Modelling primate control of grasping for robotics applications

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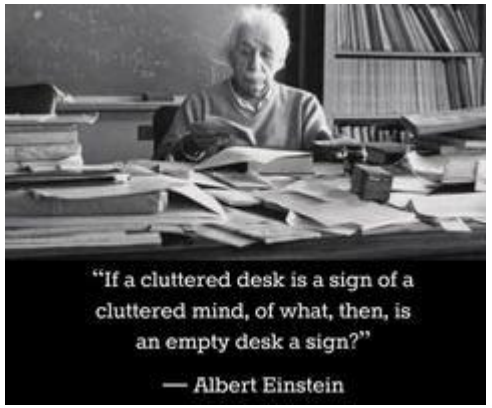
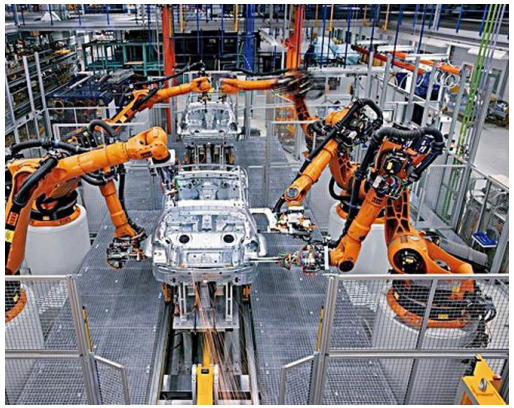
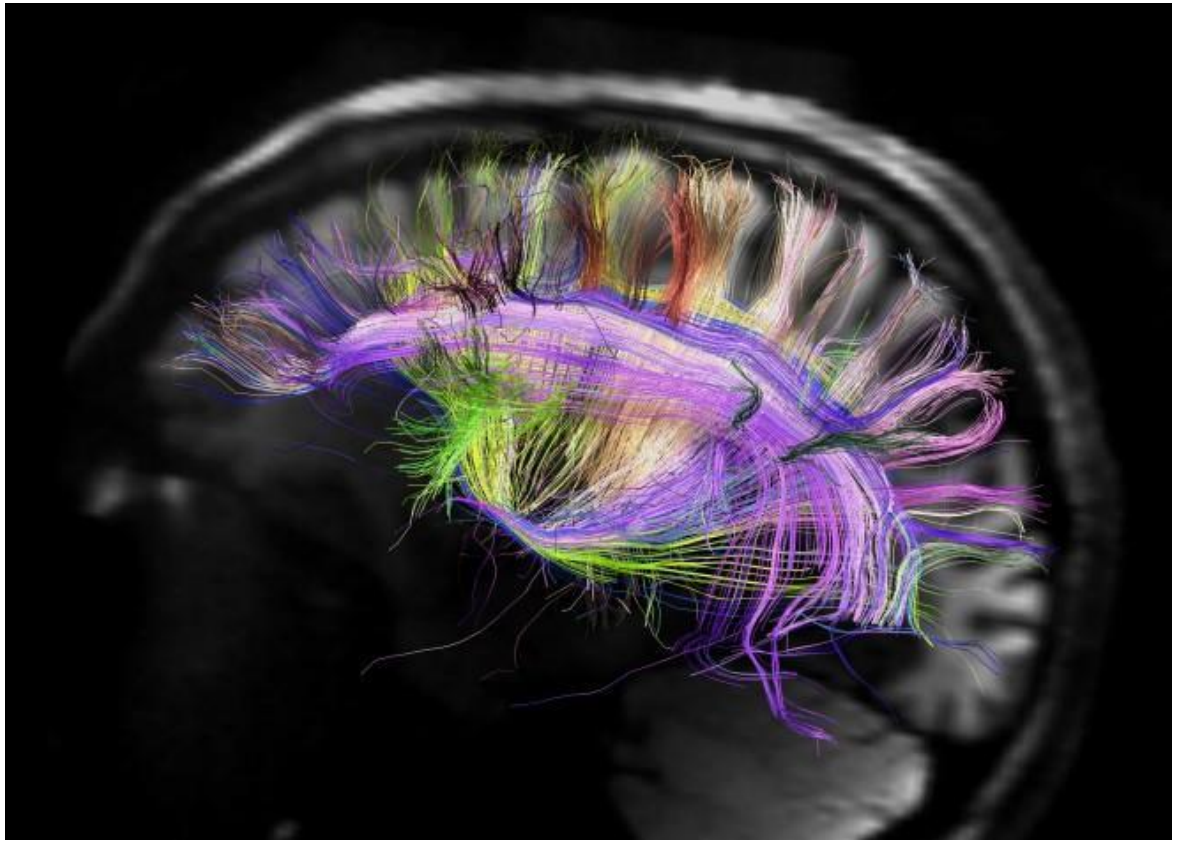
Grasping primates vs robots



