

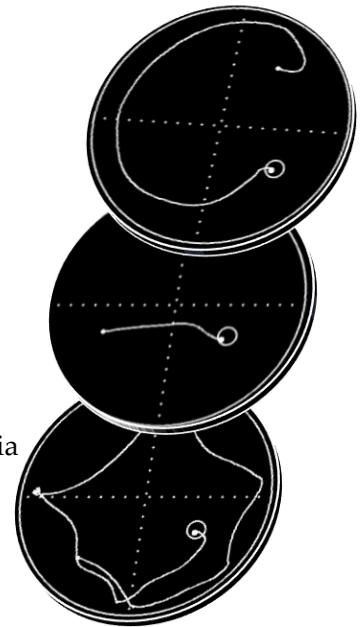
Web Service for the Trajectory Analysis of Laboratory Animals in the «Morris Water Maze»

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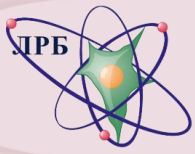
² Laboratory of Radiation Biology Joint Institute for Nuclear Research, Dubna, Russia

³ Dubna State University, Dubna, Russia

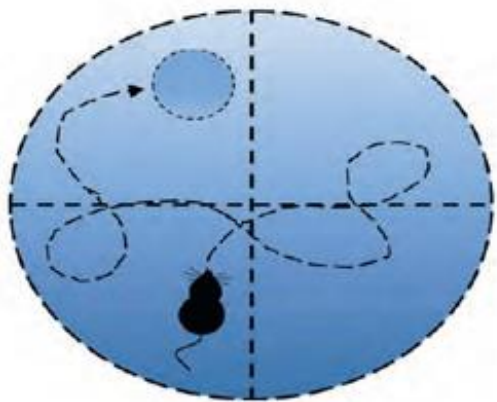
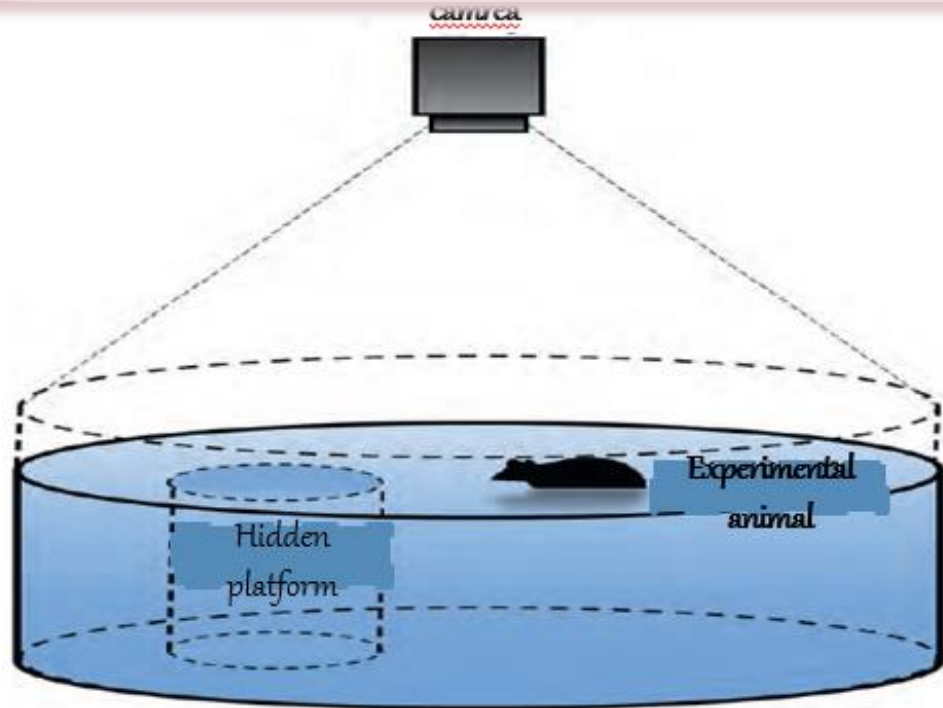


The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation
(theme No. 124092700007-4)

Yerevan, 22.10.2024



«Morris Water Maze» behavioral test



The experimental animal is placed in a circular pool filled with water. At the certain part the pool under a small layer of water is hidden a platform. During the experiment, the small laboratory animal must find and climb the platform.

