



Of Monkeys and Men

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Outline

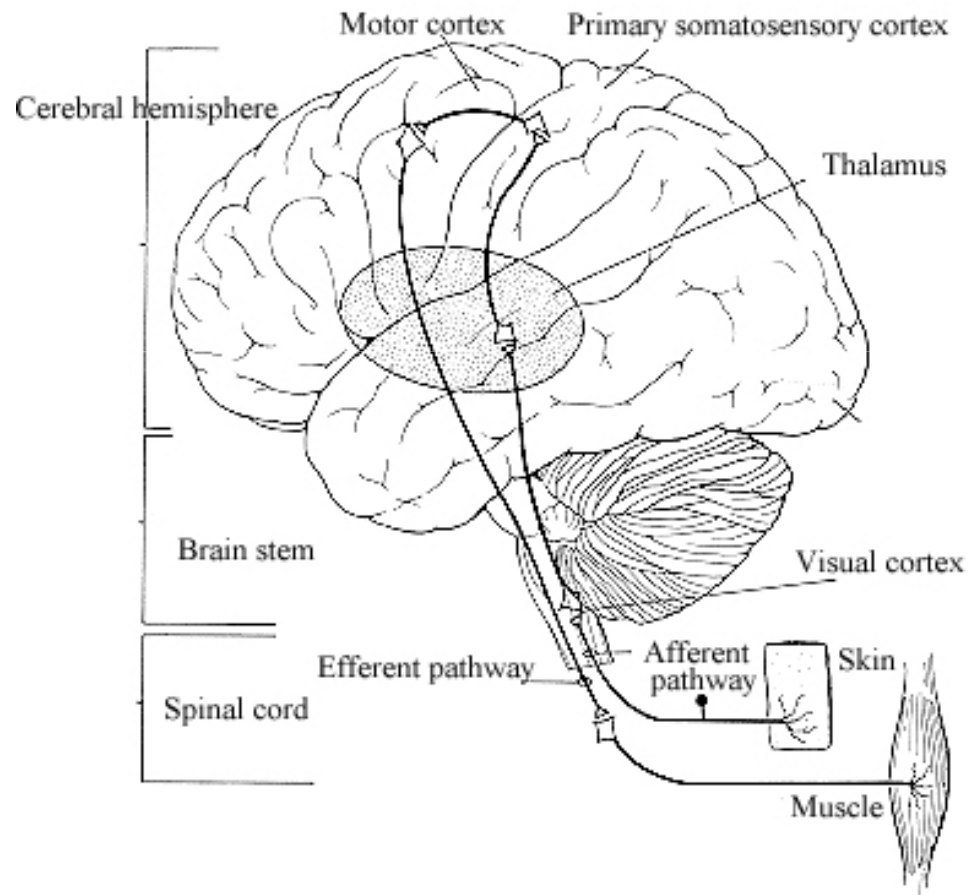
- Why neuroprosthetics?
- Biological background
- 2 groups
 - University of Reading
 - University of Pittsburgh
- Conclusions



Why Neuroprosthetics?

- Amputations
 - Paralysis
 - Spinal cord injuries
 - Stroke
 - Neurological diseases
 - Amyotrophic lateral sclerosis (ALS)
 - Multiple sclerosis
 - Muscular dystrophy
- Locked-in syndrome

