Press Release

A Software to See How Fish See

Software for behavioral studies in fish made freely available by Tübingen neuroscientists

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Zebrafish have been one of the most important animal models in neuroscience for only a few years. Laboratory equipment and software for studying their behavior is therefore often highly specialized and expensive. Neurobiologists at the University of Tübingen's Werner Reichardt Centre for Integrative Neuroscience (CIN) have developed software that is easy to use, allows a wide range of approaches in behavioral fish studies, and works with very diverse hardware components. The researchers are making this software, called 'ZebEyeTrack', freely available – including the full source code – and have now presented it in *Nature Protocols*.

At a glance, it would seem that the glassily-transparent, millimeter-long larva of a popular ornamental fish from South Asia has very little in common with a human being. Nevertheless, in recent years zebrafish have risen to popularity as one of the most widely used object of study with researchers interested in the basic mechanisms of perception. One example among many is eye motor control: when they move their eyes to follow mobile visual stimuli, zebrafish employ mechanisms very similar to those in the human visual system.

But in order to see how a fish sees, researchers must invest in extremely elaborate laboratory equipment – a fact of life in much of life science. One important component of this equipment is the software solutions to obtain and measure the numerous parameters the researchers are looking for. Quite often, they face a sort of agony of choice here: on one hand, they could use commercially available software, which rarely does precisely what a given research group needs for their specific angle of investigation. Moreover, such commercial solutions for tracking eye movements in fish are available only at great expense. On the other hand, the lab group could program their own applications – besides requiring good programming skills, this often takes years of dedicated work.

When neurobiologist Aristides Arrenberg faced this dilemma during his years as a doctoral student, he decided to develop his own software suited to his project's needs. Today he heads a research group at the CIN in Tübingen, which still uses a version of this software, retooled and expanded over the years. By now it has picked up a lot of additional func-

tionality, being able to control individually tailored light stimuli presented to fish larvae, and to automatically register, track and record their eye movements, even perform real-time analyses. On top of that, there are plugins for laser and microscope usage, as well as a graphical user interface optimized for ease of use. The researchers have decided to make their software – which they call 'ZebEyeTrack' – freely available to all laboratories studying the visual system of zebrafish.

"Naturally, researchers worldwide have very specific requirements for their software solutions. For this reason we are sharing the source code, so that anybody with a little programming skill can adapt it to their individual needs", explains Florian Dehmelt, who programmed the (for now) final version. Research group leader Arrenberg adds: "With ZebEyeTrack, we are part of the Open Source movement. We could probably have filed for a patent and sold ZebEyeTrack commercially. But we are not interested in doing so – after all, we would be continuing the very same problem that got us started in the first place."
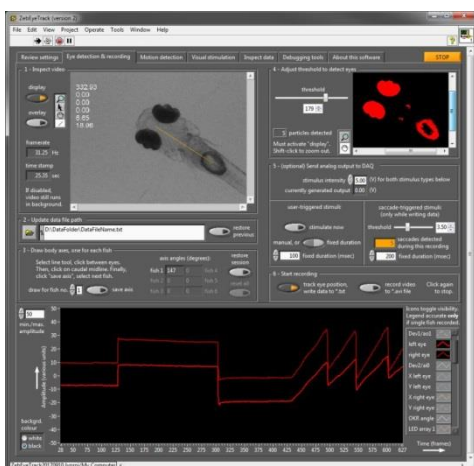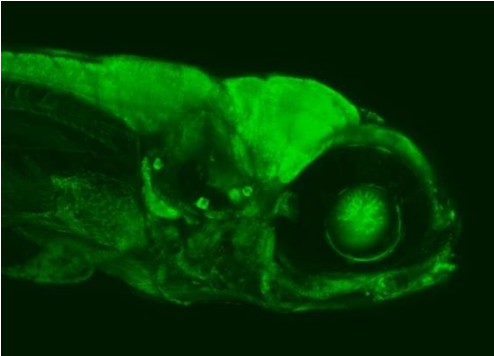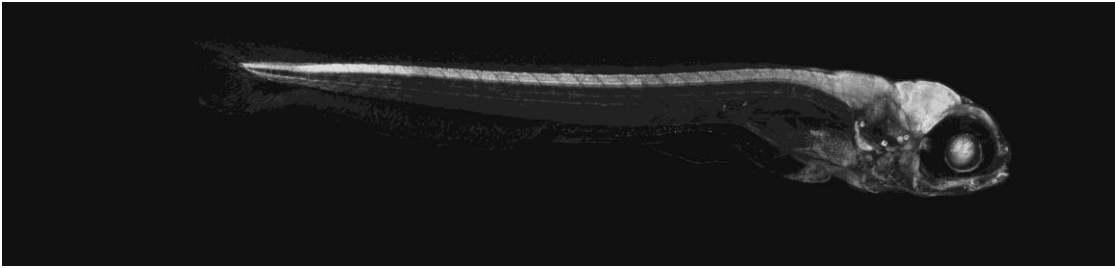
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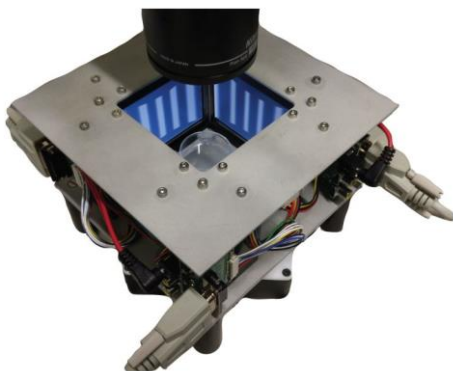
Setup for a typical oculomotor experiment: Zebrafish larvae are placed under a stereomicroscope, in the center of a stimulus arena made up of four computer screens. Visual stimuli are presented on these screens.

Image: Aristides Arrenberg

Eye movements of the fish larvae are recorded.

Abbildung: Aristides Arrenberg

6 day old zebrafish larva under the confocal microscope

Image: Aristides Arrenberg

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The University of Tübingen
The University of Tübingen is one of eleven universities judged excellent under the German government's Excellence Initiative, and ranks well in international comparisons. Tübingen is one of the world's foremost locations for neuroscientific research. Along with translational immunology and cancer research, microbiology and infection research, and molecular plant biology, it makes Tübingen a cutting-edge center of research in the Life Sciences. Further areas of core research are in Machine Learning, Geoscience and Environmental Science; Archaeology and Anthropology; Language and Cognition; and Education and the Media. More than 27,700 students from Germany and around the world are currently enrolled at the University of Tübingen, enjoying a broad spectrum of some 300 different study programs.

The Werner Reichardt Centre for Integrative Neuroscience (CIN)
The Werner Reichardt Centre for Integrative Neuroscience (CIN) is an interdisciplinary institution at the University of Tübingen funded by the DFG's German Excellence Initiative program. Its aim is to deepen our understanding of how the brain generates functions and how brain diseases impair them, guided by the conviction that any progress in understanding can only be achieved through an integrative approach spanning multiple levels of organization.