- maximum exp time **60** seconds
- **2** groups (each group contains up to **10** rodents):
 - Ionizing radiation exposure group
 - control group
- testing in **2** stages:
 - before irradiation
 - after irradiation on the 30th and 90th days
- each stage takes **5** days
- every animal being tested **3** times per day



GOAL

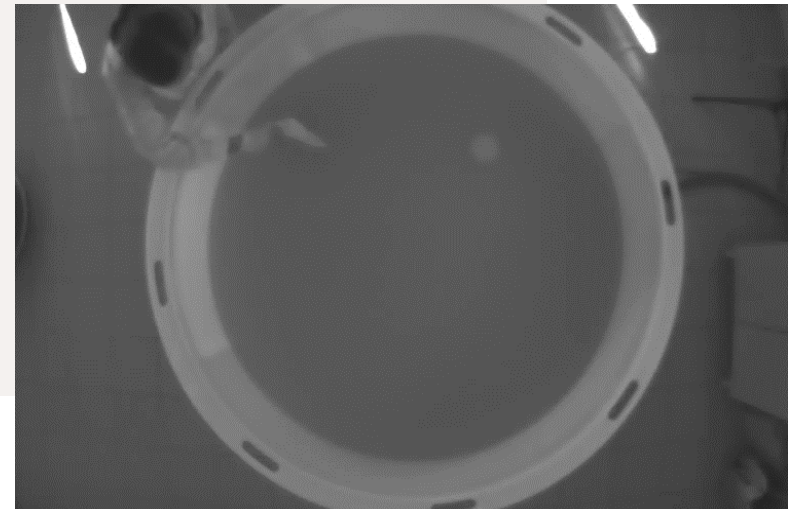
Creating a Web service for the trajectory analysis of laboratory animals in the «Morris Water Maze» behavioral test

- **Development of the algorithm for constructing trajectories**
- **Creation of a training data set**
- **Development of the algorithm for classifying the trajectories**

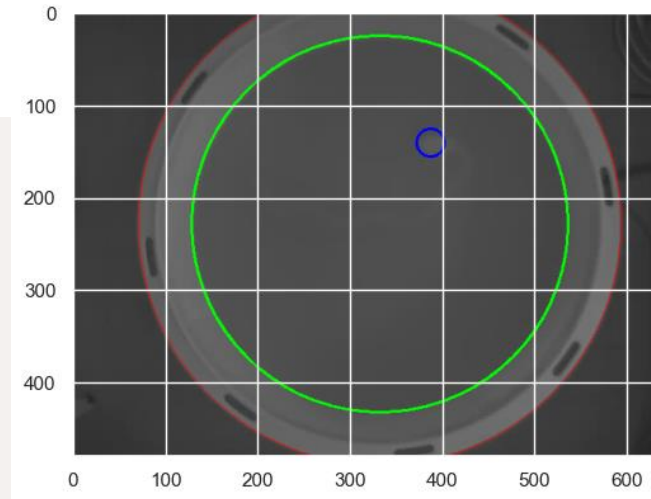
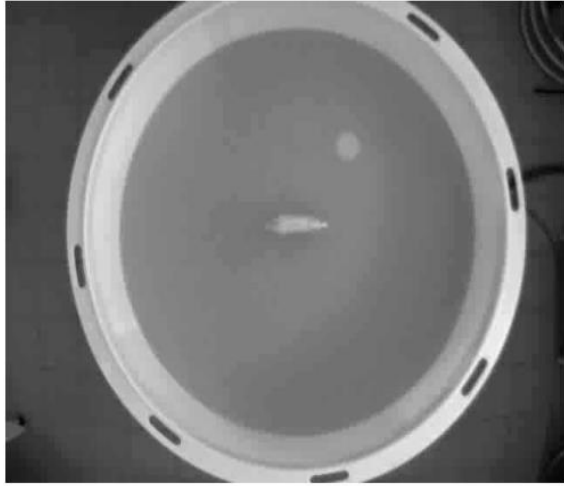


Algorithm development for trajectory construction

- Different conditions for each video/experiment (water reflection, lighting, movable background, size of lab. animal)
- Determination of the beginning of movement of a laboratory animal
- Problem with detecting moving object and etc...



