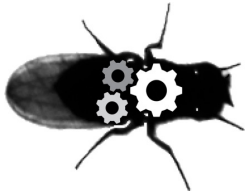
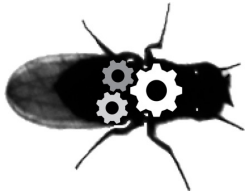
EPFL

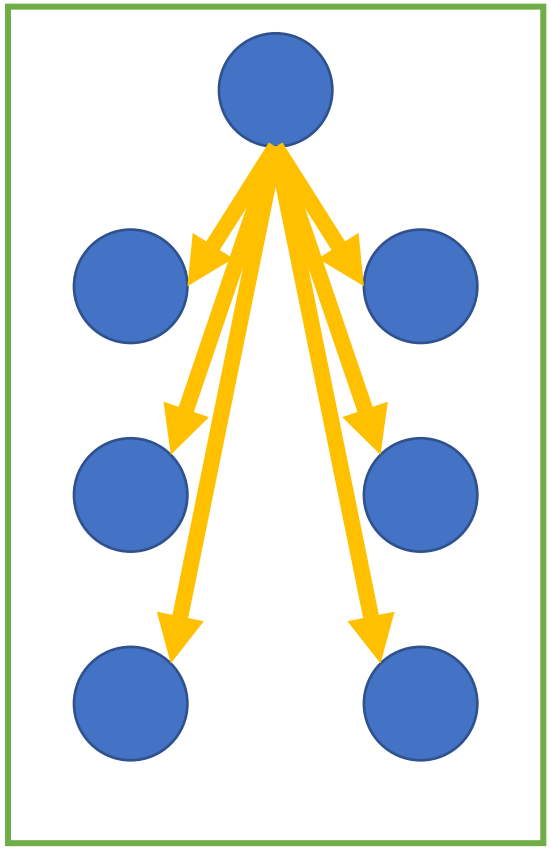


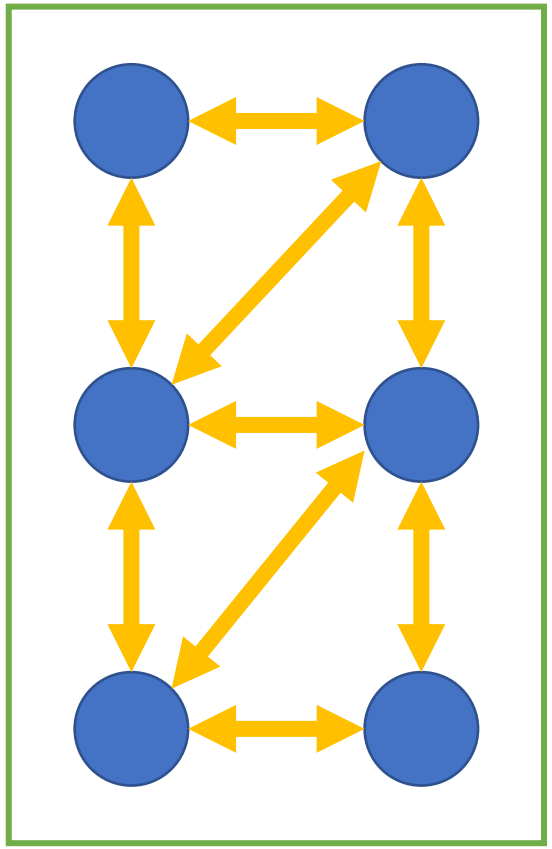
Introduction to central pattern generators (CPG)



Last week:

Decentralised or centralised?