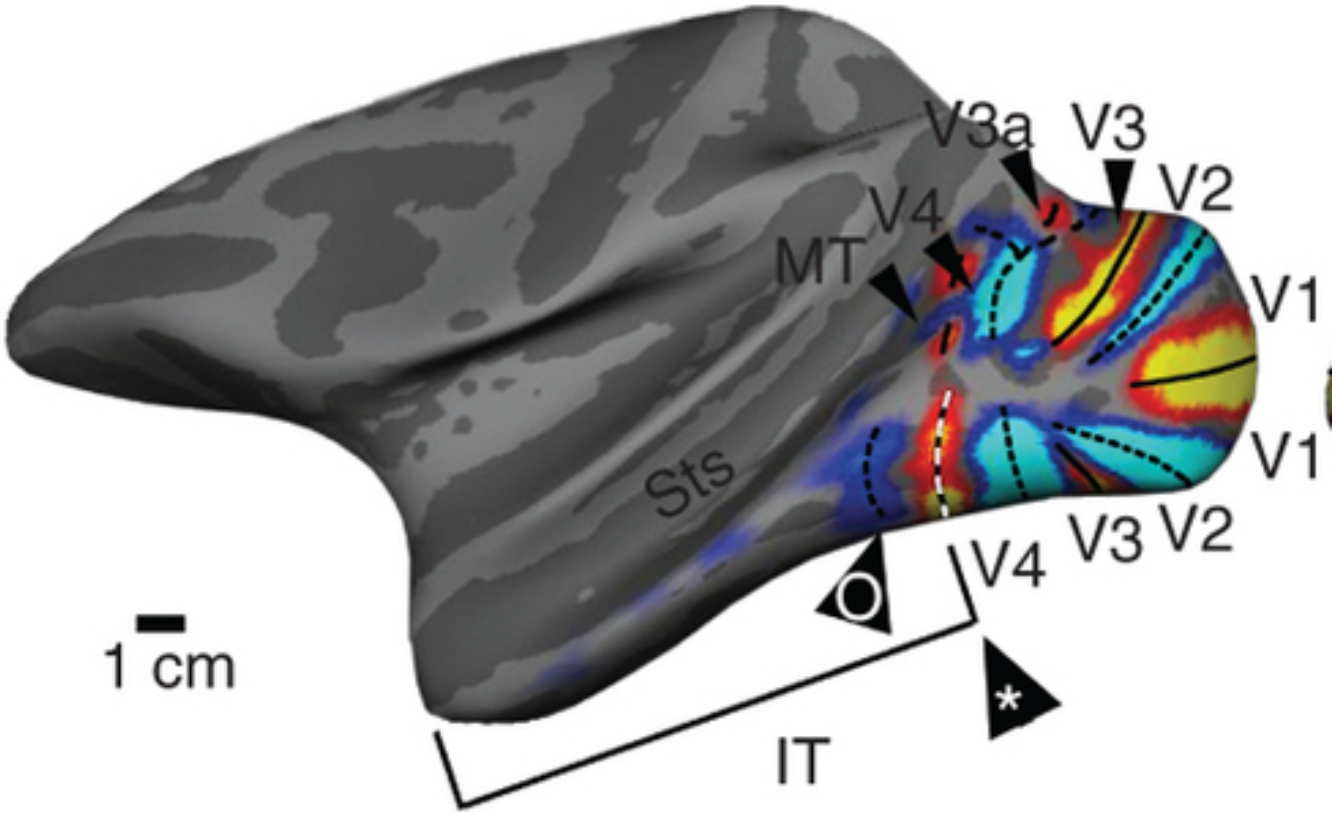
What humans can do



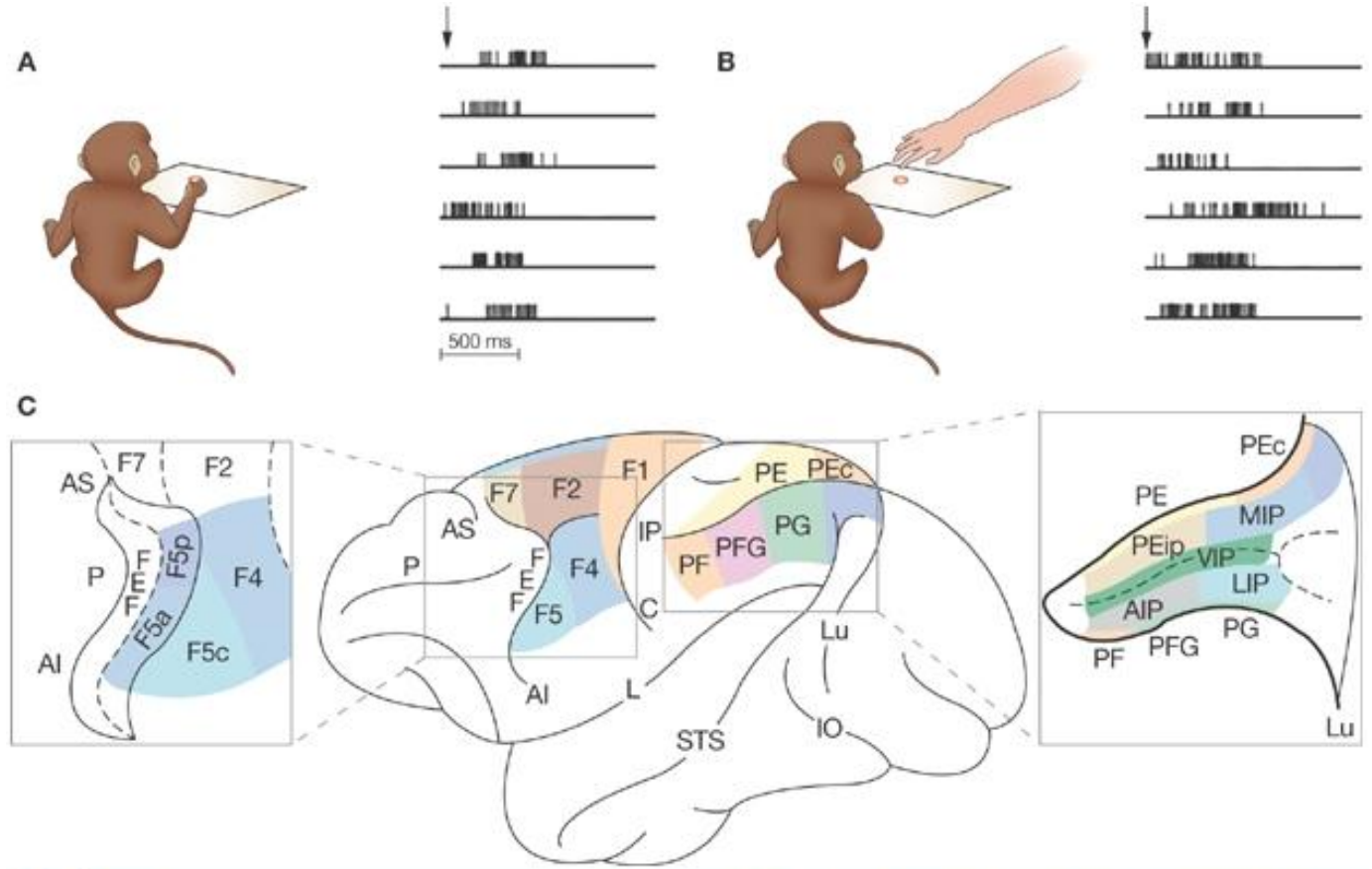
What robots can do



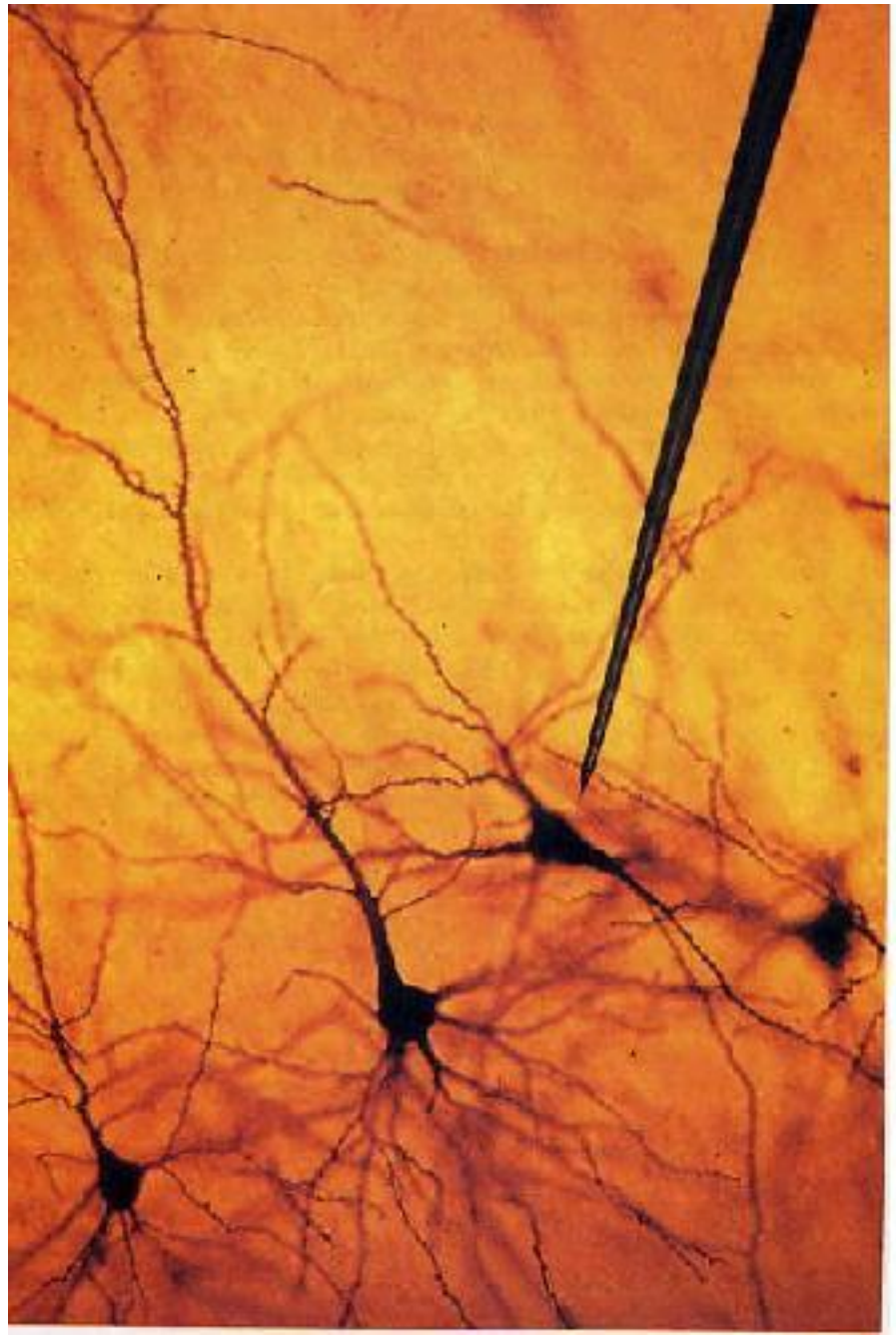