Setup field marking



- Median image construction
- Filtering
- Hough transformation

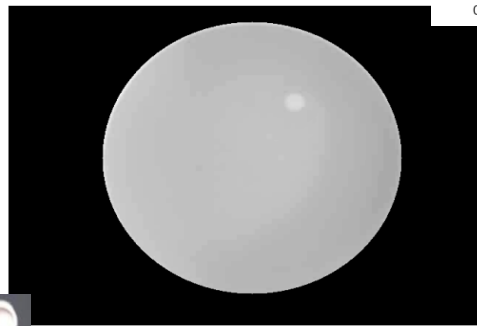
- Finding external boundary of the pool
- Finding internal boundary
- Finding platform location

Algorithm development for trajectory construction

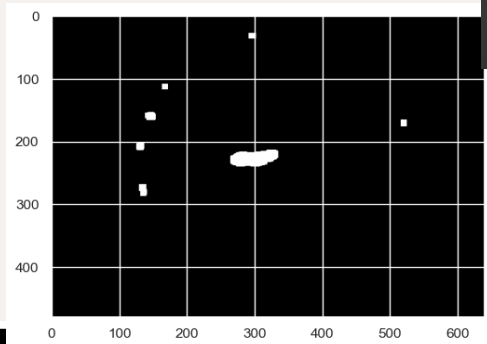
The approach is based on computer vision algorithms

Algorithm development for trajectory construction

The approach is based on computer vision algorithms

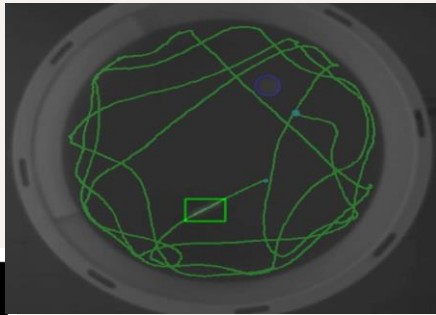


1 **Various algorithms**
Binarization
Filtering
Searching animal contours

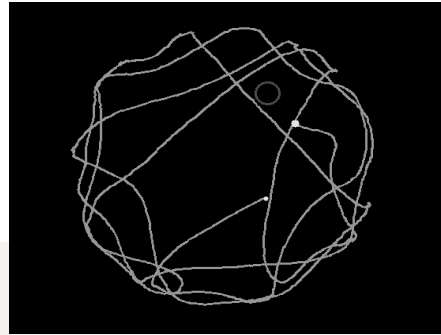


2 **Local tracking**

- Detect an object on the first frame
- Determine local area centered on the point of the object's CM
- Detect the object in the next frame



3 **Obtained the trajectory**
Marking the pool border, mouse, start and finish points, the mouse and its trajectory



4 **Created Data set**
For classification tasks



Web service for «Morris Water Maze» behavioral test

dashboard

About

Morris water tracking

ЛАБОРАТОРИЯ ИНФОРМАЦИОННЫХ ТЕХНОЛОГИЙ имени М.Г. Мещерякова

About

This app is Open Source dashboard.

the project is being created within the framework of the ML/DL/HPC ecosystem of the HybrILIT platform. Link: [here](#).

Dataset: BIOHLIT service: [Link](#).

hYBRI LIT/JINR

Анализ с кадра:

15

Траектория строится с 15 кадра

MOUSE TRACK ANALYSIS DASHBOARD

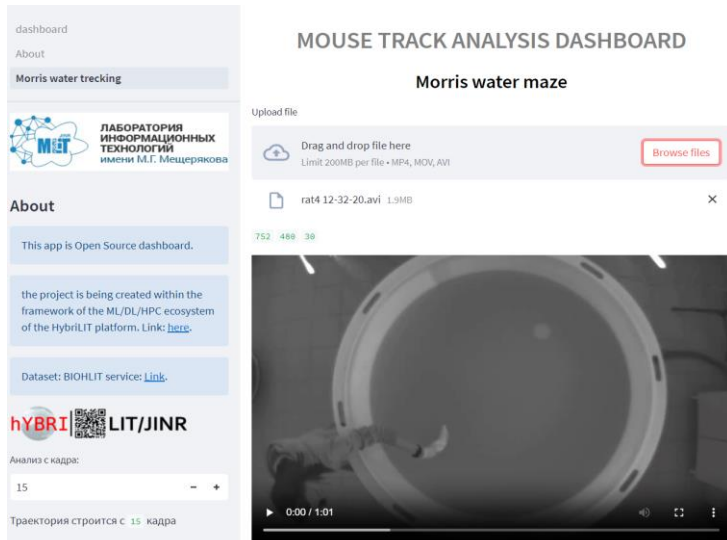
Morris water maze

Upload file

Drag and drop file here
Limit 200MB per file • MP4, MOV, AVI

rat4 12-32-20.avi 1.9MB

752 488 38



имени М.Г. Мещерякова

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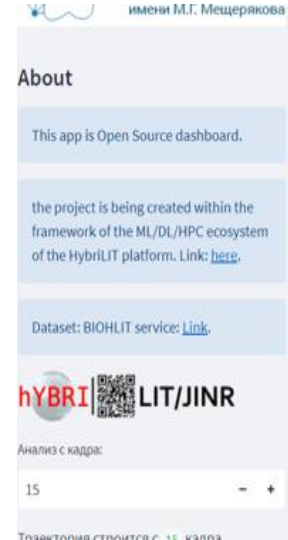
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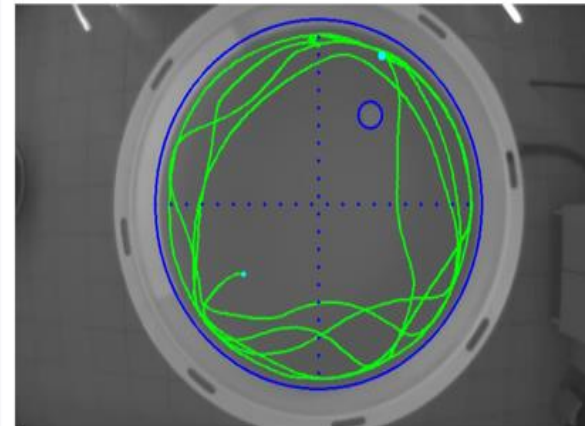
