

A Neuronal Model for Visually Evoked Startle Responses in Schooling Fish

Master thesis

by

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Abstract

Many aspects of fish school behavior can be explained qualitatively by self-propelled agent models with social interaction forces that are based on either metric or topological neighborhoods. Recently, startling of fish has been analyzed in its dependence of the network structure (Rosenthal et al., 2015) but a mechanistic model and its influence on the collective behavior is missing. Here we couple a model for collective behavior with a neuronal model that receives looming visual stimulus input to initiate a startle response, inspired by the neurobiologically well-studied Mauthner cell system. First, we analyzed the basic properties of the startle behavior of a single fish as a reaction to a looming stimulus. On the group level, we looked at startling frequency as well as group cohesion and polarization depending on neuronal and collective behavior parameters via simulations of the combined model. Our results indicate that the startling frequency strongly depends on the dynamics of the group structure, e.g. when the group approaches a boundary of the arena. In summary, we took first steps towards a biologically plausible model for startle response initiation in the context of collective motion.

- 1. Introduction**
- 2. Methods and Materials**
- 3. Results**
- 4. Discussion**

References

Rosenthal, S. B., Twomey, C. R., Hartnett, A. T., Wu, H. S., and Couzin, I. D. (2015).
Revealing the hidden networks of interaction in mobile animal groups allows prediction
of complex behavioral contagion. Proceedings of the National Academy of Sciences of the
United States of America, 112:4690–4695.

A. Appendix