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# BioWes

[www.biowes.org](http://www.biowes.org)

## Module – Aquatic organism behavior analysis

Project supported by the Technology Agency for the  
Czech Republic



Technology Agency  
of the Czech Republic

... from ideas to applications

# Module description



- Software is a part of a complete solution for the management of experimental data and metadata. Software is a plug-in for processing of experimental data, which is executed directly from the Protocol manager and directly accesses the data in the protocol.
- Software performs detection and tracking of objects (fish) in medium size tanks. The input of the program are pictures from the IR camera placed above the tank. The camera captures events in the tank with the sampling frequency of 10 fps. Software estimates the background by calculating the mean and variance of each pixel of the image, along with continuous updates this value during the changes of background or tank illumination. Based on the knowledge of the background objects are detected using background subtraction for each frame. Subsequent application of methods of tracking and objects filtering according to given parameters produce as output short 3D trajectory of fish in the tank. Software can be used to analyze the behavior of fish shoals in the case of various experiments with conditions or fish feeding or as an early warning system in case of abnormal behavior of fish.

# Graphical user interface



The screenshot shows the FishModule - BioWes application window. The interface includes a navigation pane on the left with 'Protocols' and 'Protocol templates' options. The main area displays a list of protocol files under the heading 'Protocol files'. A table lists seven files, all of which are selected with checkmarks. To the right of the table are 'Select all' and 'Deselect all' buttons. Below the table, there are two checkboxes: 'Top view - detected objects' and '3D fish tank position', both of which are checked. The 'Top view - detected objects' checkbox is linked to a 2D image showing a top-down view of a fish tank with numerous small, numbered fish. The '3D fish tank position' checkbox is linked to a 3D wireframe model of a fish tank with colored arrows indicating the position of the fish. At the bottom of the interface, there is a 'Run' button and a green progress bar. Red callout boxes with white text provide instructions for each key feature.

Name	Description
<input checked="" type="checkbox"/> inten_274630883.tiff	Experimental file
<input checked="" type="checkbox"/> inten_274630946.tiff	Experimental file
<input checked="" type="checkbox"/> inten_274631055.tiff	Experimental file
<input checked="" type="checkbox"/> inten_274631164.tiff	Experimental file
<input checked="" type="checkbox"/> inten_274631273.tiff	Experimental file
<input checked="" type="checkbox"/> inten_274631367.tiff	Experimental file
<input checked="" type="checkbox"/> inten_274631460.tiff	Experimental file

**Select images to be processed**

**Execute processing**

**Progress bar**

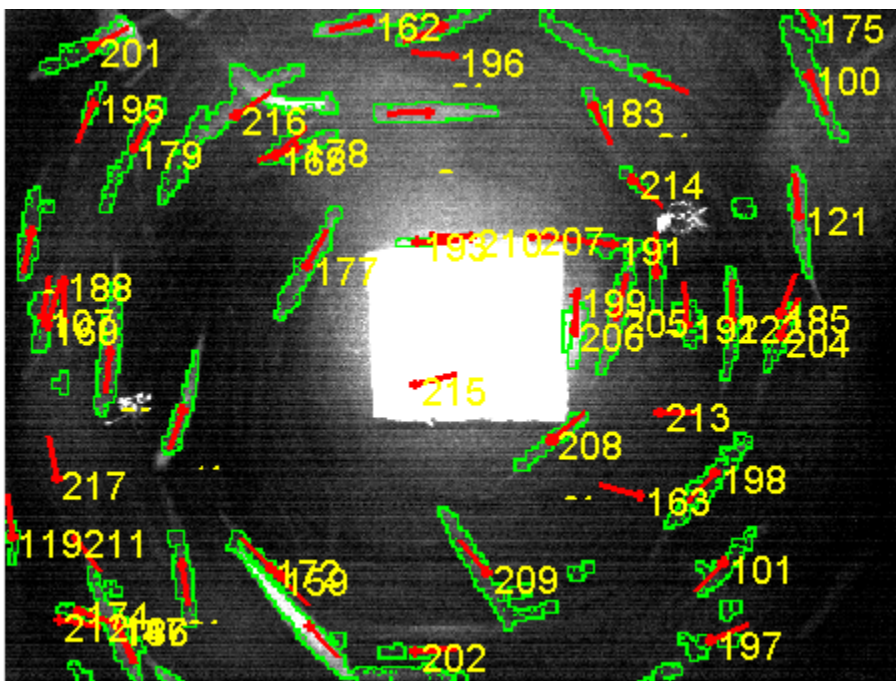
**Detected fish with unique ID**

**3D position of the fish in the tank**

# Testing data – fish behavior analysis

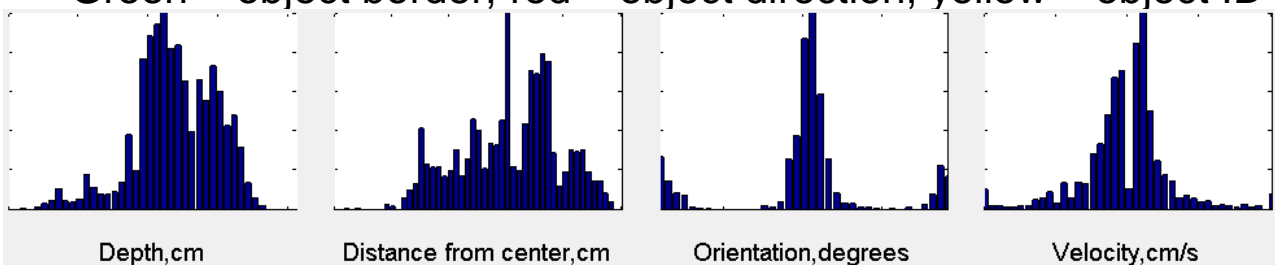


- Fish behavior analysis under different light regimes
  - Testing data are used from the experiment focused on the analysis of fish behavior based on different light regimes (24hours of light X 12 hours of light, 12 hours of darkness)
  - The data are measured in the middle size fish tank using the system of infra red camera and infra red illuminator. Just small sample of images is used for demonstration of the module.



Sample images of tracked fish + statistics of fish behavior

Green – object border, red – object direction, yellow – object ID



# Module testing



- Data processing
  1. The raw data from the camera system are stored in the protocol Fish light example
  2. The images are processed using the fish tracking module and 3D tracks are provided
  3. The tracked are processed to analyze fish behavior
- Module testing
  - Testing data and protocol are prepared under testing account at public BioWes local repository
    - Run the software Protocol Manager and log in using this credentials:
    - Login: [test@test.cz](mailto:test@test.cz)
    - Password: test
    - Go to Protocols menu and select Fish light example – fish tracking
    - Click on Fish tracking icon in the main menu
    - Select all images from the list
    - Click on run button
    - In the first step the background is estimated from 100 images
    - Then the objects are tracked and visualized
    - After all images are processed or stop button is clicked the file with objects trajectories is stored to defined directory