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Траектория



dashboard

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Morris water tracking

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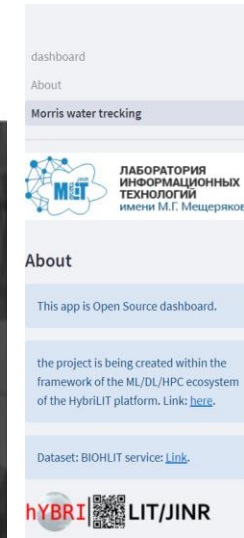
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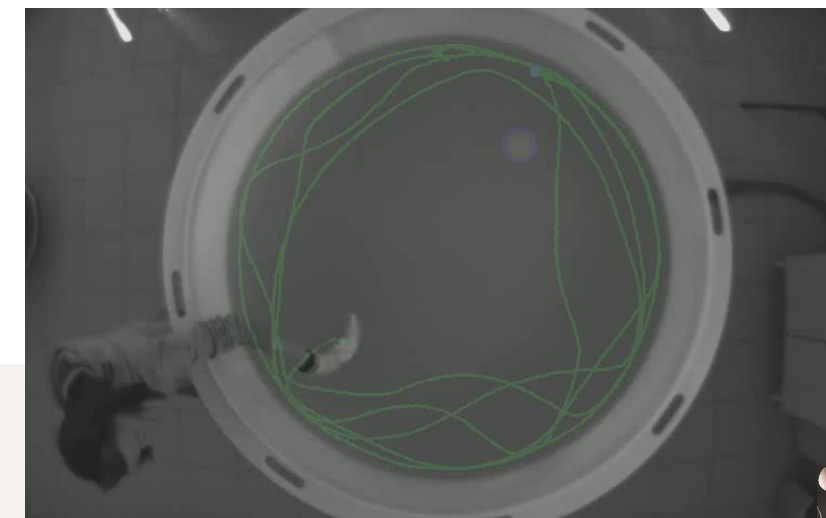
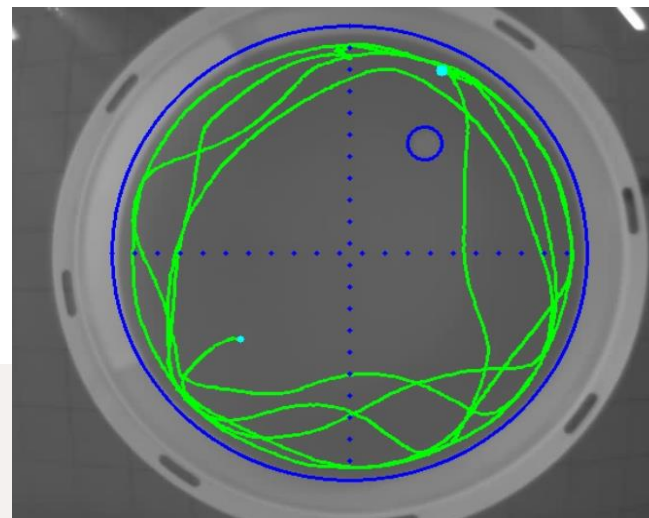
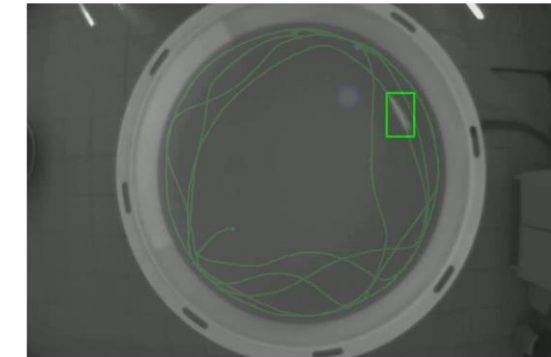


