

Delay Compensation with Dynamical Synapses

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Motivation



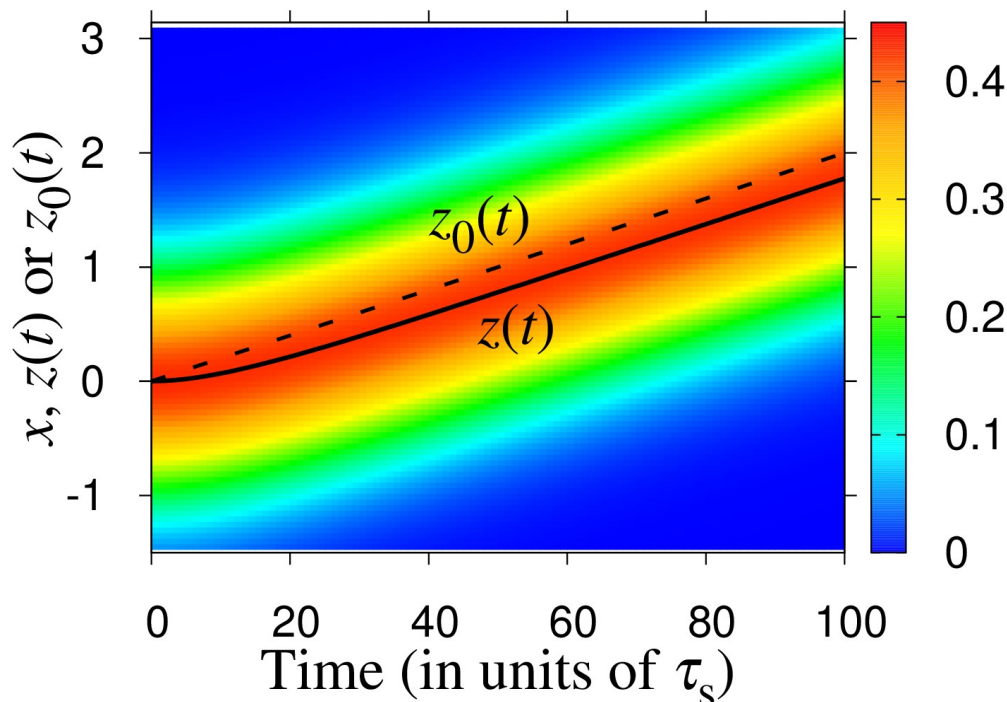
- There are many kinds of delays in the nervous system.
- For fast moving stimuli, those delays may cause a huge difference in spatial locations.
- Delay compensation is essential to process moving stimuli.

- “... ATN cell firing was aligned with the animal’s future directional heading by about +23 msec.”

Taube J. S. and Muller R. U. (1998)

- However, how to achieve this behavior is still controversial.

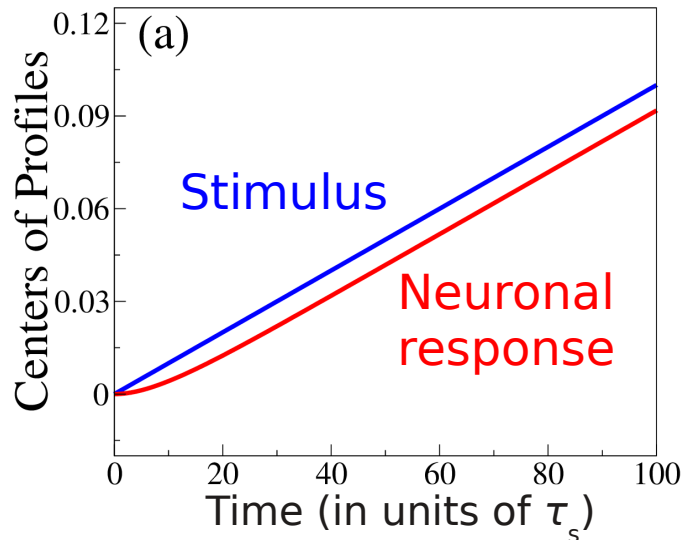
- In the nervous system, continuous information are represented by **localized profile of neuronal activity**.
- As the stimulus position ($z_0(t)$) changes, the neuronal activity profile can move to **catch up the new position of the stimulus** (trajectory of $z(t)$).



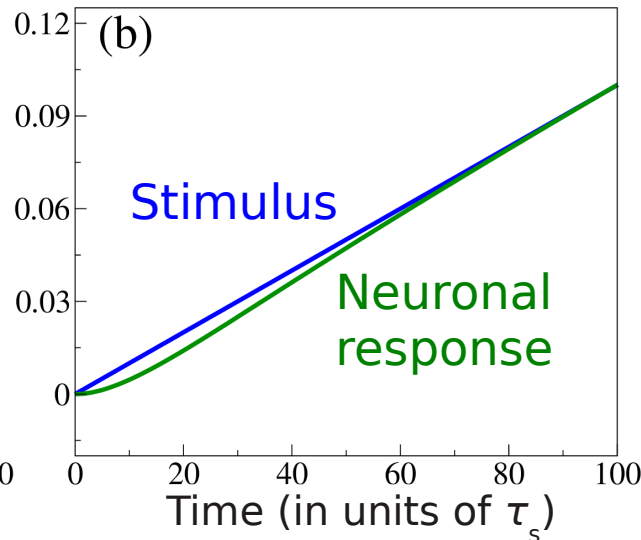
- However, in the case of static synapses, $z(t)$ is always **lagging behind**, due to the transmission delay between neurons.