Macaque visuo-motor system for grasping



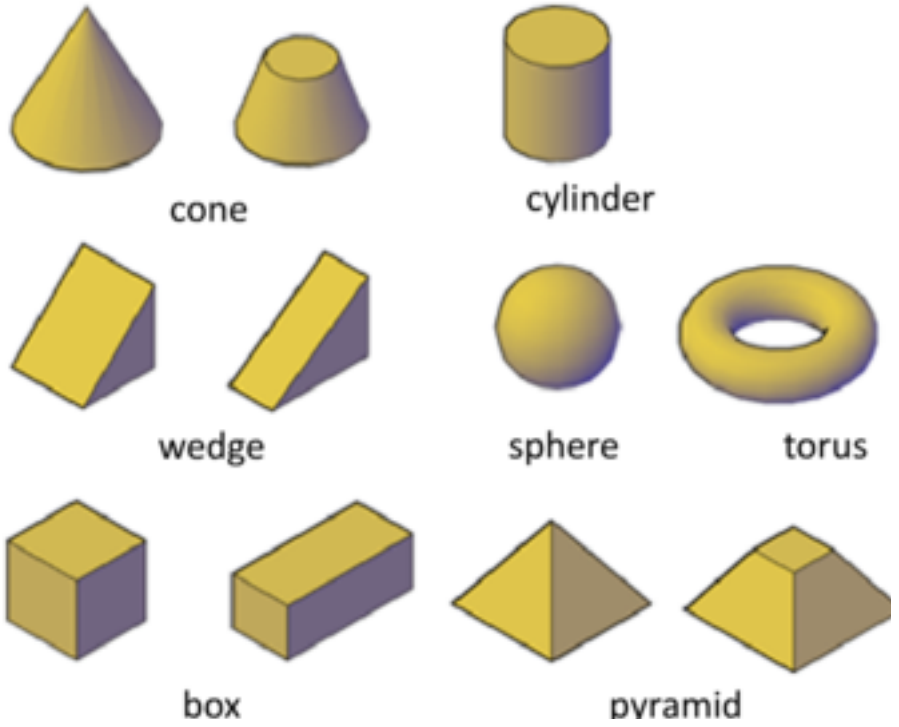
- V3: Depth (stereo)
- CIP: Curvature and Orientation
- AIP: Size, shape
  - **Affordances**