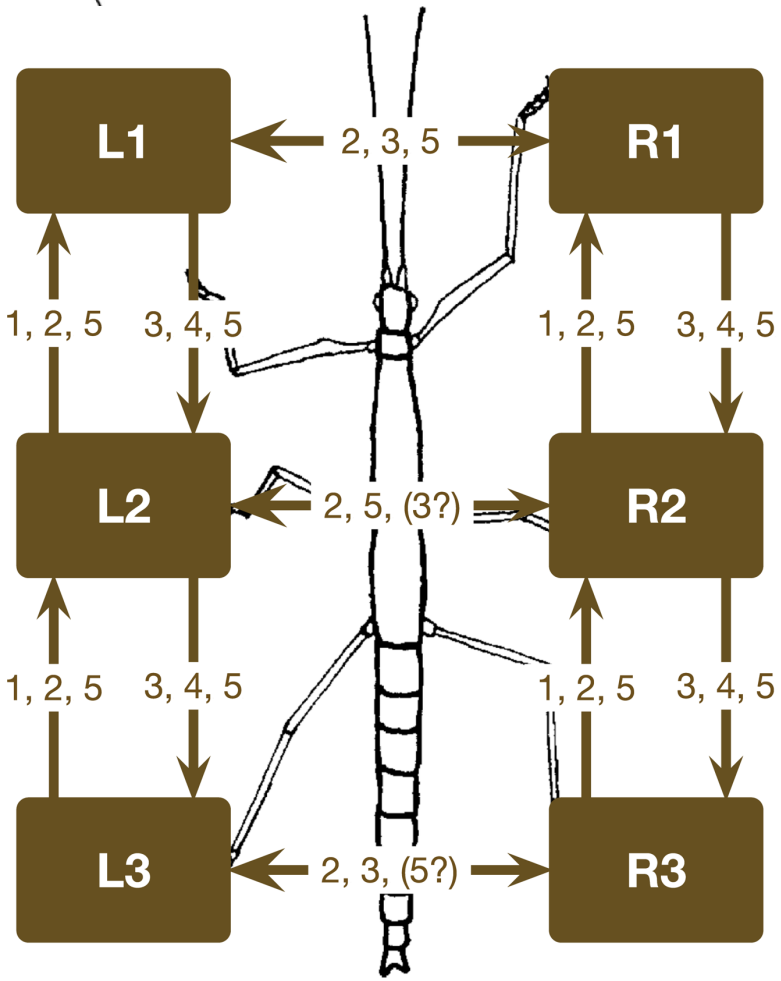




EPFL

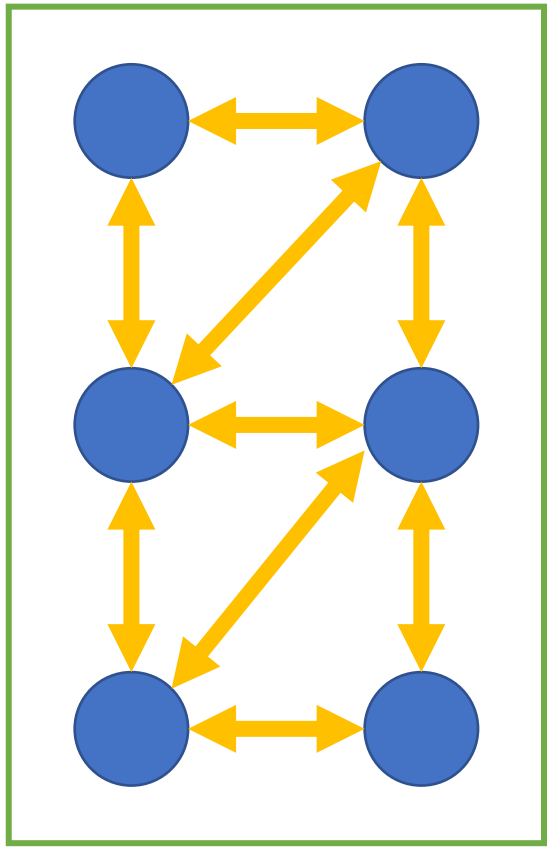
Last week:

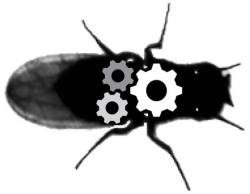
Decentralised or centralised?