Biological Background

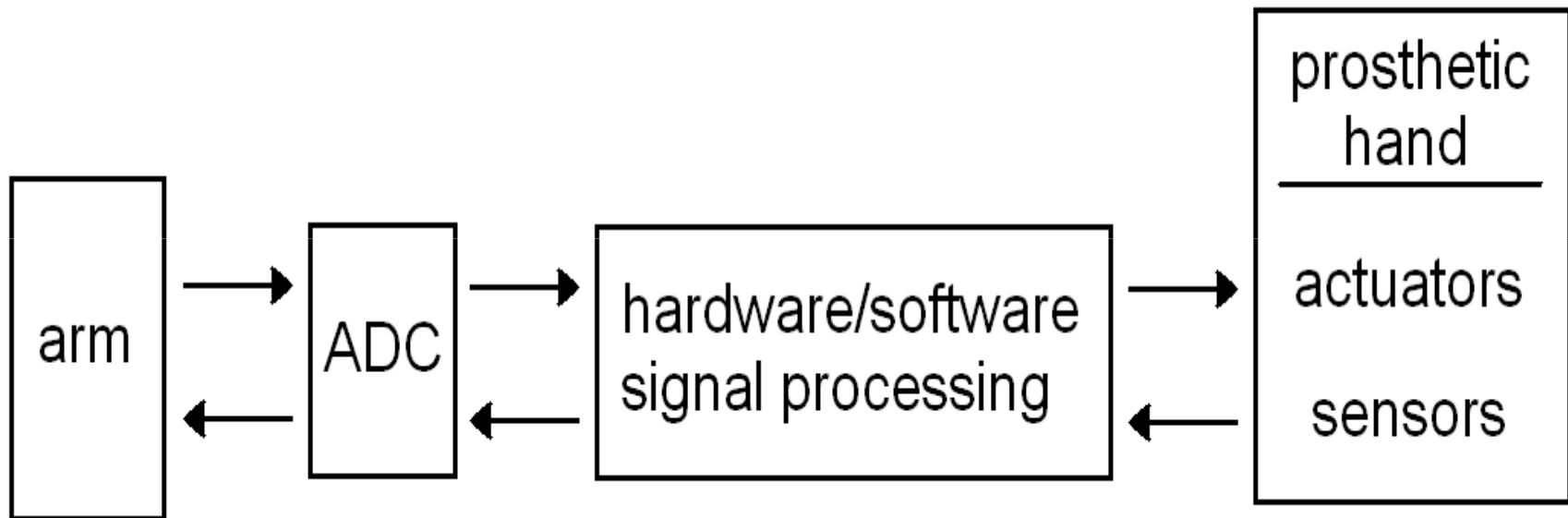




2 Groups

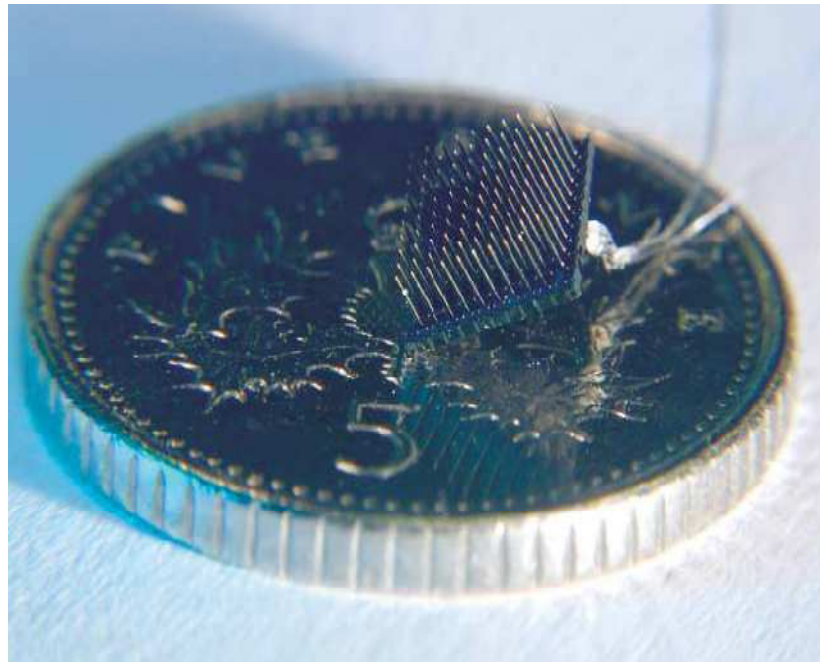
- University of Reading (UK)
 - Direct bi-directional prosthetic hand
 - Interface with median nerve of human left arm
- University of Pittsburgh
 - Indirect bi-directional control of prosthetic arm
 - Interface with motor cortex in monkey

