The Future in Animal testing

Software and Hardware of Intensity-based tracking of Aquatic Organisms

Design-Build-Test 15ECTS Autumn 2014

Background
Animal testing is a useful tool when exploring effects of drugs or industrial chemicals in the human body or the ecosystem. One problem with carrying out this sort of research is that there are many restrictions when it comes to the use of animals for testing purposes, as well as the ethical aspects. Since 2013 it is no longer permitted to use animal testing for examining the toxicity of daily care products which has increased the need of alternative testing options.

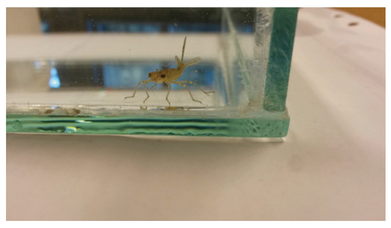
Insects are not included in the regulations of animal testing and since they share around ¾ of the disease related genes with humans they are an interesting target for ecotoxicological analyses. One way to explore the important effects is to measure the behavior changes in the organisms when exposed to chemicals. This is relevant since the behavior will affect the survival and reproduction of a species, which in turn will affect the ecosystem at large. It can also give information regarding unwanted effects in other organisms, such as humans.

One limit that arises when conducting these sorts of experimental tests is that there is a lack of standardized and automated testing methods for measuring behavioral changes in aquatic organisms. Analyzing a large amount of organisms manually demands a lot of time and resources and since the experiments are not standardized, a comparison of different results are not always possible or informative.

To overcome this problem a project group of engineering students with different kind of specialization were formed to build a product and develop a software that can measure and record the behavior of aquatic organism. The customers of this project was a collection of representatives from EMG (Department of Ecology and Environmental Science), the Physics department and the Chemical department at Umeå University.

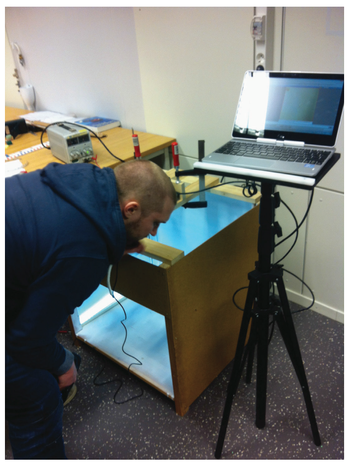
Fishing damselflies
at the lake Nydalasjön (Isabelle, Nora, Sandra and Johanna)

Changing water before treatment
(Måns,Isabelle, Susanne and Nora)



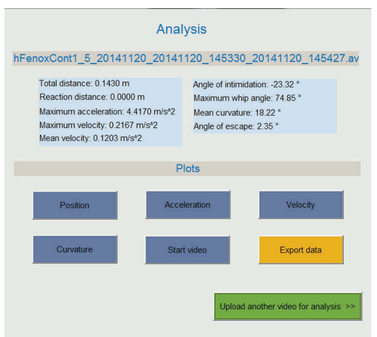
A damselfly in the arena

Olof, Jonas and Emma developing the program

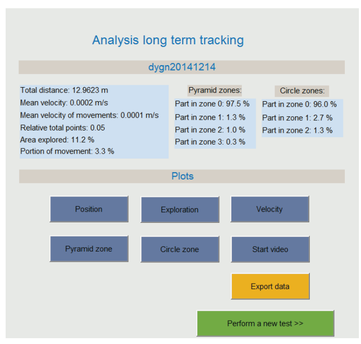


Early tests of high speed camera in TAO (Johan and Tony)

Testing the program for high speed tracking by scaring damselflies and saving the movies for analysis (Johanna, Nora, Isabelle, Måns, Susanne and Sandra)



Interface of the program after analysing a high speed movie



Interface of the program after analysing a long term movi

Tracker of Aquatic Organisms, TAO
The results of the project are two different types of arenas. A smaller one for short time tracking with high speed camera and a larger one for long time tracking with web camera. Furthermore a case with the two different cameras which allows tracking under constant terms without any influence other than the required for the experiment. Also a software which allows the user to measure and analysis the behavior of single or multiple organisms.

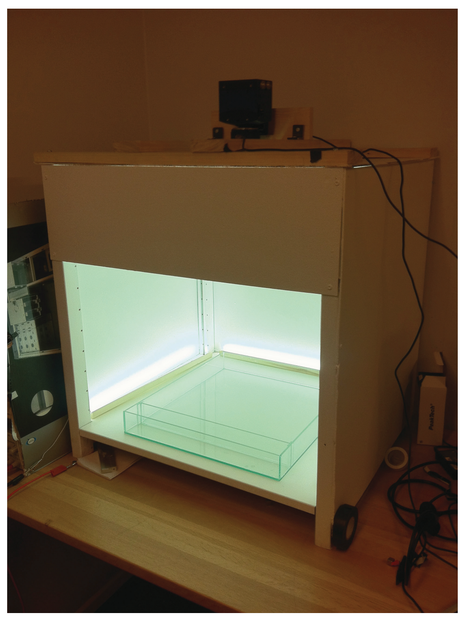
The software has the ability to measure the following values: total distance, reaction distance, maximum acceleration, maximum velocity, mean velocity, angleof intimidation, maximum whip angle, mean curvature and angle of escape. As well as show in different plots how the organism move around in the mesocosm.

These data can be used to analyze the behavior of every single individual organism or for a whole population before and after treatment.

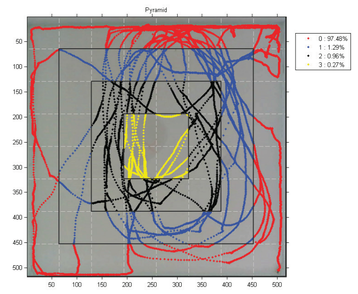
The Future
The prototype, TAO, may be the start of a new kind of animal testing. Due to its more standardized method it would be easier for researchers to analyze and compare results of behavior changes in aquatic organisms. The prototype has space for modifications with other features so that the environment is specialized for the different experiments.

At the moment it is still required that the intimidation of the organism is done manually instead of automatically.

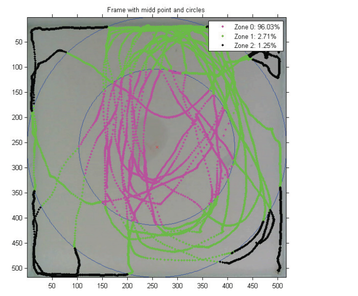
Future developments might include completely automated and standardized methods of intimidation.



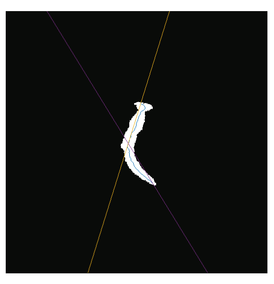
Latest version of TAO



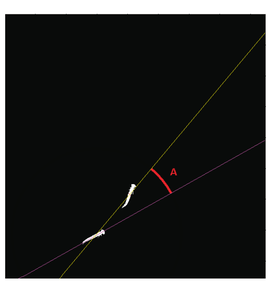
Pyramid zone analysis



Circle zone analysis



Curvature analysis



Angle of escape analysis

Johan Liedholm, Nora Ingebrand, Måns Kjellander, Sandra Jonasdotter, Isabelle Lilja, Tony Holmsund Olsson, Emma Sundling, Olof Lenti, Jonas Karlsson, Johanna Eriksson, Susanne Kadelbach