M. Schiling et al. PLOS computational biology (2020)

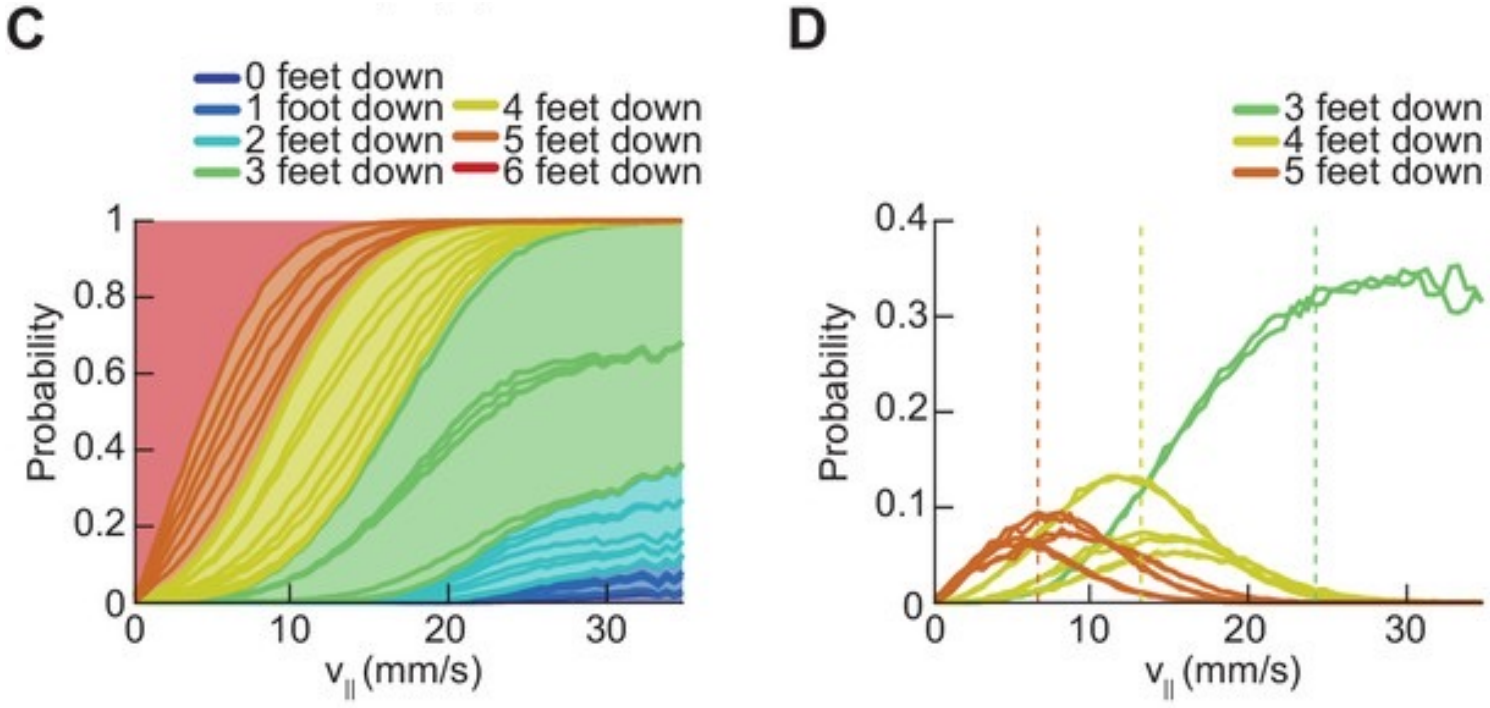
1. Return stroke inhibits start of return stroke
2. Start of power stroke excites start of return stroke
3. Caudal positions excite start of return stroke
4. ~~Position influences position at end of return stroke ("targeting")~~
5a. ~~Increased resistance increases force ("coactivation")~~





This week:

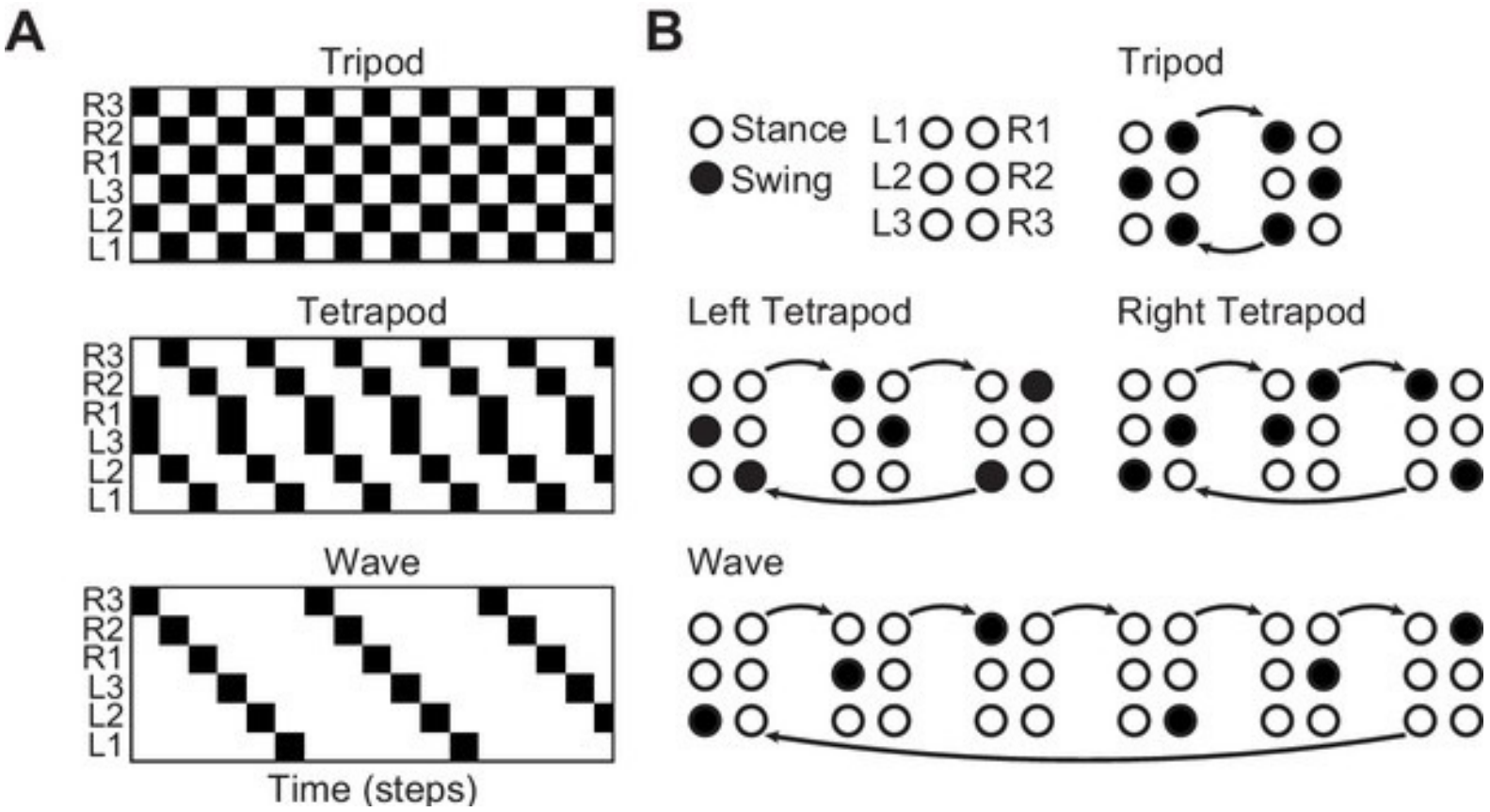
Diversity of walking gaits



- There exists more diversity than possible by following rigid rules only
- 3 main gaits, but a continuum might exist

DeAngelis et al., eLife 2019

Diversity of walking gaits



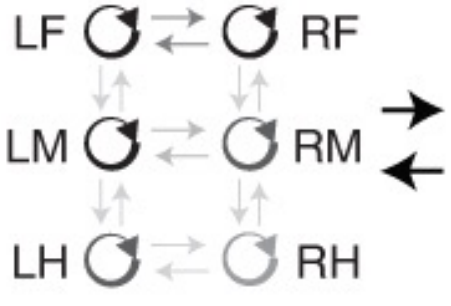
- Common features: rhythm and regularity
- Classical description: oscillators

DeAngelis et al., eLife 2019

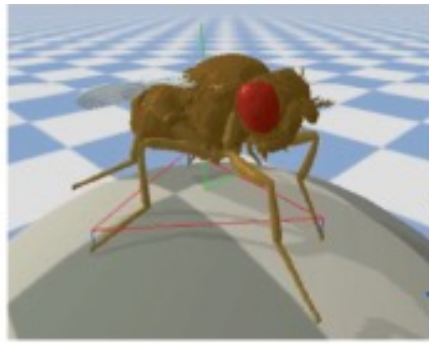
Diversity of walking gaits

One possible description:

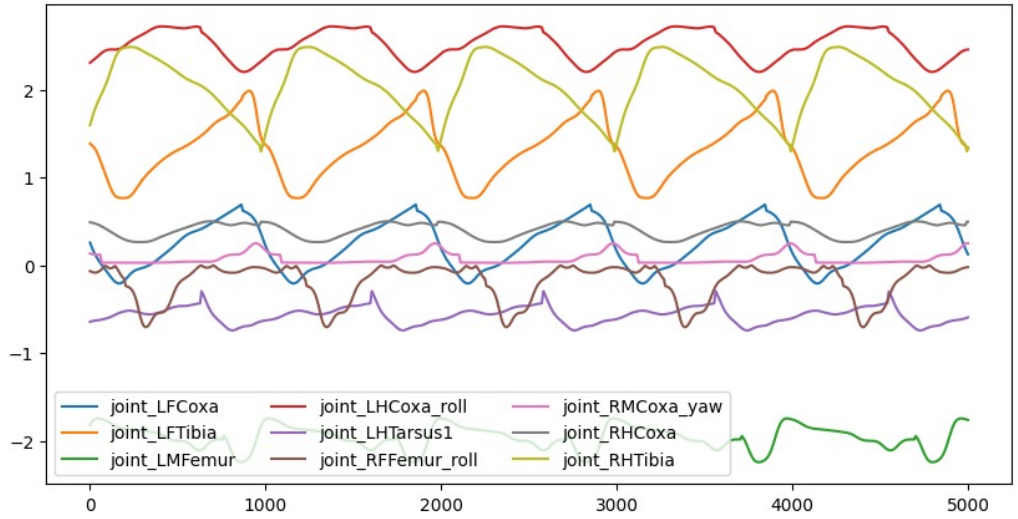
- Each leg is described by an oscillator
- The phase of the oscillator is matched to the phase of the leg swing
- Possible to tune the coupling between the oscillators to match phase difference between limbs

