

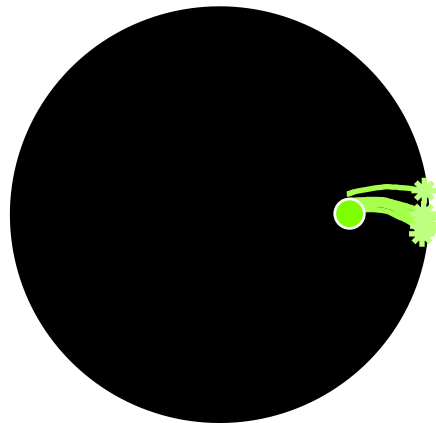


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# Non-contact control of a floating object via environmental manipulation

David Hardman

Bio-Inspired Robotics Lab, University of Cambridge



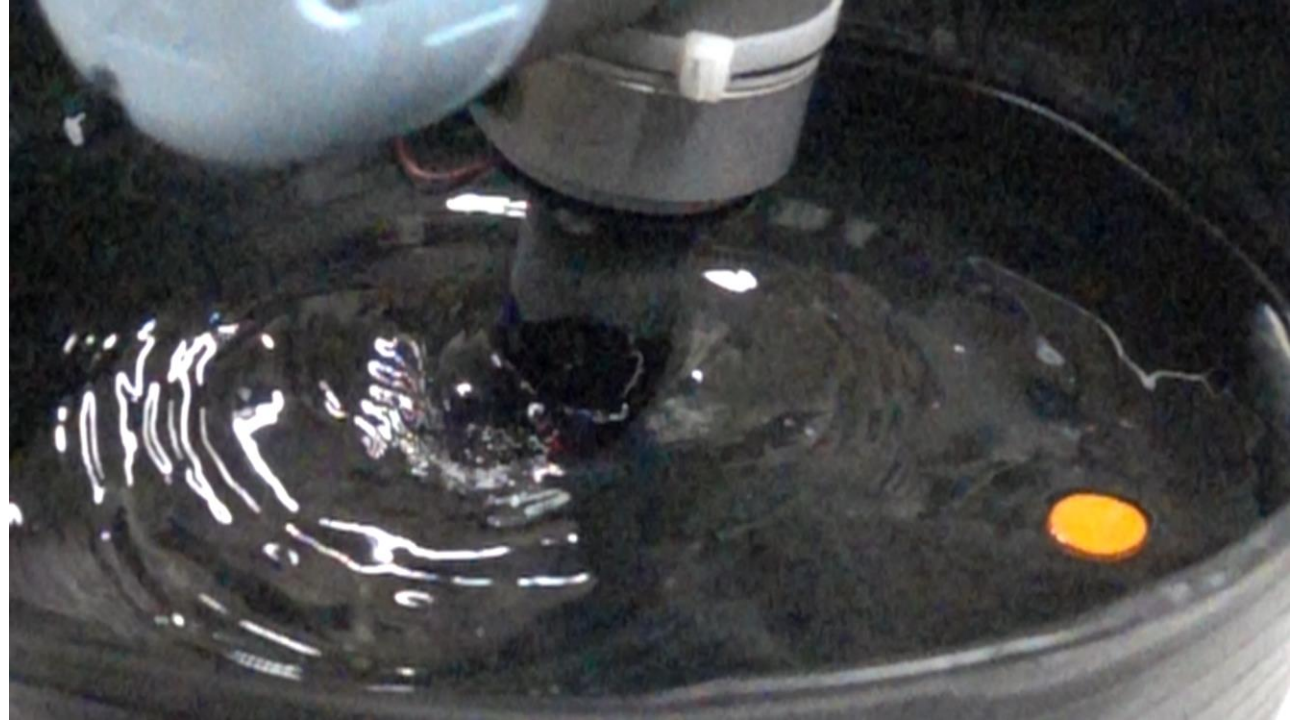
# The System

- Circular water container actuated centrally



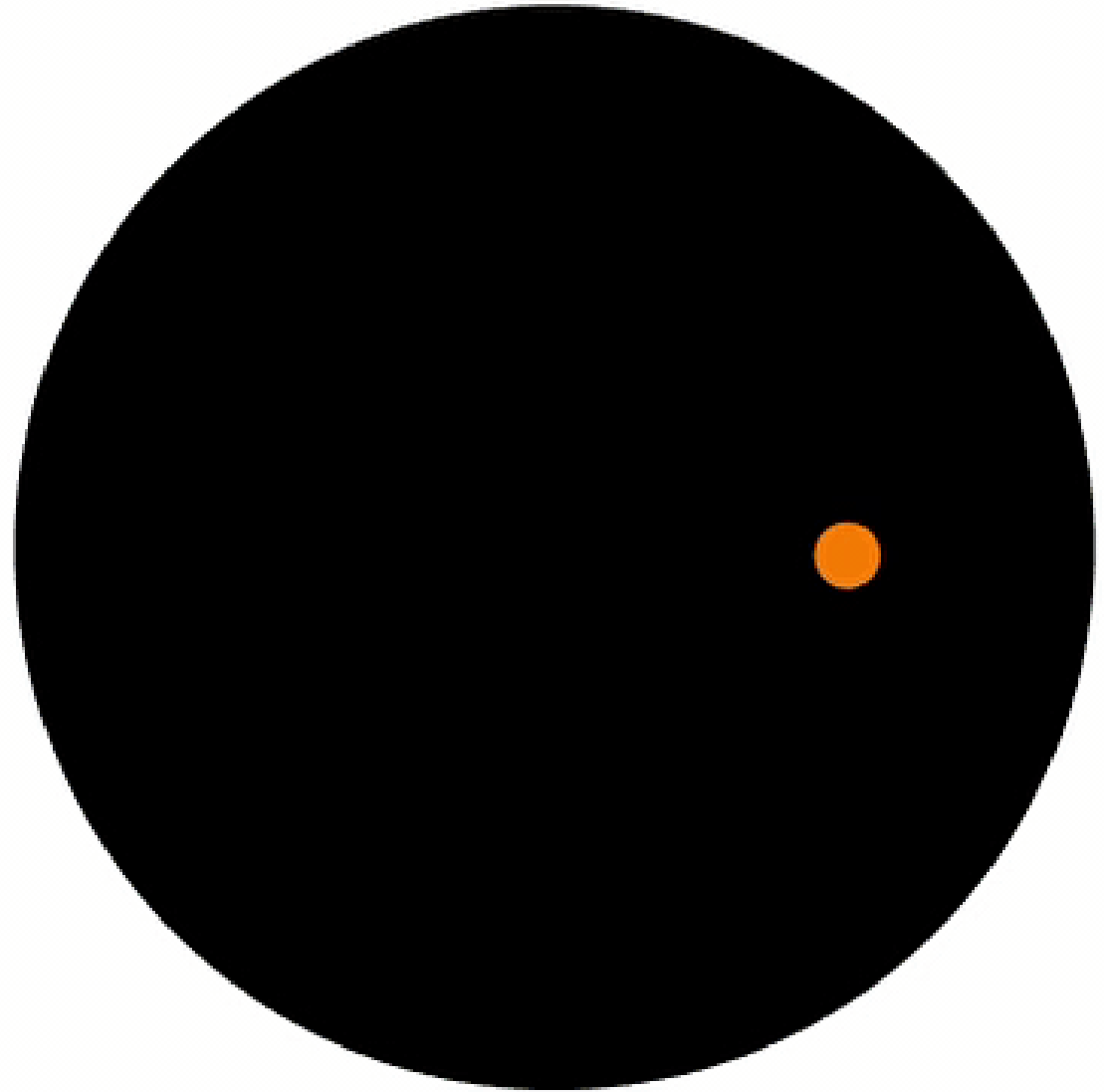
# The System

- Circular water container actuated centrally
- Floating foam disc
- Capillary interactions → macroscopic behaviours



