



## **APPLICATION OF MODERN IT TECHNOLOGIES** FOR BIOLOGICAL TASKS

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□ Space flights: the effect of ionizing radiation on the organism

□ Study of radioprotective and radiosensitizing properties of

Use of proton therapy and radioactive substances for treatment of



## RELEVANCE OF RADIOBIOLOGICAL RESEARCH

pharmacological drugs

diseases







The main task: to assess the risk of damage after irradiation both at the cellular and organismal levels.







## THE ANN IN HISTOLOGY

Automated identification of neurons and their locations (Inglis et al., «ANRA - Automated Neuron Recognition Algorithm». https://doi.org/10.1111/j.1365-2818.2008.01992.x

Histopathological Image Analysis: A Review (Metin N. Gurcan et al., 2 doi: <u>10.1109/RBME.2009.2034865</u>

Deep Learning in Medical Image Analysis (Dinggang Shen et al, 2017) doi: 10.1146/annurev-bioeng-071516-044442

Machine Learning Methods for Histopathological Image Analysis (Daisuke Komura, Shumpei Ishikawa, 2018) doi: 10.1016/j.csbj.2018.01.001







## RADIOBIOLOGICAL RESEARCH



Experimental animals: mice, rats (nursery of laboratory rodents "Pushchino") Irradiation at MTC, JINR (gamma rays, protons)





Research of pharmacology medicine: Cerebrolysin, Piracetam, etc.





## BEHAVIORAL LABORATORY ROOM

- □ Set and control light intensity
- Digital camera system Behavioral tests:
- 1. Open field
- 2. T-maze
- 3. Water maze
- Software Noldus EthnoVision XT 13.0 (The Netherlands)















## PROS & CONS OF THE NOLDUS SOFTWARE

### Pros:

- Tracking and distance made
- Heatmap
- Velocity



### Cons:

- Freezing
- Grooming
- Vertical activity: climbing and rearing

Solution: additional software component for the existing software



Hough Transform algorithm



bone marrow

Information system for radiobiological tasks (joint project of LRB and LIT, JINR)



### AUTOPSY OF LABORATORY RODENTS



**Steps:** visual estimation, cutting target parts out or taking an entire organ, tissue fixation, embedding or blocking out, staining, microscopical investigation.

thymus – mass spleen – mass liver– histology small intestine – histology kidney – histology brain– mass, histology





### MICROSLIDES



- paraffin blocks
- □ histological slides (min width: 2 µm)
- stains:
- cresyl violet (Nissl)
- hematoxylin eosin (Nissl)
- fluoro-Jade B













#### Camera





*ToupView* 

## MORPHOLOGICAL ANALYSIS. STEPS

- □ Light / fluorescent microscope
- □ Digital camera *Toupcam 3.1MP ½ "Aptina cmos* UCMOS03100KPA
- □ Software ToupView taking pictures of slides
- Pictures of microslides: ~30 pics of sensomotor cortex, ~10 pics of hippocampus (<u>1 pic takes ~7</u> <u>Mb</u>)

Microscope





## SOFTWARE FOR MORPHOLOGICAL ANALYSIS

- □ Free software *ImageJ*.
- Plugin Cell Counter.
- □ Saving as *png, gif, jpeg, avi, bmp,* etc.
- □ Saving position of a point as *excel, csv.*
- □ Saving results as *excel, csv.*



Zooming in.40x10. Nissl staining





## HISTOLOGICAL ANALYSIS USING IMAGEJ

Classification of brain cells:

normal (1);

- □ altered (2): morpho-functional and other;
- □ degenerative (3);
- **glia** (5);
- other elements of brain tissue which cannot be identified (7)







### **RESULTS OF THE CONDUCTED RESEARCH STAGES**



Leucocytes



### Qualitative and quantitative analysis

Statistical criterion :

➤ t-test

Mann-Whitney

> Anova Software for statistical analysis :

- Past •
- Origin ٠
- Excel ٠











### **Problems:**

1.Lack of a single repository with all experimental data. Risk of information loss.

2.Data unavailability for all experiment participants at the same time. Large time spent on processing the data obtained from radiobiological experiments. Processing data manually.

3.Flaws in the existing software and resulting limitations in the conditions of conducted experiments or an increase in the time spent on processing data manually.

4. Peculiarities of biological statistical analysis, use of third-party programs.

### Tasks and solutions:

1.Collection and storage of data in single information space - development of a web service.

2. Analysis of the obtained data: application of machine and deep learning methods and neural network approaches for automatic processing of digital data of experiments (development of a software component for the existing software, CNN for morphological analysis of the CNS).

3. Statistical analysis as an additional component to the service.







### THANKS FOR YOUR ATTENTION!