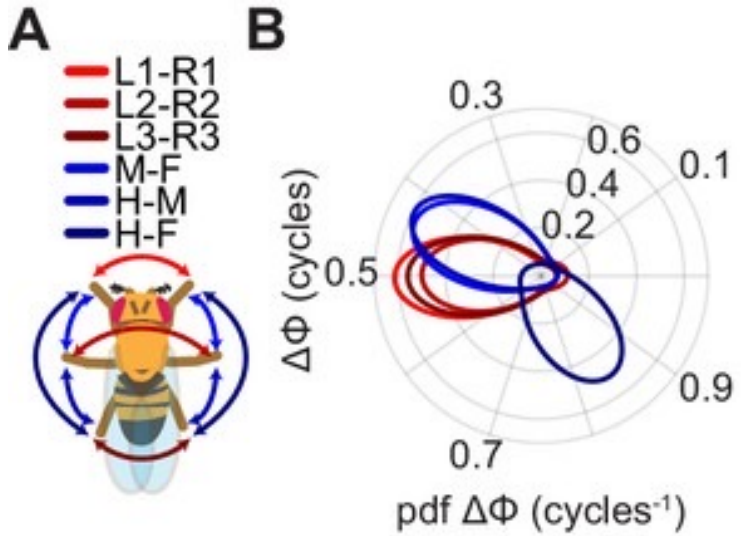


Neural network parameters

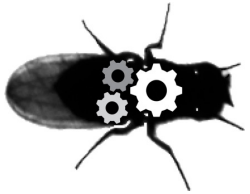


NeuroMechFly behavioral output



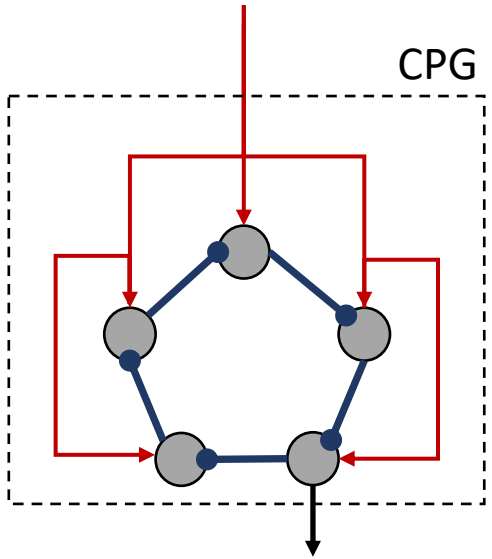


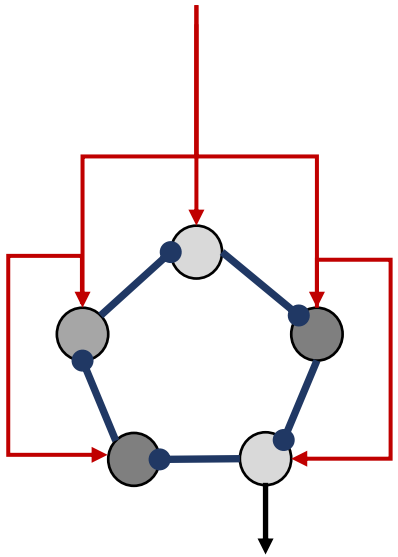
DeAngelis et al., *eLife* 2019 & Lobato-Rios et al., *Nature Methods* 2022

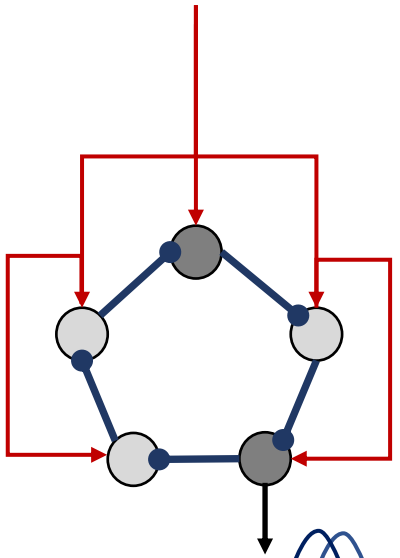


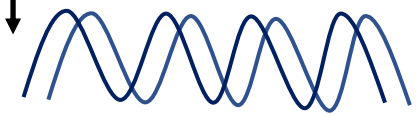
Where does the rhythm come from?

Central Pattern Generators (CPGs) are neural circuits that generate rhythmic output without receiving rhythmic input.

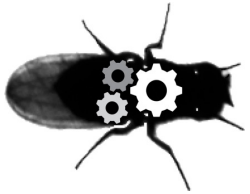








Model used to explain rhythmic activity in animals



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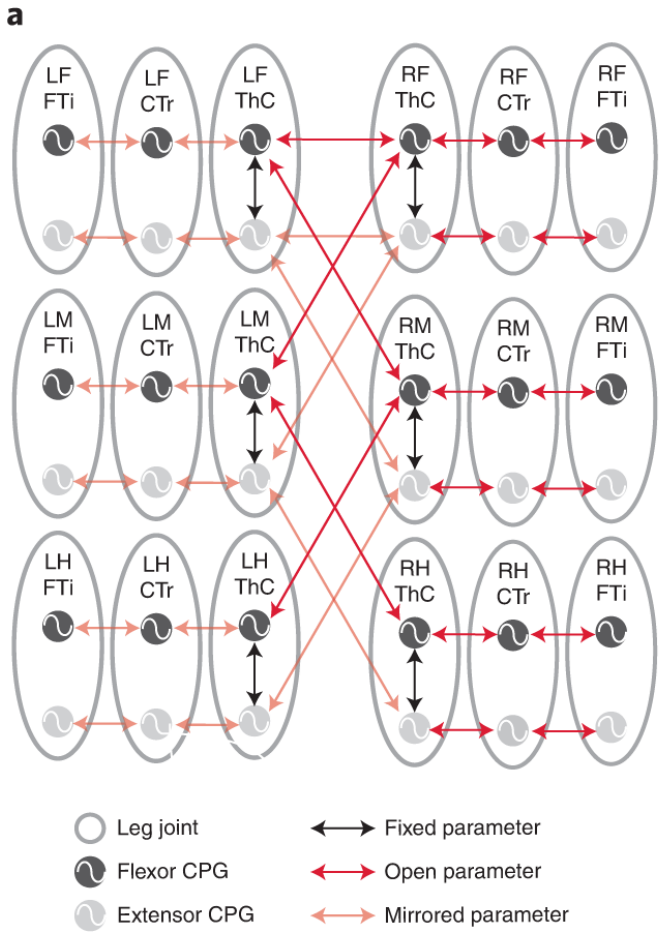
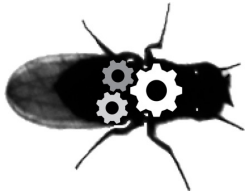


Central Pattern Generators (CPGs) are neural circuits that generate rhythmic output without receiving rhythmic input.