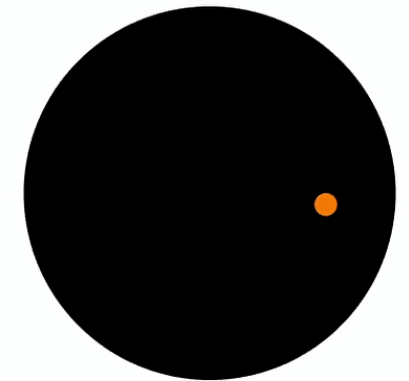
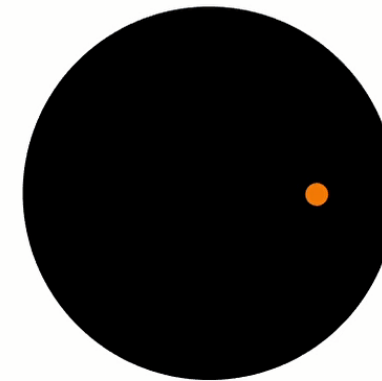
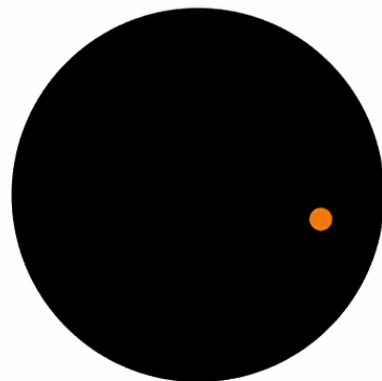
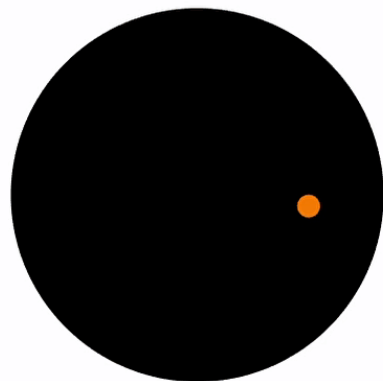
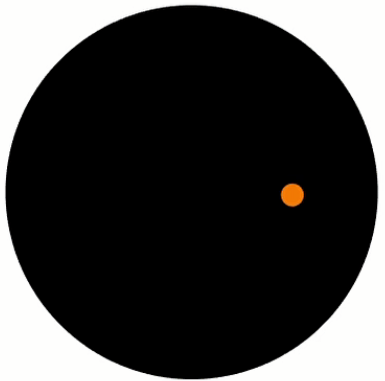
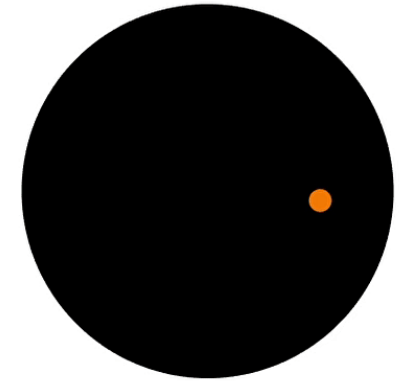
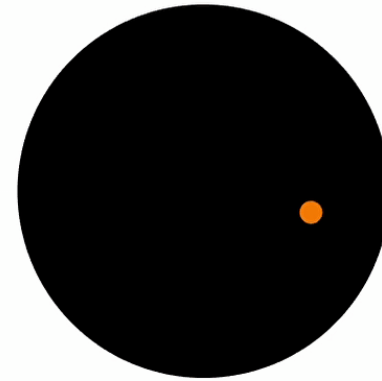
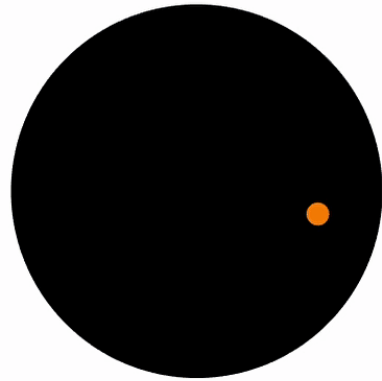
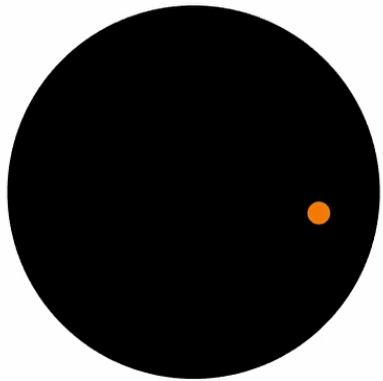
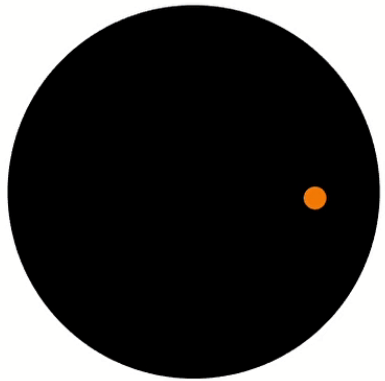
# The System

- Circular water container actuated centrally
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# The Difficulties