Reading



Electrode Array

- 100 electrodes
- 4x4 mm, 1.5mm length

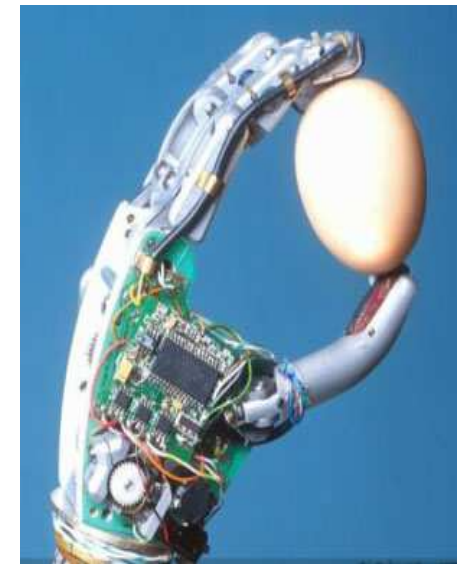
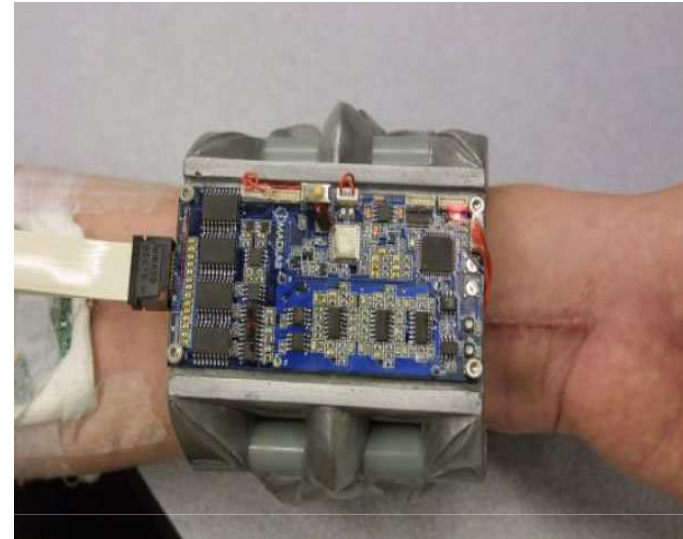
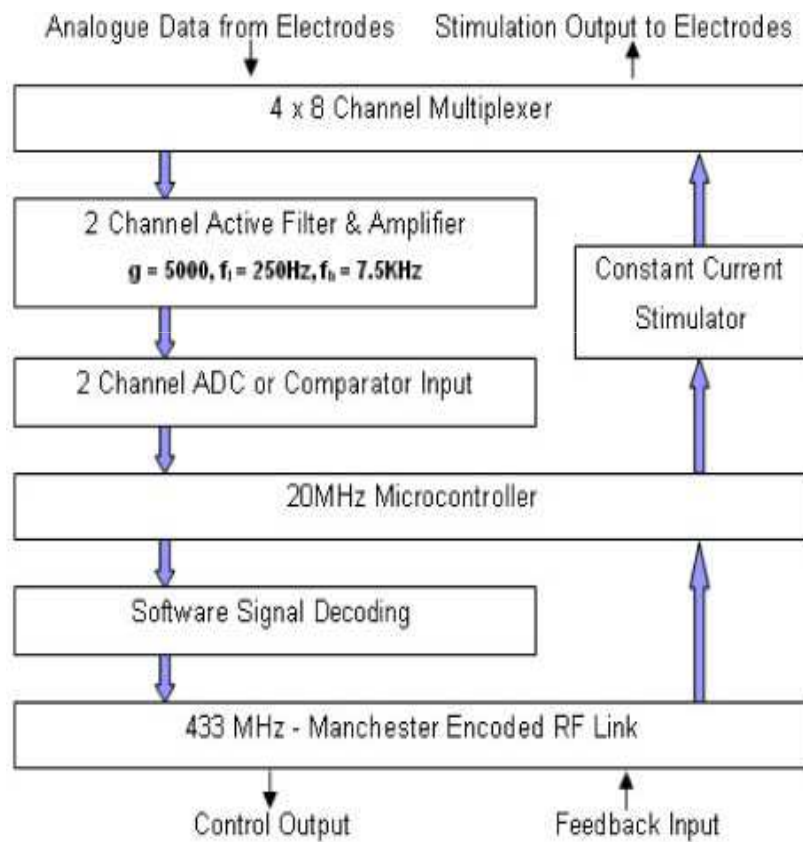


