Study of the Sequential nature in neuronal dynamics **Case of study Feeding CPG** Lymnaea stagnalis **Computational approach Experimental approach** N3 Burst Duration N1 Burst Duration $R^2 = 0.9718$ $R^2 = 0.0343$ Presence of N1 Burst Duration (s) dynamical invariants under different cases of stimulation 10 Period (s) **Universality of** N1 Burst Duration N3 Burst Duration 4.0 sequential dynamical 3.5 $R^2 = 0.2843$ invariants Importance of reproducing the **Transformation of sequential intervals** functional variability in into effective robot movement computational models Hyperpolarization Burst duration Light sensory feedback from FLC-Hybrot to living circuit **Functional living** current injection **Robot** 100 mV **CPG** circuit Hyperpolarization waveforms Burst waveforms LP period Legs period 50 n 500 ms **Robot legs oscillation** Living neurons **CW-NIR Infrared laser Stimulation Technique to study it** Single neurons in RPG Lymnaea stagnalis **Sustained illumination Activity-dependent protocol** 808nm 830nm 0.80 980nm Intracelular ♀ 0.75 1450nm electrode 발 0.70 NIR CW laser : □ 0.65 ਰ 0.60 € 0.55 0.50 Ganglia from Lymnaea stagnalis 20 ms Activity analysis and spike prediction Under the effect of different **Sutained laser stimulation** laser wavelengths, the metric accelerates the action potential Neural activity changes are different With the activity dependent protocol we could assess the action potential sequential generation at different time instants **CGC Capacitance** CGC Sodium gnaP CGC Potassium gD Aligned spikes 2.00 1,20 0.5 duration 0.575 1.75 1.15 depolarization slope 0.550 repolarization slope 1.50 1.10 0.525 3.0 Normalized change 2.0 1.25 1.05 0.500 1.00 1.00 0.475 0.75 0.95 1.0 0.450 20 mV 20 mV 20 ms 20 ms 0.0 (-100, -80] (-80, -60] (-60, -40] (-40, -20] (-20, 0] (0, 20] (20, 40] Time from illumination offset to spike peak (ms) The closed-loop protocol unveiled the CW-laser No candidate alone in the model could reproduce the effect and a effect at different phases of the neuron global change when simulating the temperature dependency dynamics, shifting the maximum effect at reproduced better the observed effect

different spike generation times