

Building bio-mimetic algorithms by injecting function into brain models

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Abstract

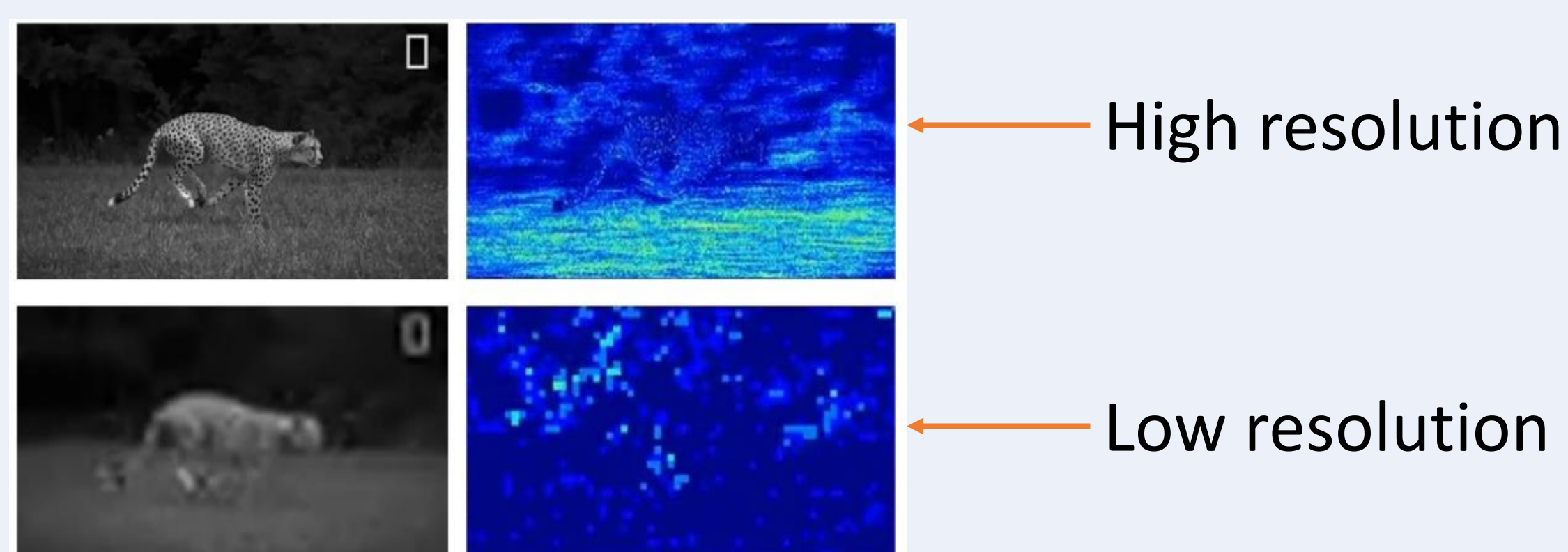
- Bio-inspired robots use a plethora of algorithms for self-localisation and navigation with recent work using spiking neural networks.
- To avoid path planning mishaps, can Lobula Giant Movement Detector (LGMD) modelling be used for collision avoidance?
- Such a reactive algorithm is a key part of more complex navigation.

Dynamic vision sensor (DVS)

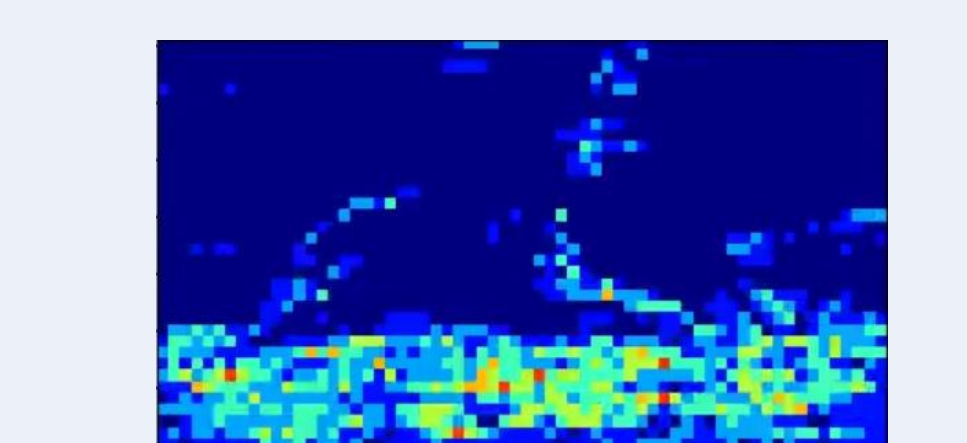
- Neuromorphic camera that mimics a retina by only sending information when a local contrast change occurs.
- Events are triggered asynchronously.