Implantation

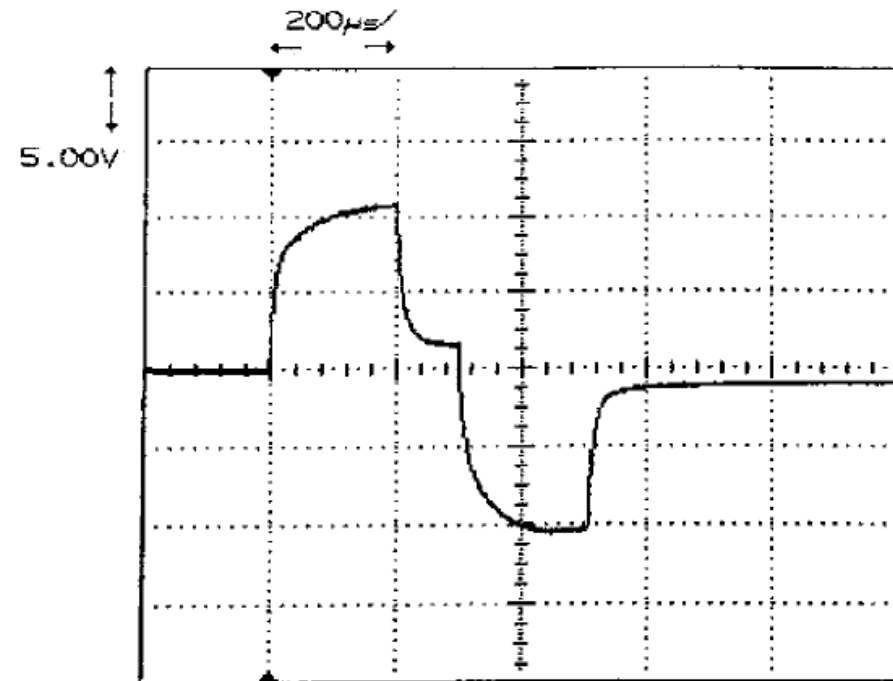
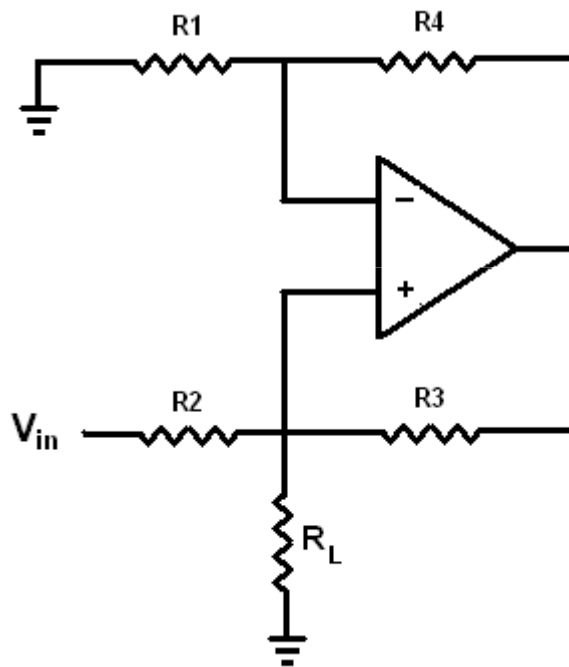
- Median nerve