Видео файл для проверки правильности построенной траектории

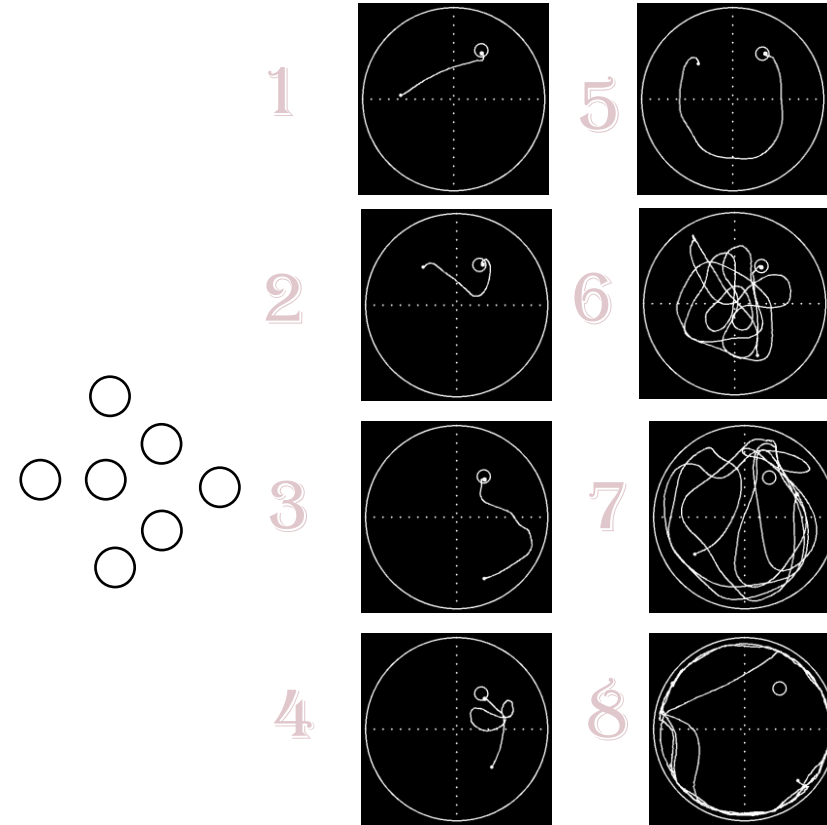
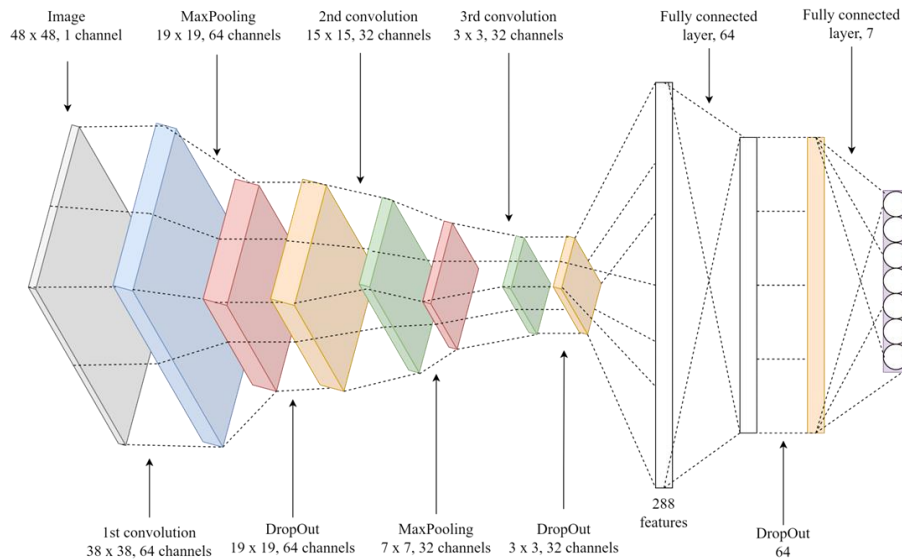
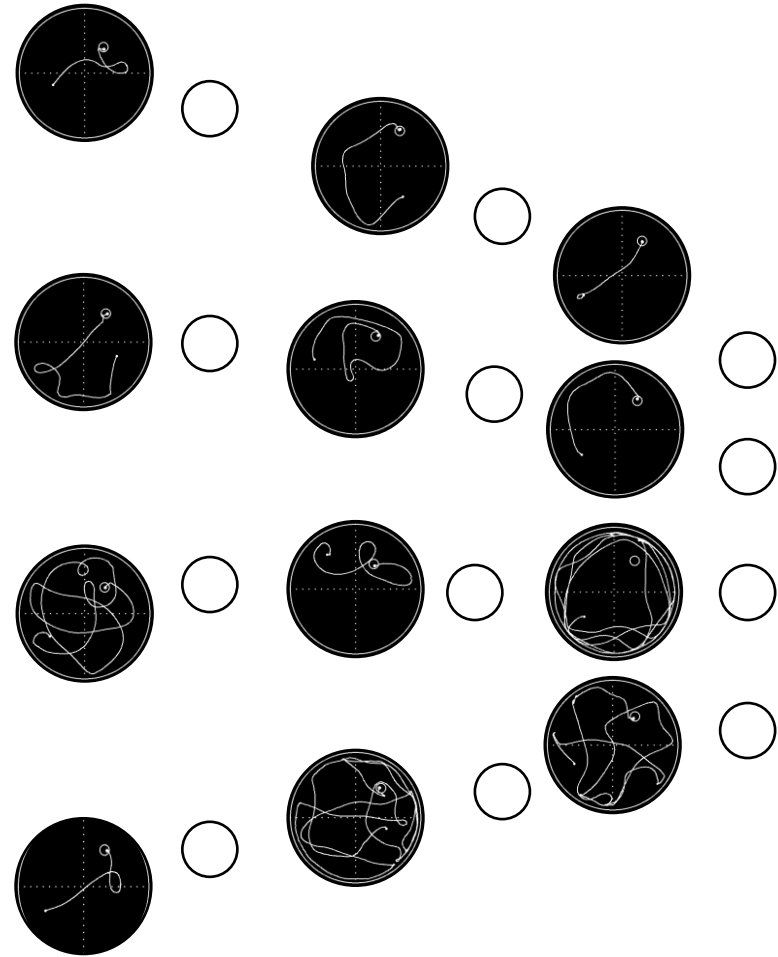
Запись видеофайла с FPS =