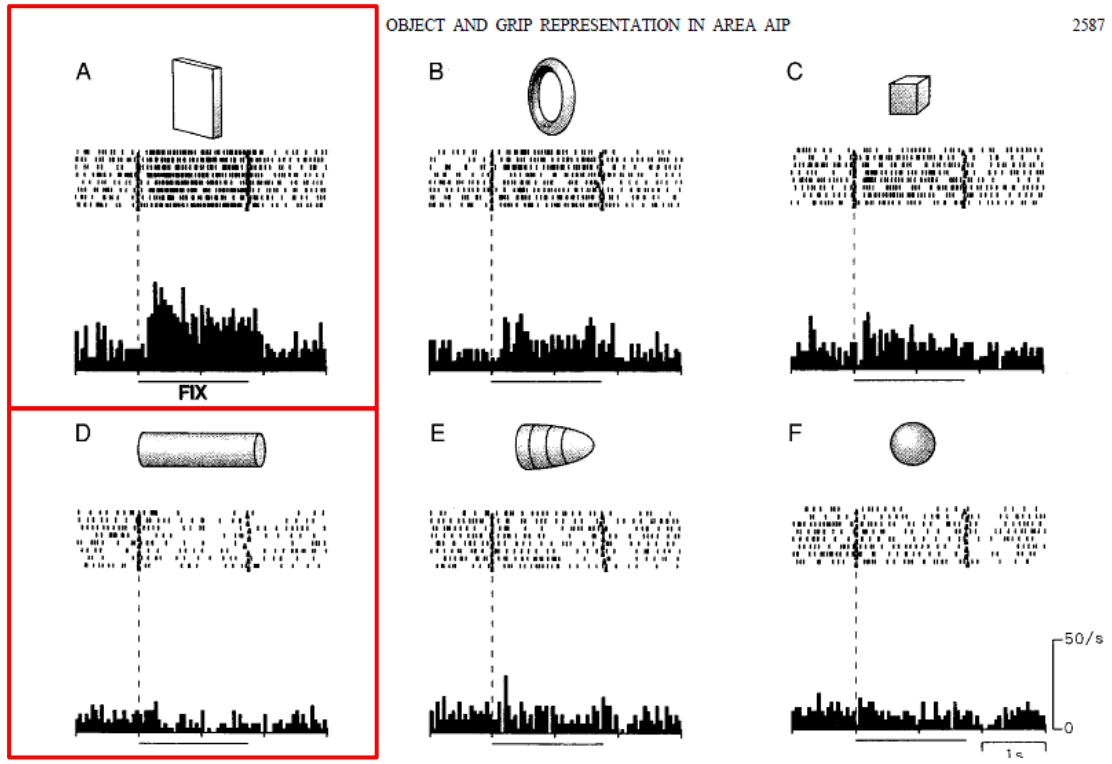


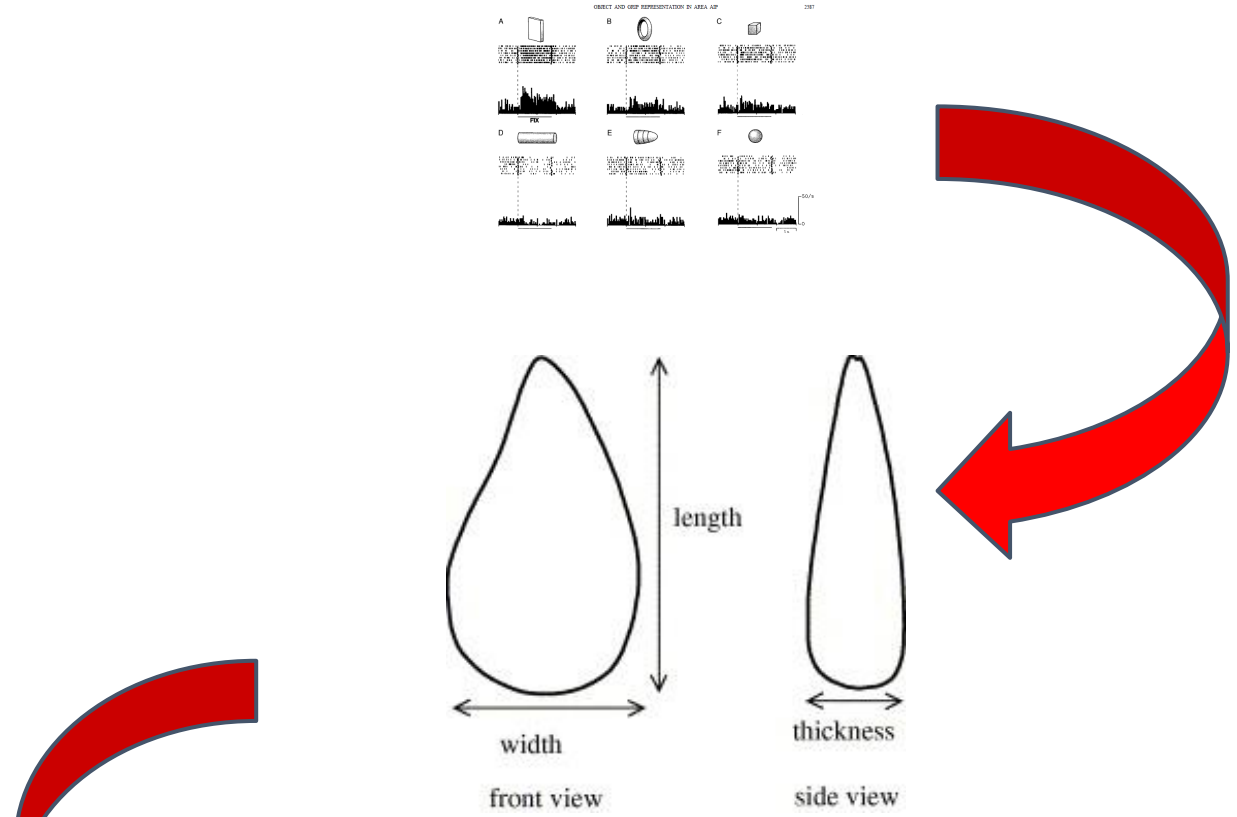
Medscape Source: Nat Clin Pract Neurol © 2009 Nature Publishing Group