Collision avoidance with a computational model of the LGMD - Downsampling

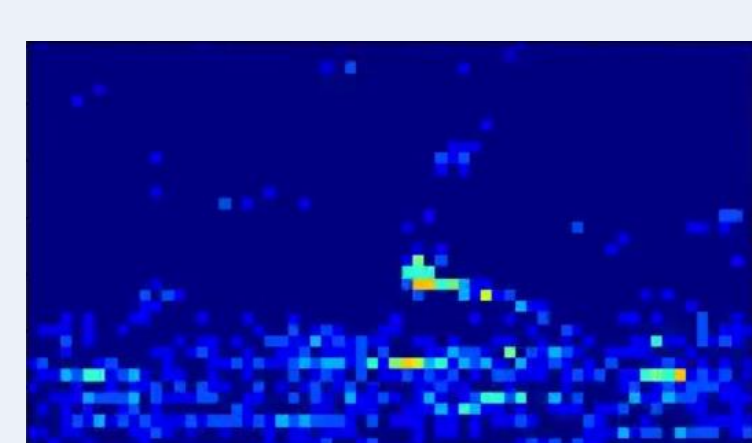
- Locust ommatidia number in the low thousands. However, since the DVS resolution is high relative to the intended resolution, downsampling is used.
- Current ubiquitous method of downsampling is not reliable.
- Using ESIM [5] to downsample monochrome images, simulated events can be rendered.
- Two methods proposed to reflect actual downsampling.
- SSIM used to compare similarity of event frames across tensor.



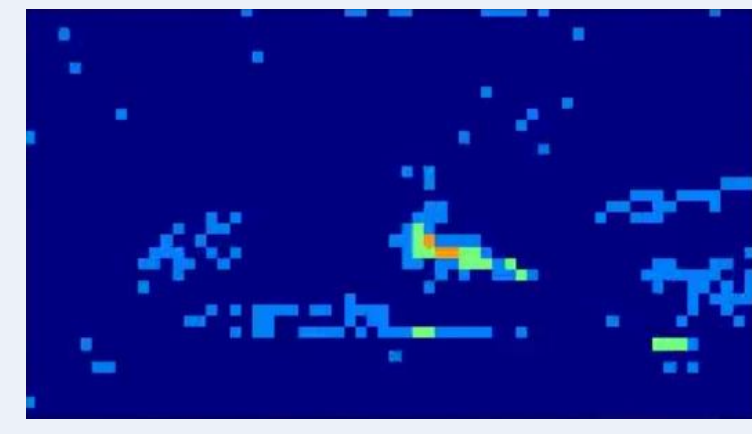
Over 800 frames...