Hardware



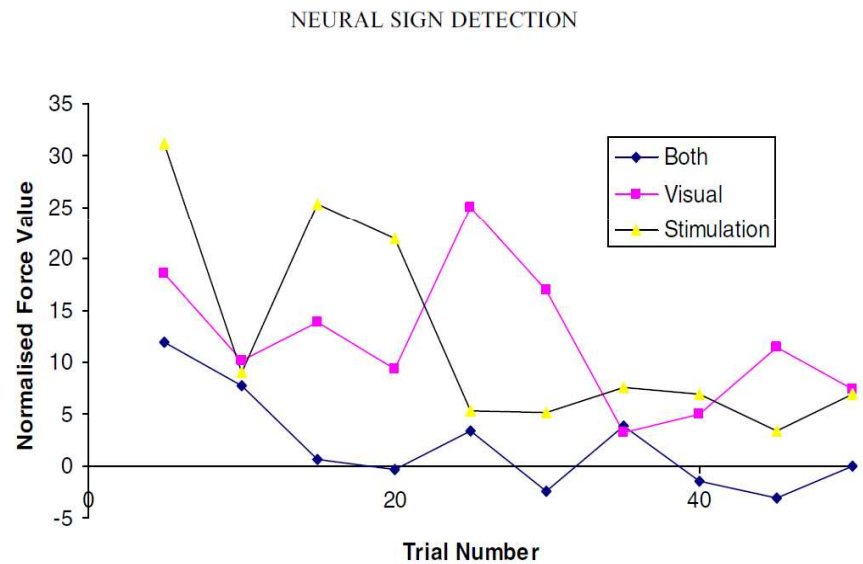
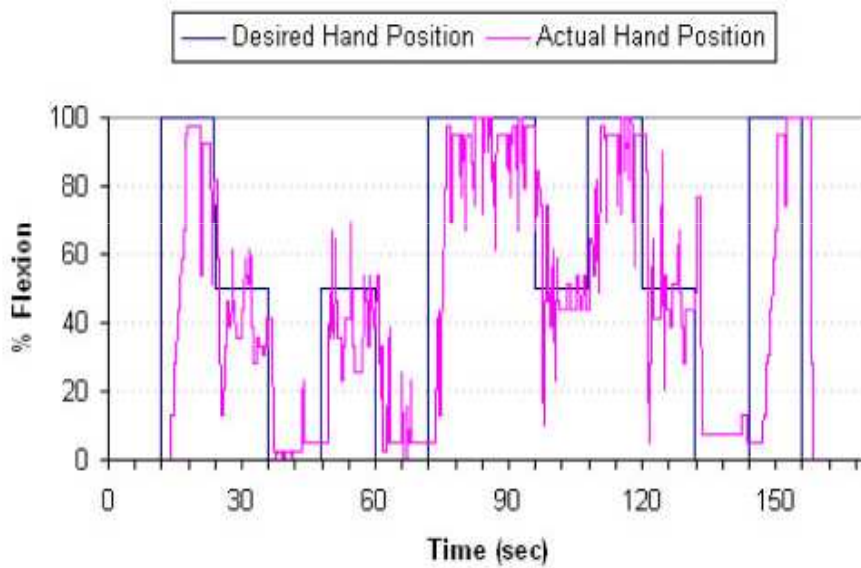
Current Source



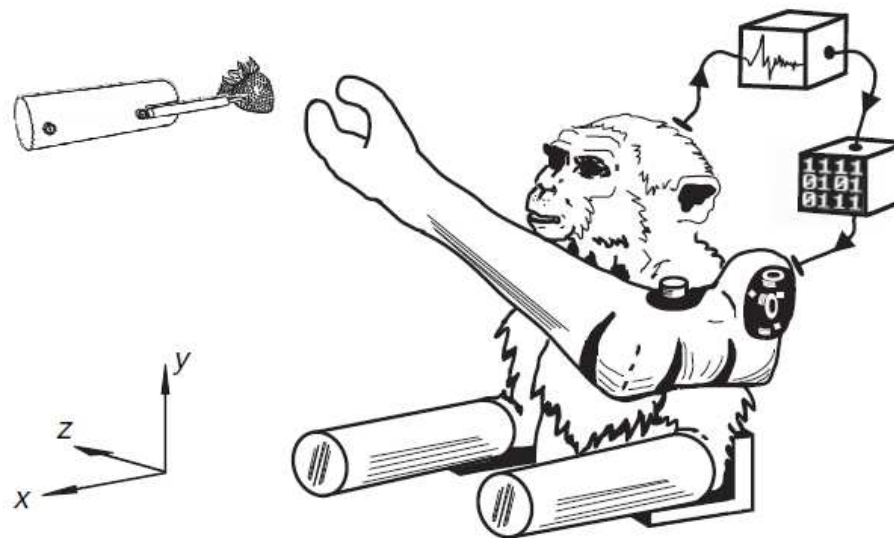
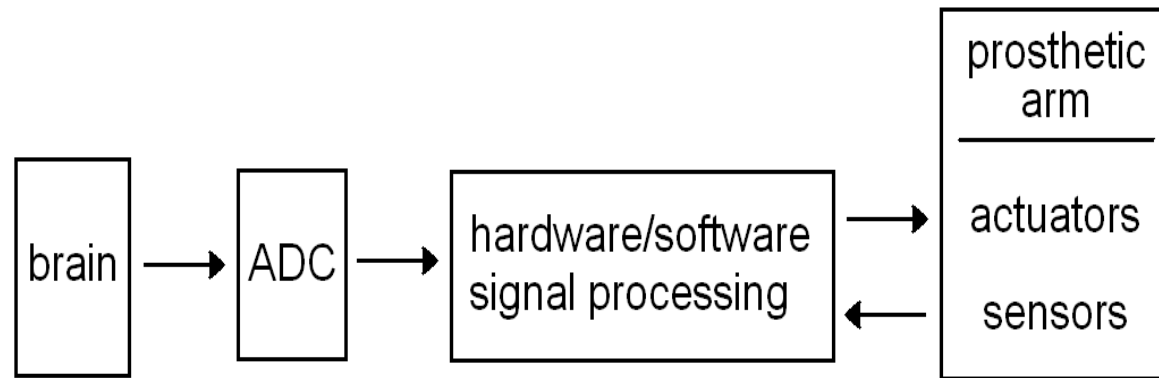
■ Howland configuration