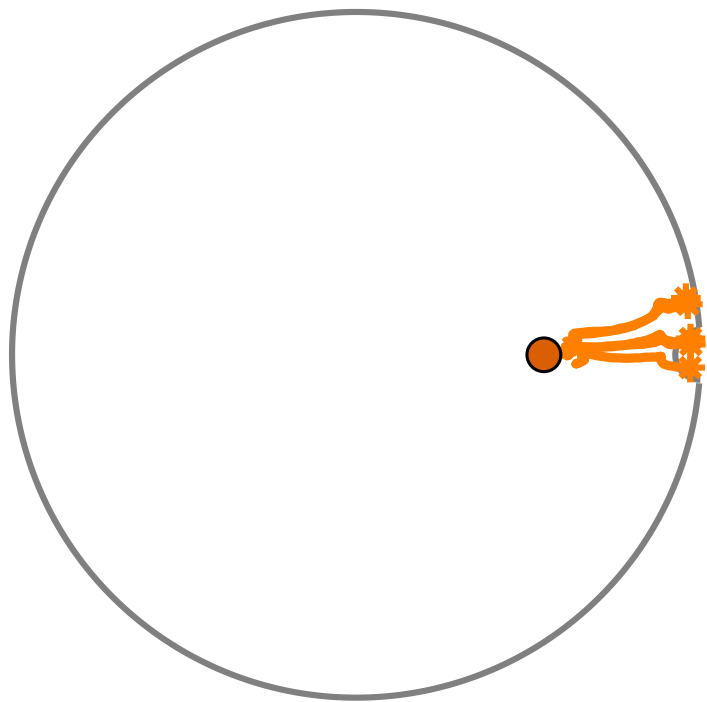
- *Underactuation, inertial effects*
- *Bifurcations, turbulence, limited repeatability*