Naïve result
0.137 – 85,731 spikes



Binning result



Integrate-and-fire result

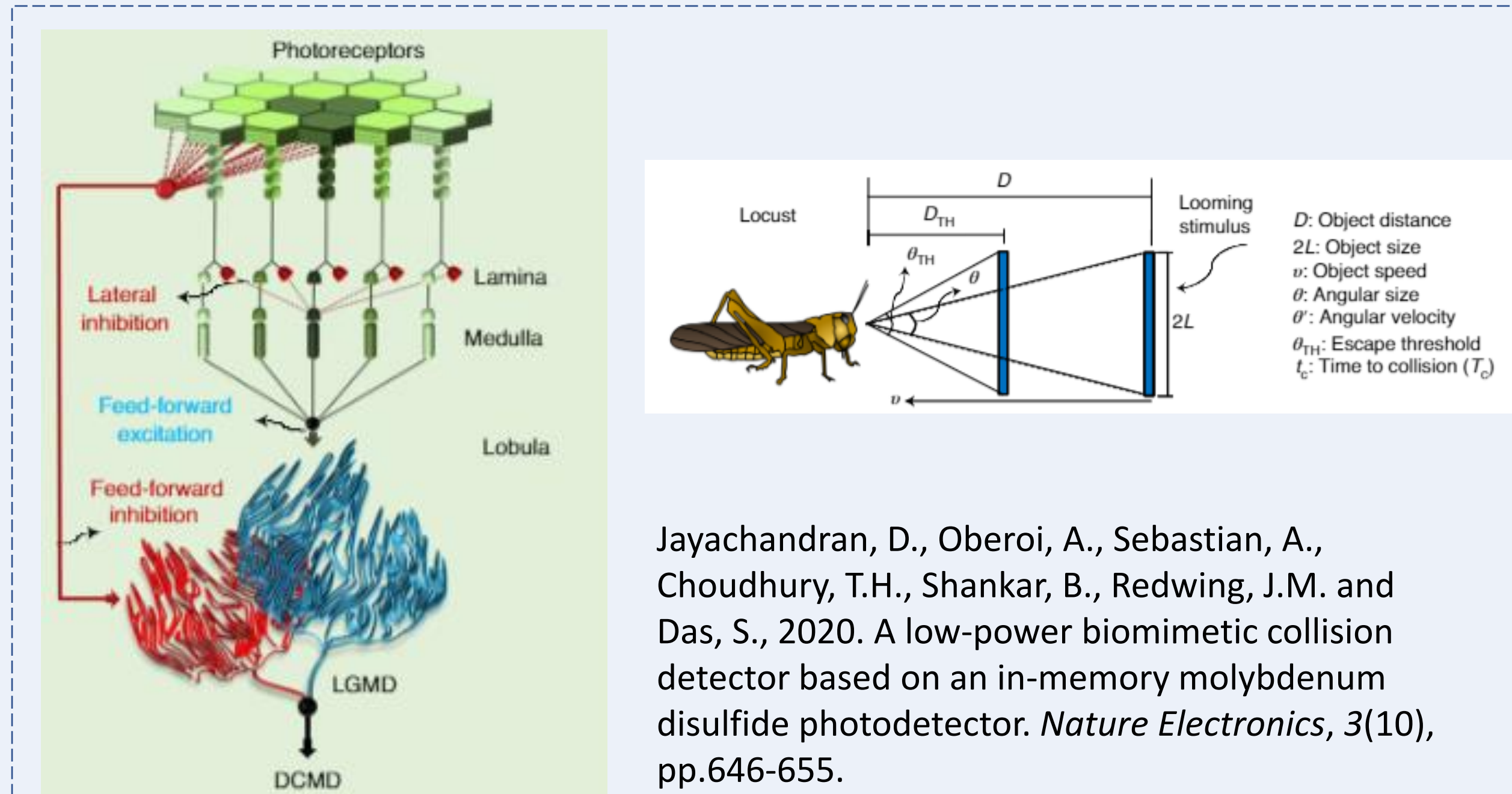
0.144 – 44,290 spikes

0.168 – 14,766 spikes

Proposed methods

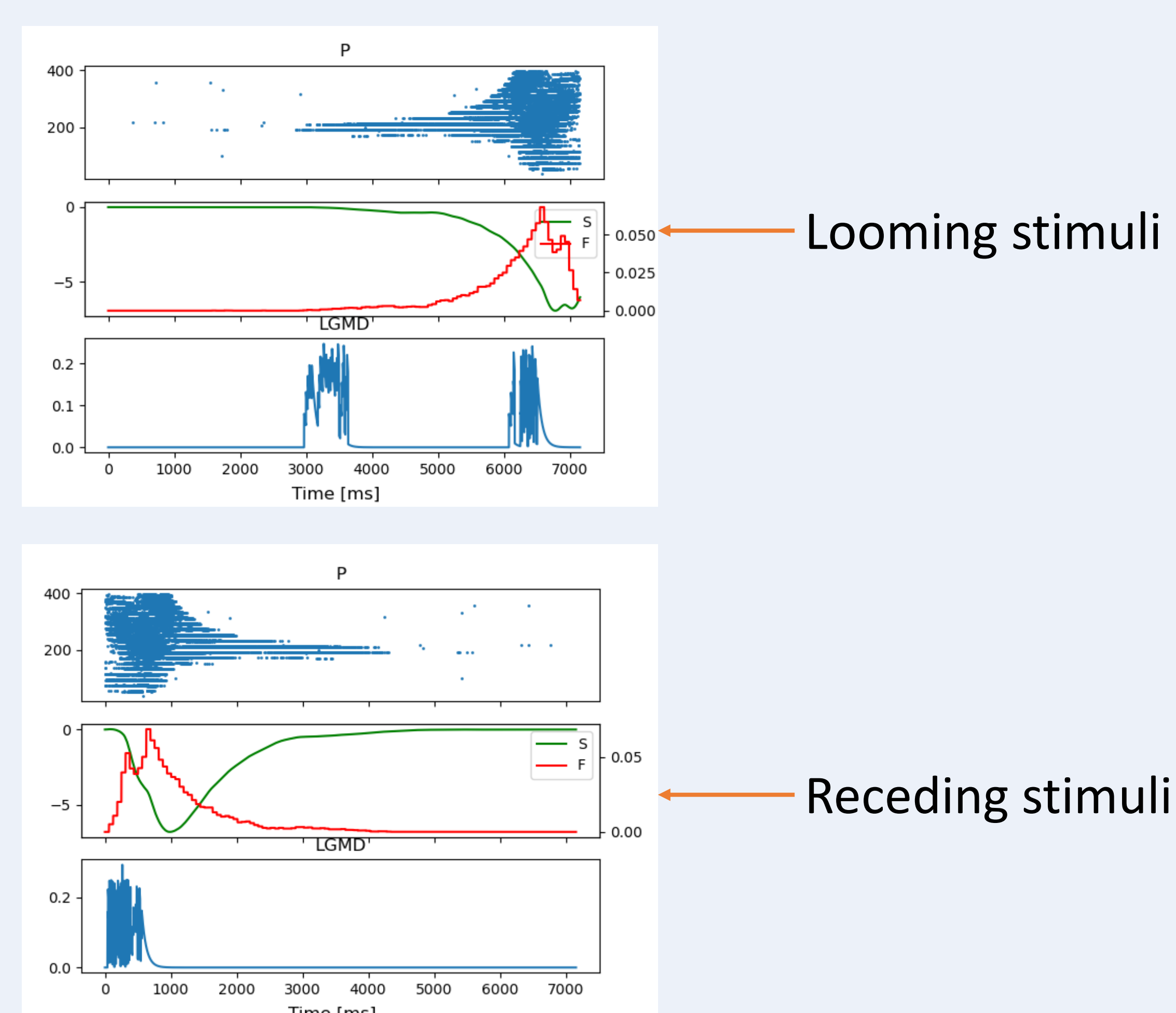
Science “Push” and Application “Pull”

- Long history of modelling the LGMD although it is still not fully understood [1]-[3], with a mixture of biologically feasible and deep learning algorithms.
- The work extends [1] using a DVS camera to apply the network using PyGeNN [4].
- The aim is to create an autonomous looming (approaching) vs receding direction-selective neuromorphic collision avoidance system inspired by locust visual system.



Model performance and work in progress...

- Looming vs. receding stimuli can be discerned albeit with a transient phase (seen at the beginning of the looming stimuli).



Software



GeNN

GPU enhanced
Neural Networks

References

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