■ Single bi-phasic pulse

Results

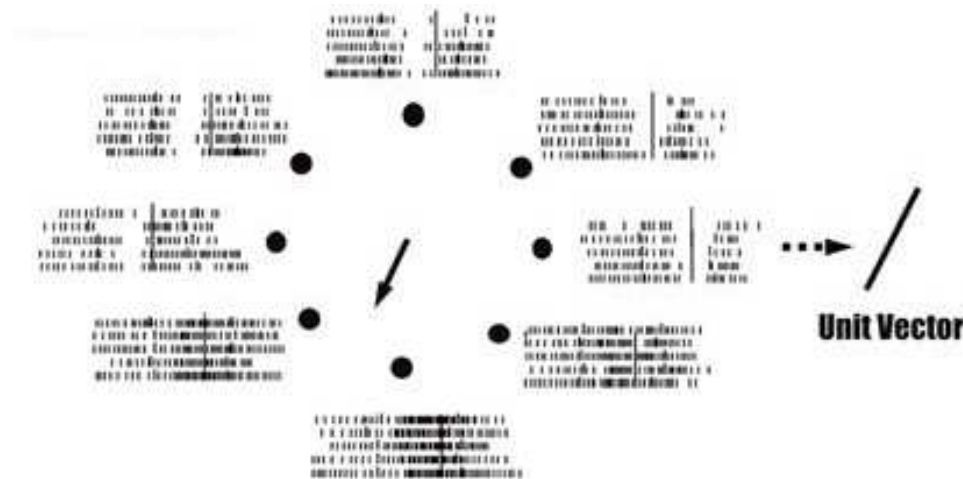


Pittsburgh

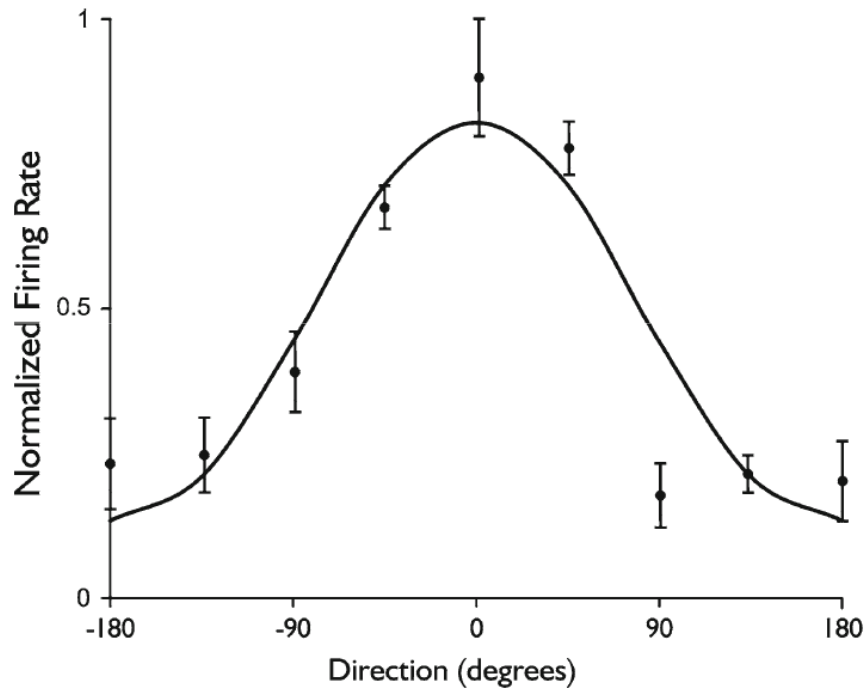


Population Vector

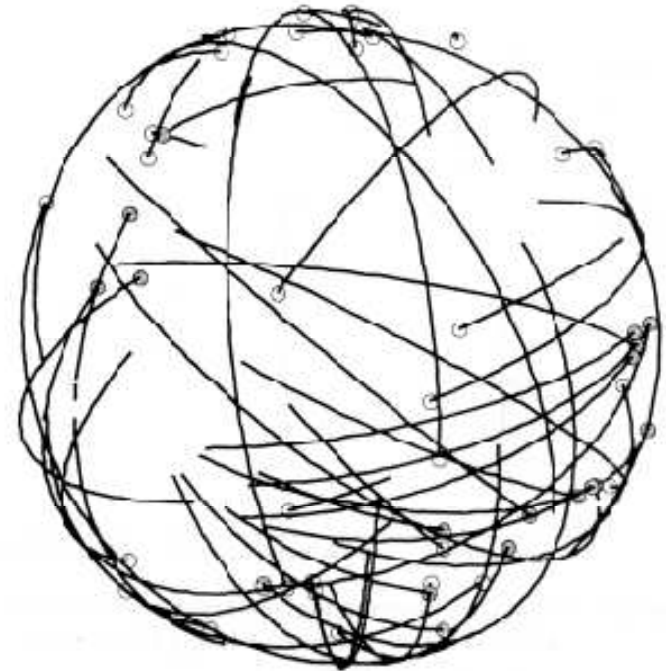
- Firing Rate = $a_0 + a_1X + a_2Y + a_3Z$
- Pop vector = $[a_1, a_2, a_3]$



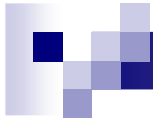
Adaptive Algorithm



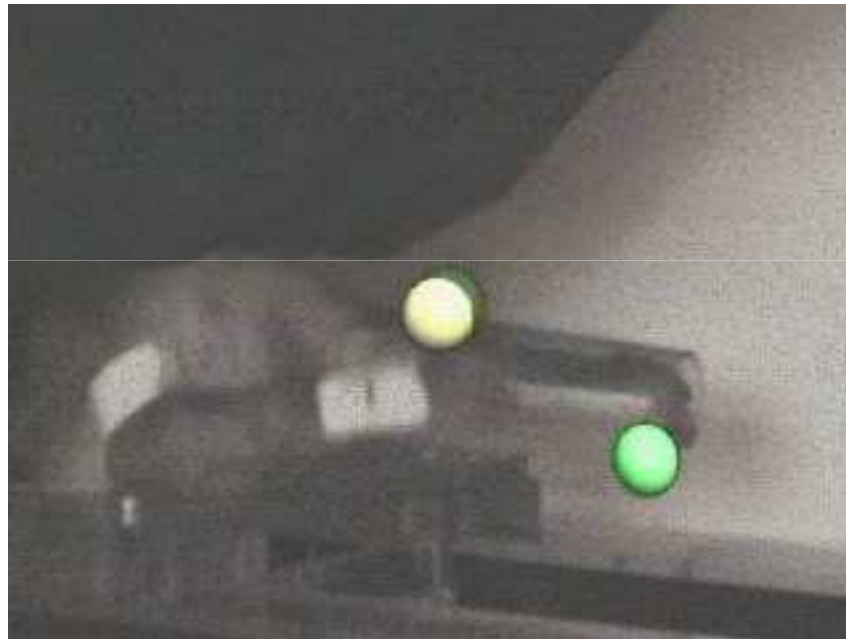
- Cosine tuning



- Changes in preferred directions over time



Virtual Simulation



Prosthetic Testing



Video Source: [8]

Finger Licking Good





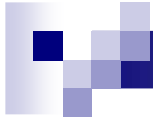
Conclusions

■ Reading

- Pros: sensory feedback, natural
- Cons: electrodes degrade, invasive, relies on functional nerves

■ Pittsburgh

- Pros: directly from motor cortex
- Cons: electrodes degrade, extremely invasive, only visual feedback



Next Steps

- Sensory feedback directly to sensory cortex



References

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