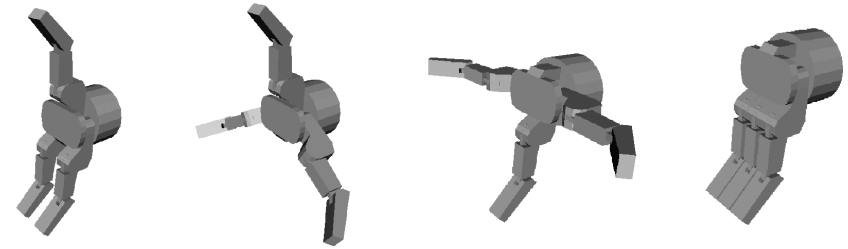


Modelling visual influences on primate grasping



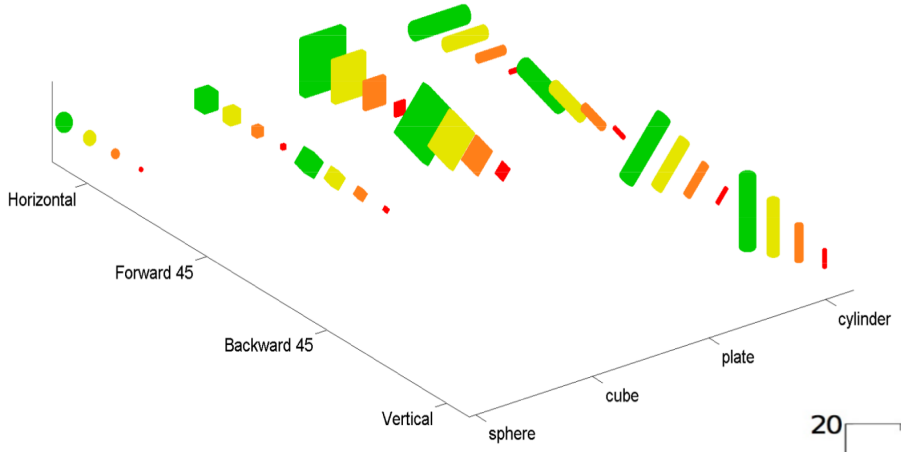


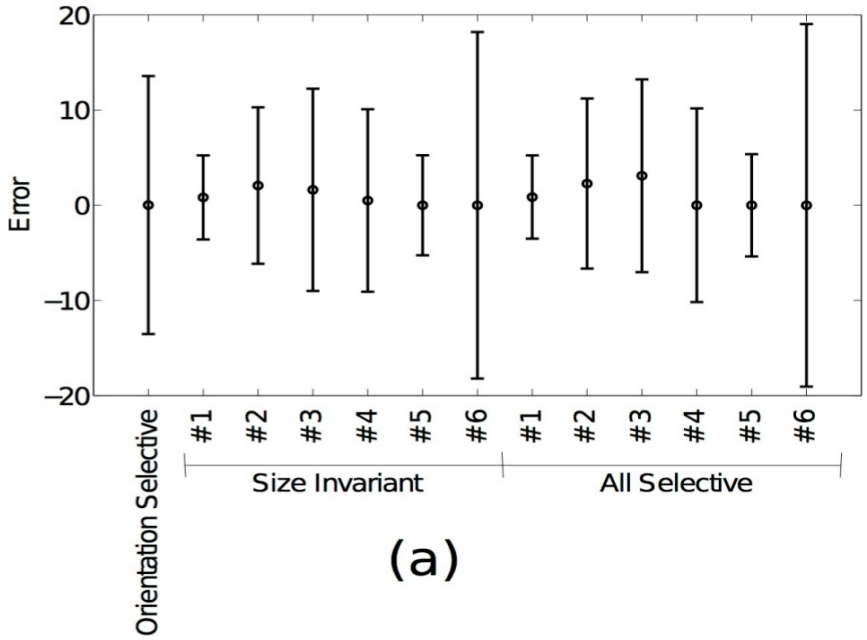




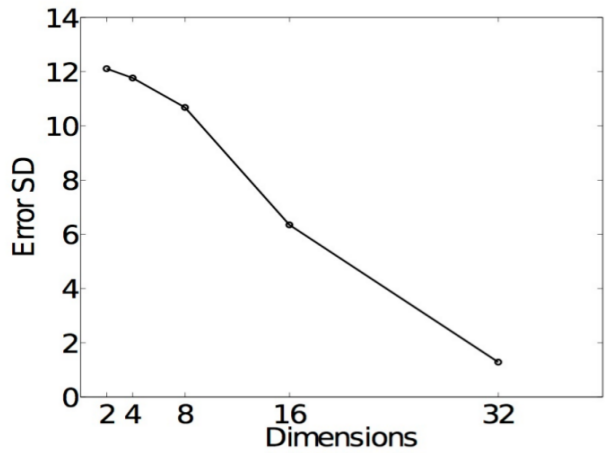
