Clockless Biologically-Plausible Architecture for Temporal Perception Using Convolutional Neural Networks

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Submitter Zafeirios Fountas

Affiliation Imperial College London

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Presentation Abstract Summary The focus in understanding how humans or other animal species perceive time has been on mechanisms relying on fine alignments of intrinsic dynamical features, such as heartbeat, or the oscillatory cortical input to the striatum. Although they are often biologically consistent, these theories fail to address a number of important characteristics of temporal perception, including age-related differences, domain-specific biases and how interval timing can be scaled up to long durations (e.g. hours or days). In this work, we present a novel neural architecture that is able to make accurate time estimations of a given episode without the need for internal, clock-like processes. Instead, it relies on the amount of information that flows through hierarchical sensory areas and a feature detection mechanism, also employed for episodic memory formation. Using the power of convolutional neural networks for image classification, we built an implementation of this architecture in the visual domain. In this system, egocentric visual streams resulted in accurate interval estimations across time scales from ~1-64s, both during real-time exposure to novel scenes and for episodic memory recall. Our results demonstrate that sufficient information exists in sensory classification networks to estimate duration without the need for any internal clock-like process.

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Co-author Information

* Presenting Author

First Name	Last Name	Affiliation	E-mail
Zafeirios *	Fountas *	Imperial College London	zfountas@imperial.ac.uk
Kyriacos	Nikiforou	Imperial College London	k.nikiforou@imperial.ac.uk

David	Bhowmik	Imperial College London	d.bhowmik10@imperial.ac.uk
Murray	Shanahan	Imperial College London	m.shanahan@imperial.ac.uk
Warrick	Roseboom	University of Sussex	W.J.Roseboom@sussex.ac.uk
Anil	Seth	University of Sussex	A.K.Seth@sussex.ac.uk

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