Model used at many levels:

- Entire legs
- Single joints
- Single muscles
- …

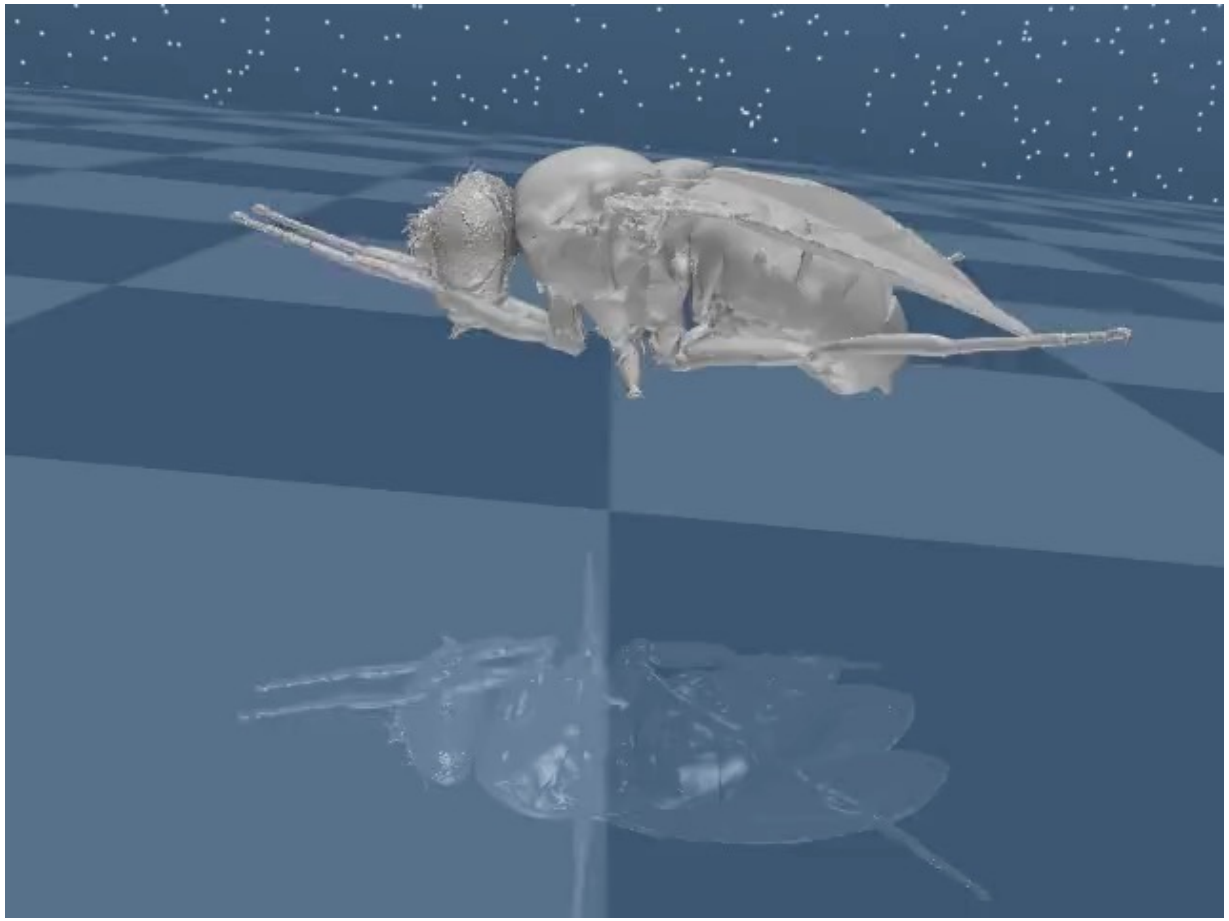
Lobato-Rios et al., *Nature Methods* 2022



Today: implement CPG-driven walking

Parameters of the CPGs:

- Input
- Frequency
- Coupling



Tripod gait