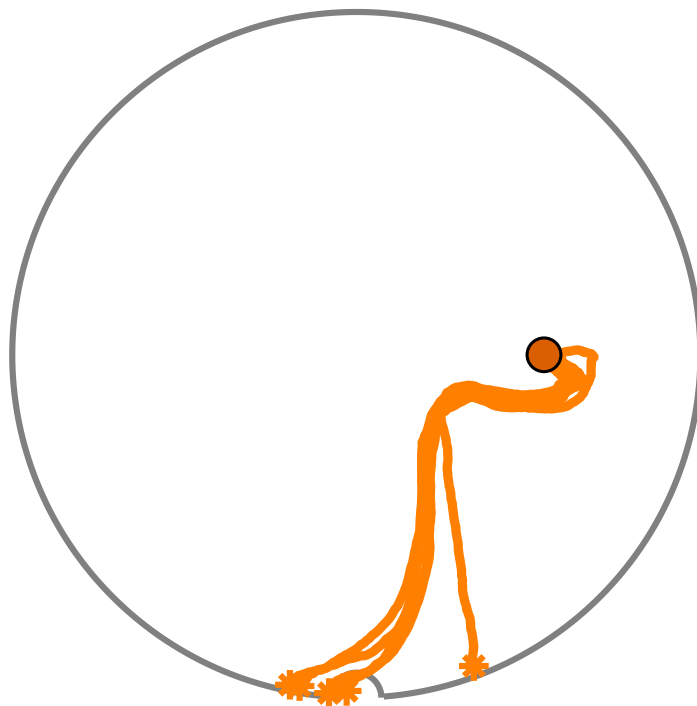


# Bayesian Optimisation

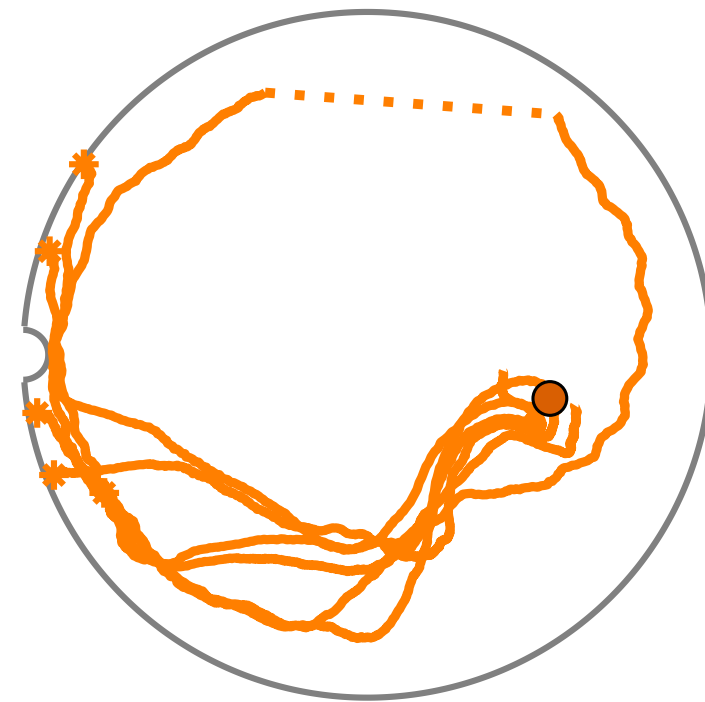
0°



90°



180°



# Reinforcement Learning

0°



●  
Agent 1000



●  
Agent 3000

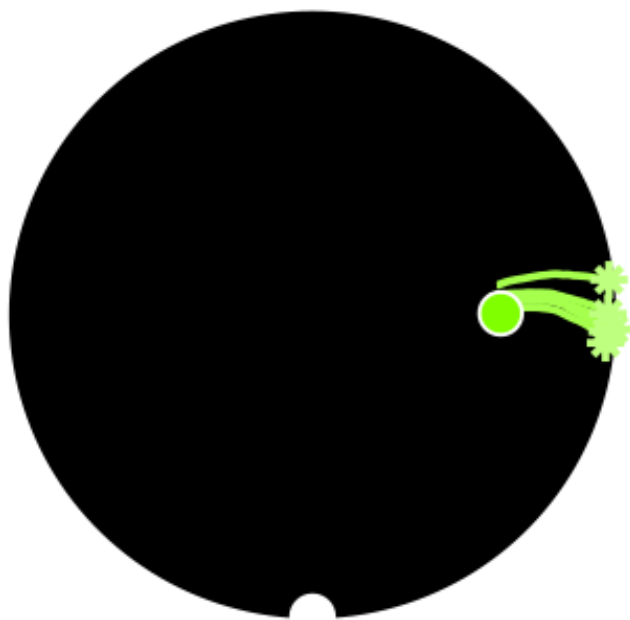


●  
Agent 5000



# Reinforcement Learning

90°



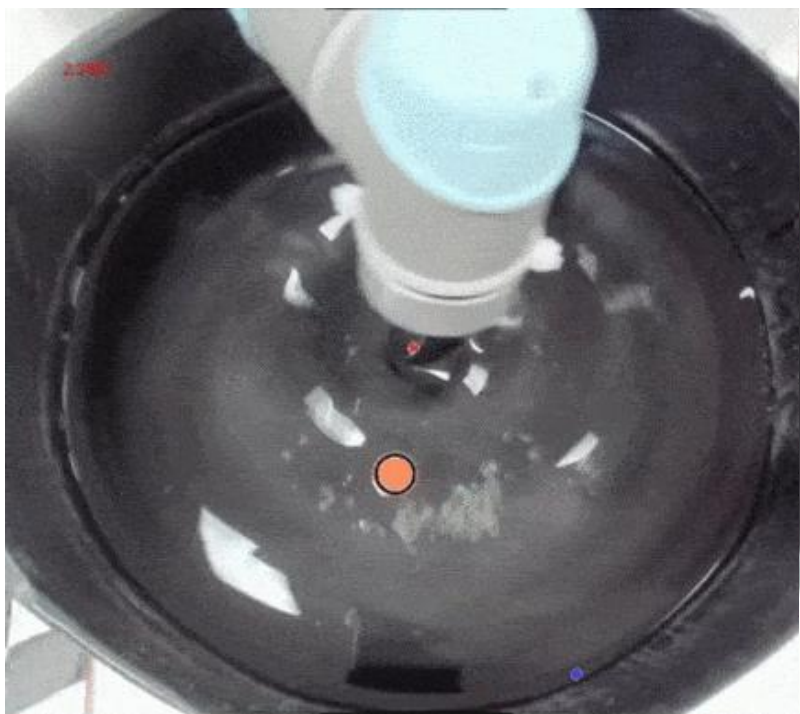
●  
Agent 1000



●  
Agent 3000



●  
Agent 5000



# Solution Transferability

*Changes in morphology shift behavioural boundaries*

20mm Circle



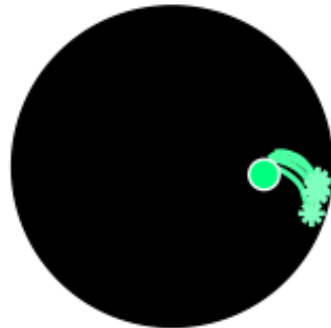
8mm Circle



46mm Circle



72mm Circle



22mm Square



35mm Square



25mm Quatrefoil





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