Timescales in neuronal activity (and how to find them)

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Ongoing neural activity unfolds across different timescales, reflecting networks' specialization for task-relevant computations. However, it is unknown whether these timescales can be flexibly modulated during trial-to-trial alternations of cognitive states (e.g., attention state) and what mechanisms can cause such modulations. We analyzed autocorrelations of population spiking activity recorded from individual cortical columns of the primate area V4 during a spatial attention task and a fixation task [2]. We developed a method to correctly estimate timescales from short trials and rigorously determine the number of timescales in neural activity [1]. We found at least two distinct timescales in spontaneous and stimulus-driven activity. The slower timescale was significantly longer on trials when monkeys attended to the location of the receptive field of the recorded neurons than on control trials when monkeys attended to a different location. Interestingly, under the attention condition, the timescale predicted the reaction time. Using computational models, we show that the observed timescales emerge from the recurrent network dynamics shaped by the spatial connectivity structure. We discuss how the timescales could be reflecting optimization to perform the information processing tasks.

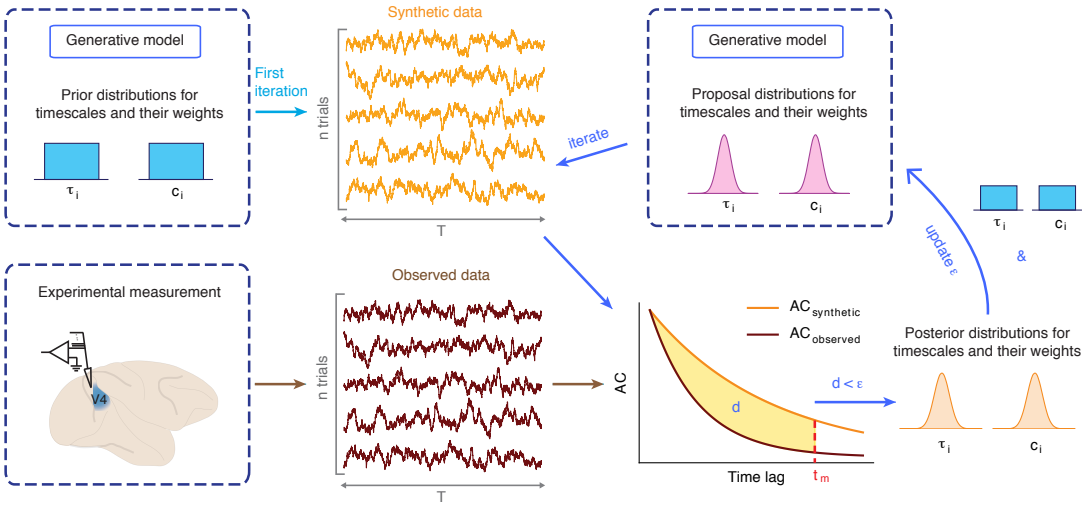

Figure 1: Using generative models to find correct timescales for data organized in short trials [1].

Acknowledgements

LA is supported by the Sofja Kovalevskaja Award from the Alexander von Humboldt Foundation.

References

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