(**a**) Cylindrical grasp (**b**) Spherical grasp (**c**) Pinch grasp (**d**) Hook grasp

Modelling 3D features in neurons

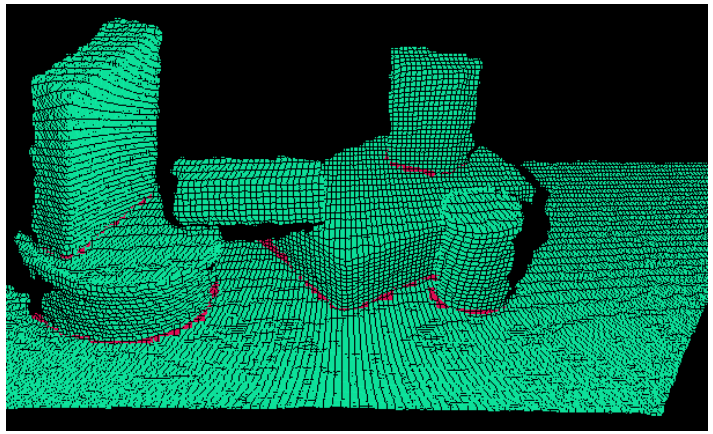


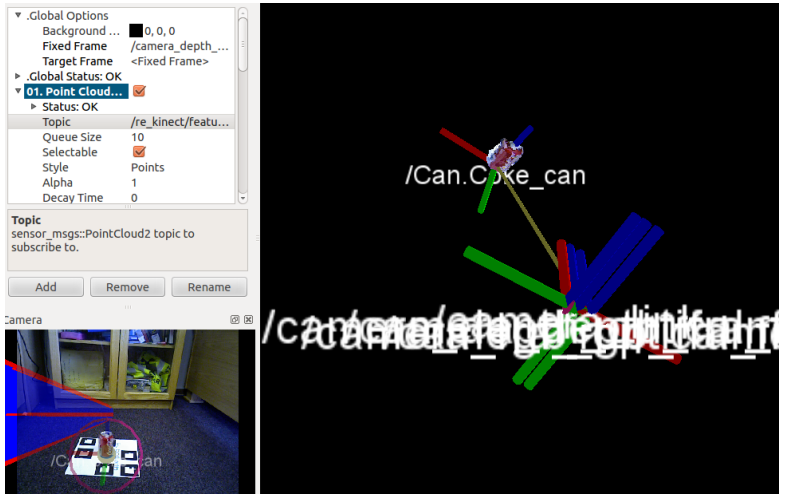


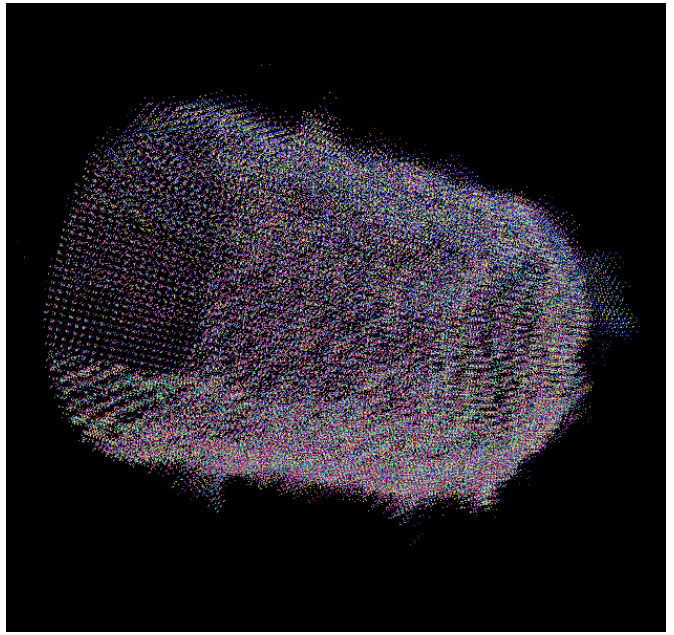
(a)



(b)



