T9.5.3 Object recognition (UoS (26), M01 - M24):

It has been established in animals that stimuli are interpreted, and objects recognised, based on stimulus onset synchrony or temporal correlations in stimulus occurrence. For example, in vision, dots that move in a correlated fashion on a background of randomly moving dots are interpreted as an object. In hearing, mixtures of pure tones are conceptualized as a single sound, if they have a synchronous onset, but as separate sounds if not. In olfaction, mixtures of odours that co-fluctuate are distinguished from those where onsets of stimuli are asynchronous.
In this Task we will investigate neuromorphic solutions to object recognition based on neural networks from
neuroscience models of olfaction and vision. In addition to the temporal binding of stimuli to objects described above, this work will also investigate the formation of stimulus primitives through "lifetime learning", i.e. the ability to identify particular complex stimulus mixtures as one elemental stimulus, e.g. the smell of coffee, or a complex Chinese character, based on familiarity acquired from a large number of such inputs and over a long time period. The speedup of NMPM will be of particular value here.
The work will combine the refinement of networks (neuromorphic algorithms) on standard PCs and GPUs with
implementing and investigating them on the hardware systems. Some basic benchmark measurements will be taken as in our earlier work in SP11.3.6 during the HBP Ramp-Up Phase.
The Task will be complemented by related work in the "Odor Objects" project (biological basis of the neuromorphic algorithms investigated here from honeybees, HFSP 2015-2017) and the "Brains on-Board" project (bee-inspired neuromorphic algorithms on GPUs for use in autonomous drones, EPSRC 2017-2022)

Specific tasks:

- Develop a neuromorphic solution to object recognition that exploits temporal correlation of sensory inputs.
- Investigate the formation of elemental stimulus prototypes in very long simulations, exploiting the speedup factor of the BrainScaleS hardware.
- Quantify network performance and compare to GPU implementations.
- Active contribution to supporting platform users via mailing list.

Component Contributions:

- SP9-T9.5.3-SGA2 Neuromorphic network model for object recognition (component id: 2631)

Milestones:

MS378 MS9.5.3 Object recognition model network 106 - UoS 12 Task 9.5.3: Tagged release of the model on GitHub and short report of proof of concept.

MS382 MS9.5.7 Object recognition on BrainScaleS 106 - UoS 24 Task 9.5.3: Tagged release on GitHub with short report of results obtained on BrainScaleS platform.