30

The current FPS is 38

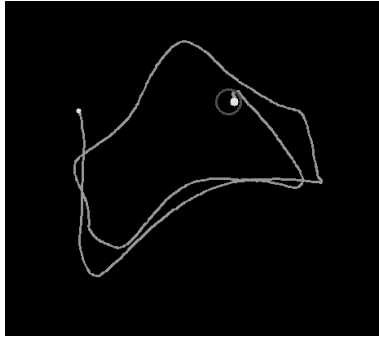


Classification Task



Classification task - Dataset generating

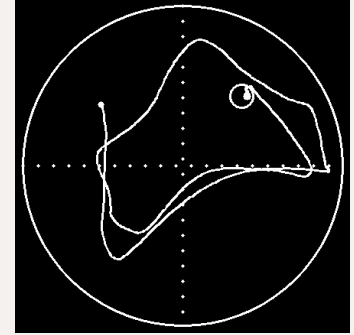
➤ Approach 1



➤ Different dimensions

➤ Small and short trajectories are not always detected

✓ Approach 2



✓ Converting to Single Channel Grayscale images

✓ Resizing in the same scale: $480 \times 480 \times 1$

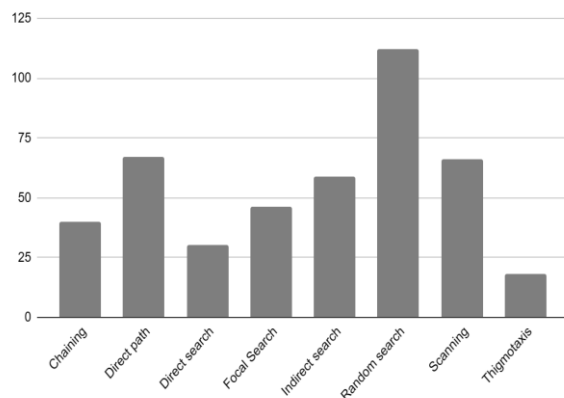
✓ Operations of binarization and expansion of the image to obtain smaller trajectories

✓ Data augmentation: make geometric transformations to images

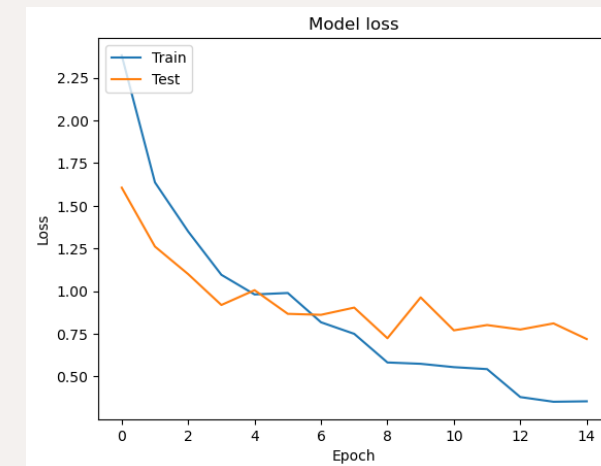
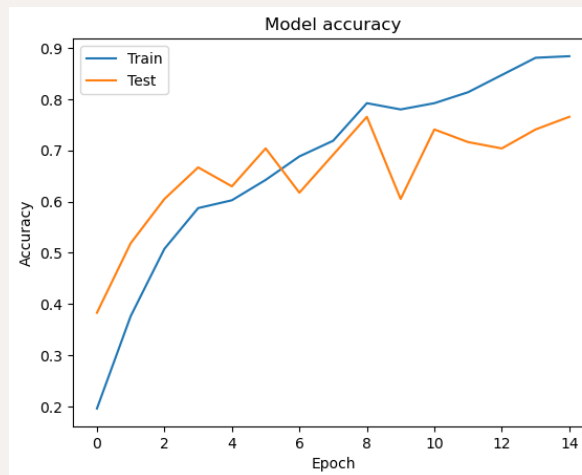


Classification task - Dataset generating

➤ **Significant imbalance
(8 classes)**

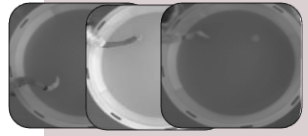


➤ **It is a fairly small set
(~ 475 images)**



✓ **Do more experiments**





Video files



**Marking the
pool border**



**Marking the
platform**



**Removing the
background
noise**

**Local
tracking**



**Object
tracking**



**Creating file
with
trajectory**

**Movement
parameters**



Dataset



Classification



RESULTS

We are developing a Web service for the trajectory analysis of laboratory animals in the «Morris Water Maze» behavioral test

- ✓ **Developed and tested algorithm for trajectory construction**
- ✓ **Received trajectories are annotated**
- ✓ **Created a dataset for classification**
- ✓ **Currently improving our Web service to classify the trajectories**



Thank you for attention



Save our trajectory