width (ms)

5B

Failure Rate (%)

Decoded Integration Bin Width (ms)

5C

Mean Integrated Distance To Target (mm)

Decoded Integration Bin Width (ms)

5D

Time To Target (ms)

Decoded Integration Bin Width (ms)
Figure 6

Closed Loop: Does MID increase with bin width?

6A

Open Loop: Does MID increase with bin width?

6B

Does closed loop decrease PVA decoding bias?

6C

PVA: Do tuning curves shift?

6D

OLE: Do tuning curves shift?

6E

Hypothesis

P-value of hypothesis

Is P-value < .05?
7A Constant Base Rate and Tuning Depth

7B Varying Base Rate and Tuning Depth

7C Dominant Eigenvector of Inverse PVA

7D Arm Mode ○ PVA Mode ● Dominant Eigenvector of Inverse PVA