

## *Drosophila* courtship song: modeling behavioral pattern in terms of neural and muscle dynamics

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### Abstract

Males of the species *Drosophila melanogaster* – the common fruit fly – court their females. During courtship the male extends and vibrates his wing and thereby produces courtship song, which consists of two qualitatively different modes: sine and pulse song. During song, males repeatedly switch between sine and pulse. Recent studies suggest that the male switches not randomly, but chooses whether to sing sine or pulse depending on sensory input [11, 3] – this is despite courtship song being innate and hard-wired [2, 7]. Besides sensory inputs, muscle contraction is known to determine song mode [9, 5] and song features [1].

I have designed simple neuromuscular models of courtship song, that allow one to study (1) the effect of neuronal frequency on song and (2) the effect of muscle contraction dynamics on song, and (3) to simulate natural looking courtship song. I have started to validate my models and simulations. My simulations excite male wild-type flies, when played back to them. Song playback is a well established paradigm to study hearing in flies and the excitatory potential of song [6, 8, 4]. Further my simulations show and reproduce the link between excitation and song choice their design was based on. I expect simulated song from my models to match song parameters of real song. For matching real and simulated song I apply Approximate-Bayesian-Computation (ABC) with Sequential-Monte-Carlo (SMC) sampling to my models [10].

In my future research I will study the link of muscle dynamics and courtship song amplitude structure which has only recently been described [1] and is part of my models. Further I will study whether synaptic plasticity affects courtship song. For studying this I will extend my model to include a simple Hebbian learning rule and thus allow model weights to dynamically change depending on previous input. I will validate model predictions with opto- and thermogenetic experiments using song box 2.0, a new device for recording song during opto- and thermogenetic experiments.

## References

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