

Questions to guide your reading – Week 2

Paper 1. Lobato-Ríos et al., “NeuroMechFly, a neuromechanical model of adult *Drosophila melanogaster*.” *Nature Methods* (2022).

Q1: What are the opportunities provided by using neuromechanical animal models in neuroscience?

Q2: What are some advantages of using the adult fly, *Drosophila melanogaster*, for neuroscience research?

Q3: Why is it important for NeuroMechFly to have an accurate body morphology and accurate joint degrees of freedom?

Q4: What new kinds of behavioral analyses can be accomplished using NeuroMechFly by performing “kinematic replay” of real animal behaviors such as grooming and walking?

Q5: Towards achieving what goal did the authors use evolutionary optimization to parameterize the oscillator network and muscle parameters of NeuroMechFly?

Q6: How might NeuroMechFly be improved in the future and what new experiments might these improvements enable?

Paper 2. Wang-Chen S et al., “NeuroMechFly v2: simulating embodied sensorimotor control in adult *Drosophila*.” *Nature Methods* (2024).

Q1: How does the FlyGym package facilitate updates to NeuroMechFly and Reinforcement Learning?

Q2: Why was it important for the authors to add leg tip adhesion to NeuroMechFly?

Q3: What were the three kinds of locomotor controllers explored and how did these distinct strategies perform with respect to speed and stability over flat and complex terrain?

Q4: How is the fly retina similar and different from the human eye?

Q5: How is the fly smell organ (antenna) similar and different from the human nose?

Q6: How were visual and olfactory signals transformed to generate forward locomotion and turning in NeuroMechFly?

Q7: Which two variables were integrated during path integration? How were they calculated?

Q8: What is the purpose of head stabilization for NeuroMechFly? In which kinds of task is it required?

Q9: Describe the task for which Reinforcement Learning (RL) was used. What information and movements did it have at its disposal?

Q10: What were two biorealistic environments and controllers described in the paper?