Visual Processing during Navigation

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Rendering by Ben Gorko
An unique representation of orientation

Tethered fly

Calcium imaging of compass neurons with GCaMP

Mutual suppression between compass neurons

Ring attractor

Kim*, Rouault* et al. (2017)
Movie credit: Shin-ya Takemura & Steve Plaza

Hulse et al. 2021
Also see:
Omoto et al. (2017) Curr. Biology

57C10-Gal4; UAS-GCaMP5

Seelig & Jayaraman, (2013)
Zheng et al. (2018; Bock lab), Dorkenwald et al. 2023 bioRxiv
Rendering by FlyWire team at Princeton
Anterior Visual Pathway

FlyWire
A human-AT collaboration to map the fly connectome

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Hulse, Haberkern, Franconville, Turner-Evans, et al. (2021)
Garner, Kind et al. (2023) bioRxiv
MeTu1
MeTu1
MeTu1 pathway to ER4d neurons processes vertical stripes

Animation by Ben Gorko
MeTu3

MeTu3a

MeTu3b and c

postsynaptic side

MeTu3a

MeTu3b

MeTu3c_dorsal

MeTu3c_ventral
MeTu3 pathway to ER2abd processes 2D scene (dorsal)

Animation by Ben Gorko
MeTu3 pathway to ER2abd processes 2D scene (ventral)

Animation by Ben Gorko
MeTu1 $\rightarrow$ ER4d

MeTu3 $\rightarrow$ ER2abd
A novel visual stimulation setup

Jennifer Lai
ER4d: process vertical stripe

ER2: process 2D scene
A hierarchy of sensory inputs to the compass

Uniform synapse count = Uniform synaptic weights?

Hulse, Haberkern, Franconville, Turner-Evans, et al. (2021)
Calcium sensor GCaMP6f in compass neurons
Representation is maintained in darkness

Seelig & Jayaraman (2015)
Experience-dependent plasticity (Hebbian plasticity)


Ocko, Hardcastle, Giocomo & Ganguli (2018) PNAS, "The emergence of multiple retinal cell types through efficient coding of natural movies."


Self Organizing Map (Competitive Hebbian learning, Unsupervised learning)


Uniform synapse count ≠ Uniform synaptic weights?

Hulse, Haberkern, Franconville, Turner-Evans, et al. (2021)
The Fellowship of the Ring

Dustin Garner
Jennifer Lai
Lucy Houghton
Mathias Wernet
Emil Kind
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FlyWire
A human-AI collaboration to map the fly connectome

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Postdocs wanted!
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