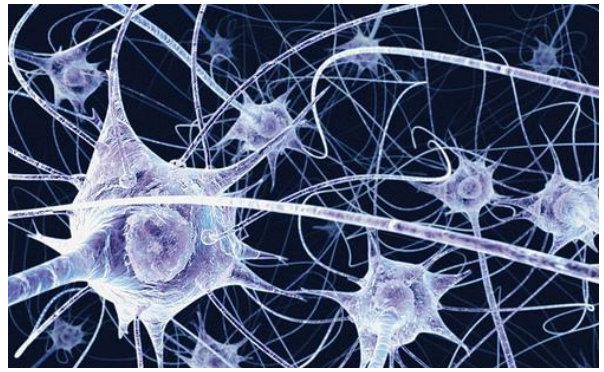




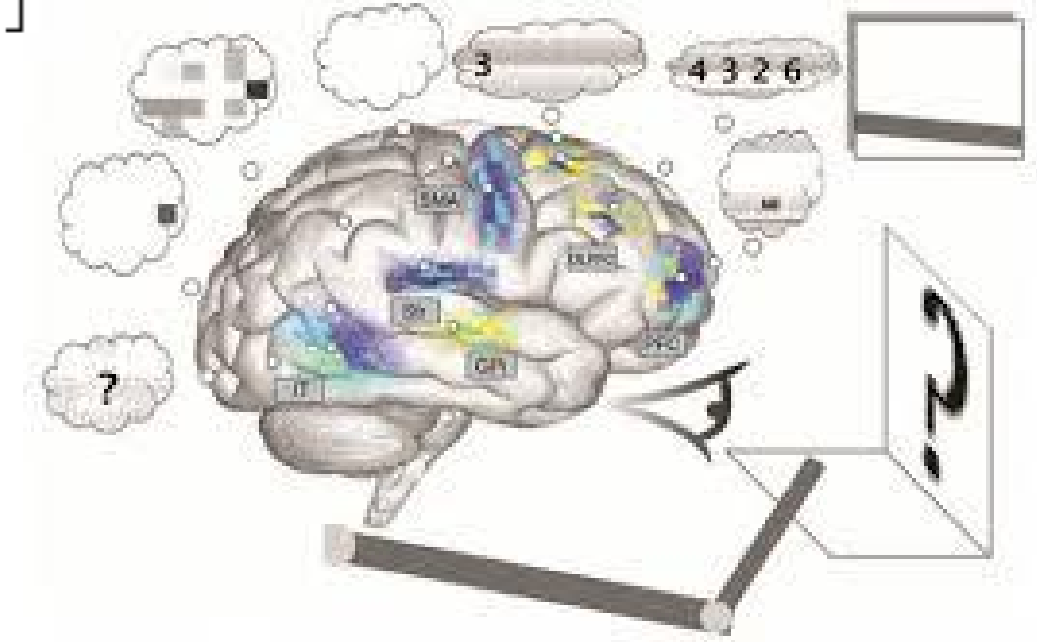
- Database
- Metadata
- 10 Classes.. 10 Objects.. 10 Views.. 10 Grasps

Modelling cognitive influences on primate grasping

Neural Engineering Framework (NEF)



- Map between high-level function and neural activity
- Encoding $r_i = G\left[\mathbf{e}_i^T \mathbf{x} + b_i\right]$
- Decoding $\hat{\mathbf{x}} = \sum_i \mathbf{d}_i r_i$



Holographic Reduced Representations (HRRs): Tony Plate

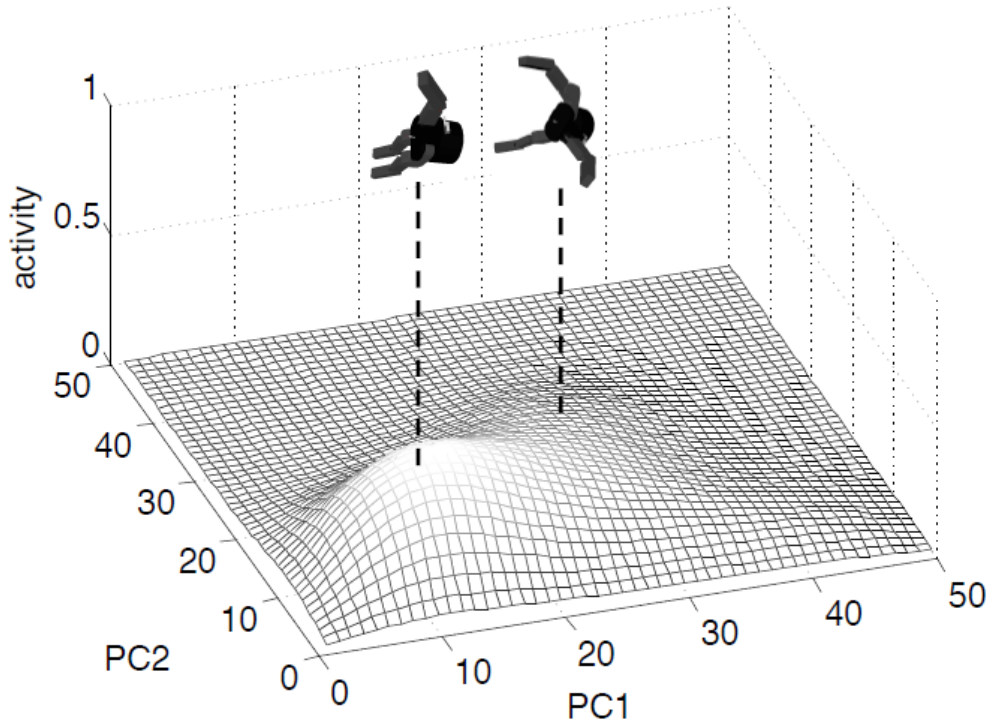
[DOG] [BITES] [MAN]