- Short-term synaptic depression (STD) can modulate the tracking behavior

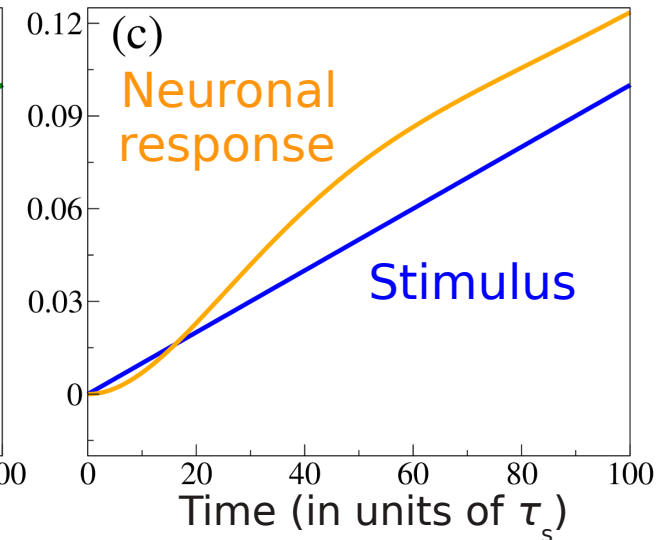
No STD



Perfect Tracking

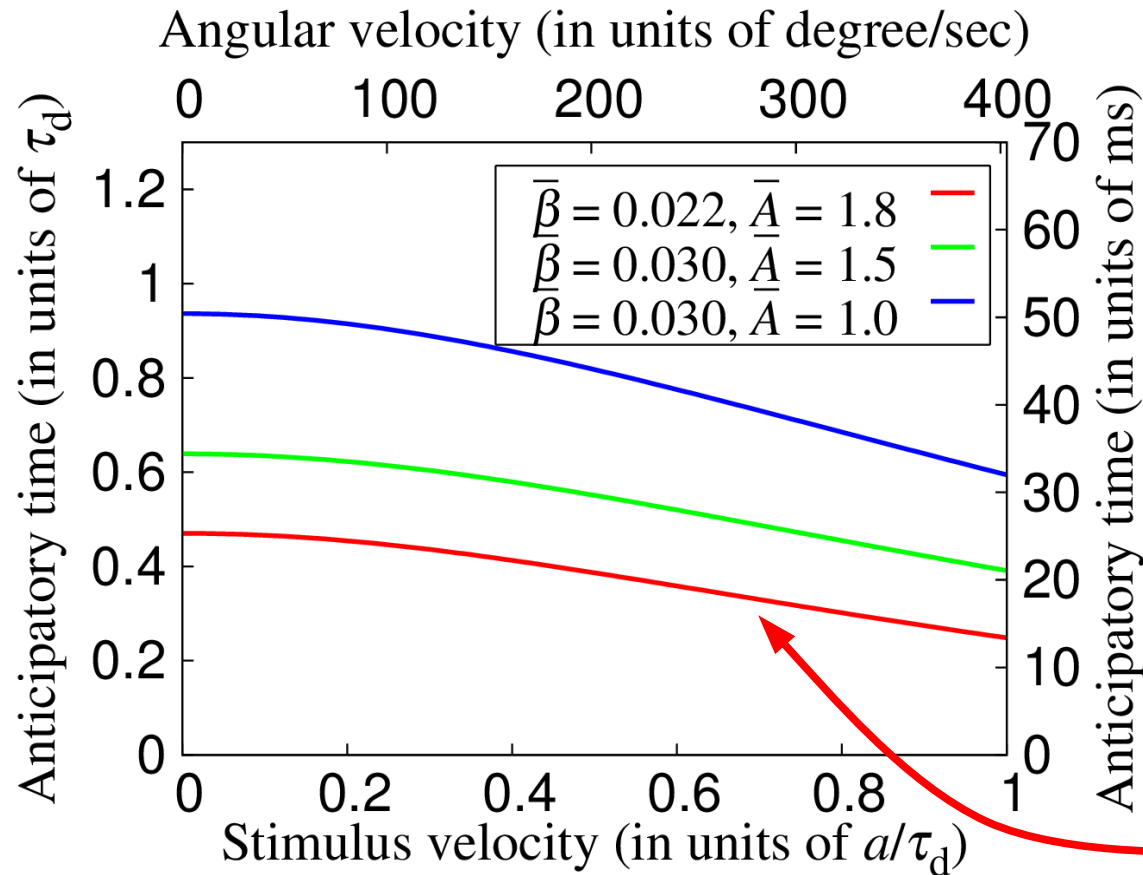


Anticipatory Tracking



- If the strength of STD is too small, the neuronal response always lags behind.
- If the strength of STD is about right, the lag is almost zero
- If the strength of STD is large enough, the network response can lead the stimulus

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- Define **anticipatory time** \equiv 'How far the neuronal response leads the stimulus' / 'velocity of the stimulus'
- **The anticipatory time is effectively independent of the stimulus speed**
- With some parameters, the anticipatory time is **comparable to results in a rat experiment**

Goodridge, J. P. & Touretzky, D. S. (2000)

Thank you for your attention.
Wish we may have nice discussions
during the poster session.
The Poster ID is Th90.