Continuous lateral oscillations as a core mechanism for taxis in Drosophila larvae

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Continuous lateral oscillations as a core mechanism for taxis in *Drosophila* larvae

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**Larvae exhibit continuous rhythmical alternations between left and right turns**

- Example of larva trajectory
- Tail speed, Anterior body angular speed, Body bending

**Fourier analysis**

- Individual 11
- Fourier plot

**Distribution of tail velocity**

- Time (s)
- Distribution of headcasts amplitude
- Distribution of headcasts duration

**Body bending (deg)**

- 0.05
- 0.25
- 0.2
- 0.3

**Tail speed (mm/s)**

- −4
- −50
- 4
- 35

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**Hypothesis**

Taxis in larvae results from a continuous modulation of ongoing left-right turning oscillations

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**No need for ‘decision making’. Seemingly discrete actions spontaneously emerge**

- Straight RUN
- Curved RUN
- HEAD CAST
- STOP

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**The simulation captures taxis trajectory signatures**

- Real larvae
- Simulation

**Learning as a simple change in gain**

- Real larvae
- Simulation

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**A simple solution for combining multiple modalities along both sensory and memory pathways**

- Summed Sensory Signal (T)

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**We embodied this hypothesis into simple agent based simulations**

- Neural model

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**Both small and large headcasts share the same underlying oscillatory rhythm**

- Example of larva trajectory
- Tail speed, Anterior body angular speed, Body bending

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**Distribution of headcasts duration**

- Time relative to stop (s)
- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5

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**Stronger sensory inputs = stronger gain**

- Real larvae
- Simulation

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**Body Bending (deg)**

- −100
- 0
- 20
- 60
- 100
- 120
- 140
- 160
- 180

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**Groups of larva exhibit continuous rhythmical alternations between left and right turns**

- Average anterior body orientation
- Time (s)
- Average crawling speed during stop phase

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**Body angular velocity (deg/s)**

- −10
- 0
- 10
- 15

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**Tail speed, Anterior body angular speed**

- −200
- −100
- −50
- 0
- 50
- 100
- 150

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**Velocity**

- −20
- −10
- 0
- 10
- 20

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**Distribution of headcasts amplitude**

- Maximum angular speed (deg/s)
- 0
- 0.2
- 0.4
- 0.6
- 0.8

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**Distribution of headcasts duration**

- Time (s)
- 0
- 0.2
- 0.4
- 0.6
- 0.8

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**Distribution of tail velocity**

- Tail speed (mm/s)
- 0
- 0.05
- 0.2
- 0.3

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**Gain modulation**

- Gain = -5
- Gain = -2
- Gain = -10