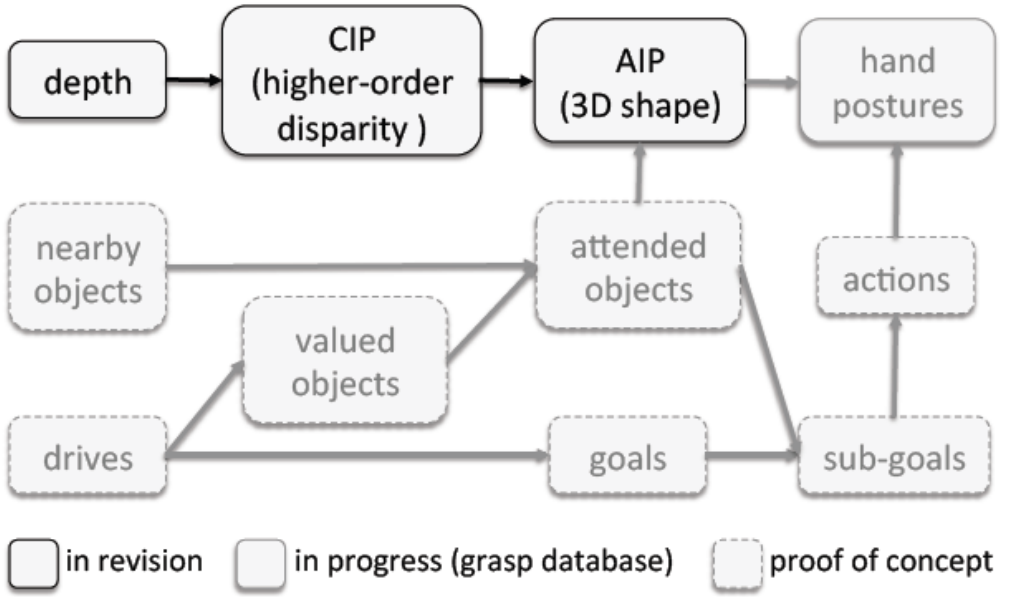
Binding: [DOG $\circledast$ BITES $\circledast$ MAN]

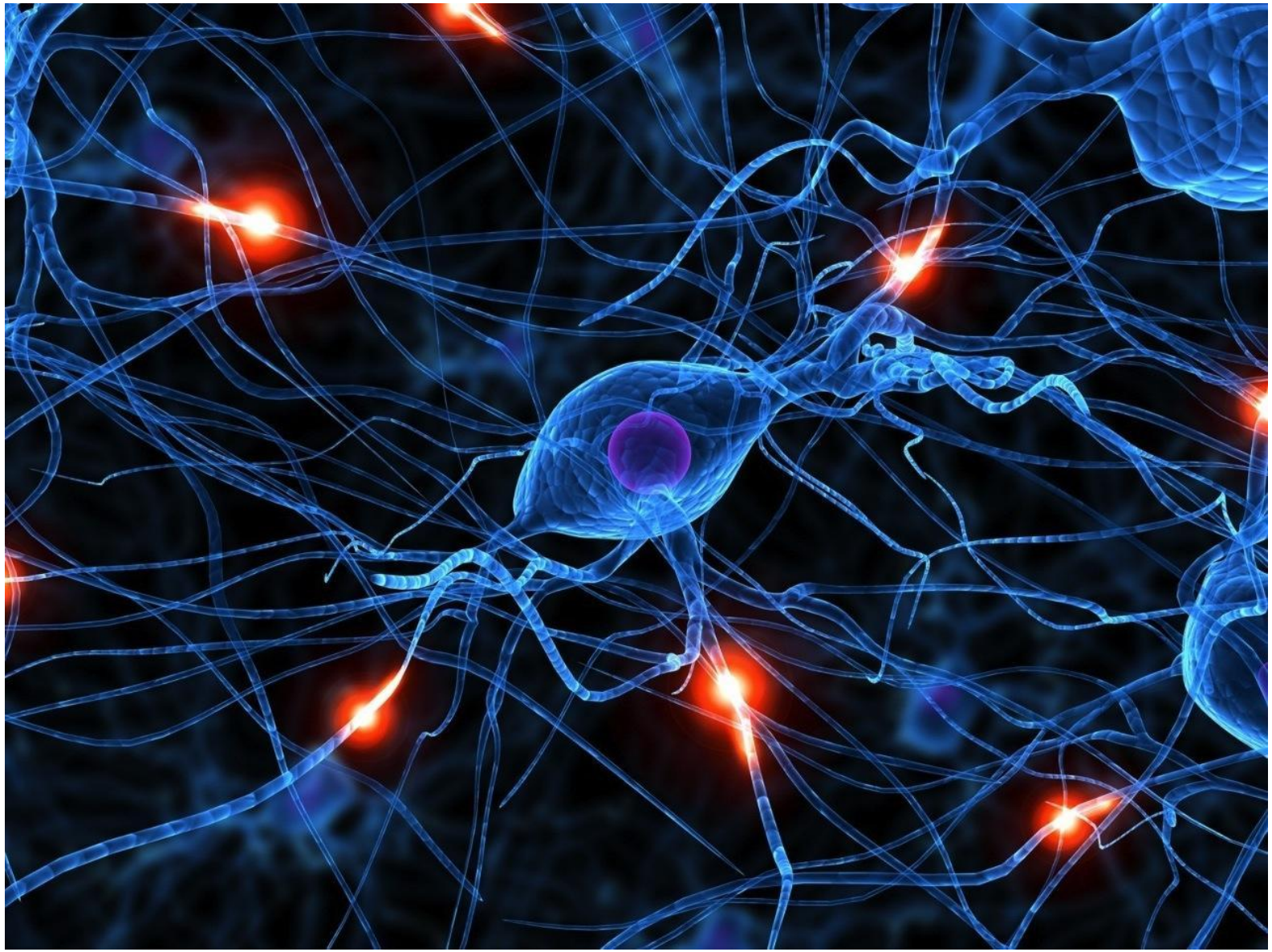
(Equal in magnitude)

Unbinding: Circular correlation

Our model


activity
1
0.5
0
50
40
30
20
10
0
PC2
0
10
20
30
40
50
PC1


depth
CIP
(higher-order
disparity)
AIP
(3D shape)
hand
postures
nearby
objects
attended
objects
actions
valued
objects
drives
goals
sub-goals
in revision
in progress (grasp database)
proof of concept



Thank you!

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