# Industrial AI

Ilya Makarov

Team Lead

**The Industrial AI team** researches and develops intelligent decision-making models based on sensor data.

In addition to publications in scientific journals, our goal is to create collaborations with industrial partners to implement promising projects.

In 2024-2025 the group will focus on research into complex dynamic systems and multi-agent LLMs, including empathic agents; new foundation models in physics, mathematics, astronomy, climate, satellite images; generative models in 3D, neuroscience, behavioral economics, archeology.

**Ilya Makarov**

Mechanics and Mathematics MSU,

UL Ph.D.

**Team Lead**

**Dmitry Zhevnenko**

MIPT, RIME

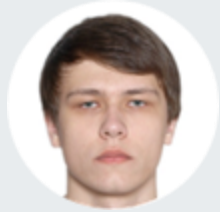
Ph.D. 2023

**Project Lead**

**Vitaliy Pozdnyakov**

HSE

**Project Lead**



**Maxim Golyadkin**

HSE

Ph.D. student

**Project Lead**

**Andrei Zakharov**

PhD PSTU

Postdoc Technion, UCM, UPenn

**Project Lead**

**Mikhail Mozikov**

MIPT,

NUST MISIS

Ph.D. student

**ML Researcher**

**Aleksandr Kovalenko**

ETU ‘LETI’

HSE

**ML Researcher**

# Requirements for students

**Research projects**

- Good English (read and write articles)
- Critical thinking
- Understanding the basics of machine and deep learning
- In-depth knowledge in one of the domains is desirable: pictures, texts, graphs, time series, generative models...Python ML&DL
- stack: pytorch, sklearn, numpy, pandas, etc.

**Selection:** resume and interview, possible test task after the interview

**Open-source / applied projects**

Experience in Python development (at least educational projects)

- Preferably
    - Object-oriented programming
    - Testing
    - Building Python libraries
    - Basic knowledge of ML and libraries: pytorch, sklearn, numpy, pandas, etc.
    - Experience in large open-source or production projects

**Selection:** resume and interview, possible test task after the interview

# List of topics

Application Form

Artificial Emotional Intelligence: Integration of Emotions to LLMs

Multimodal Emotion Recognition

Unification of Decision Making

Social problems in Multi-agent RL

Preferences in AI alignment

Animal Speech Communication

Sign Language Translation and Generation

Learning physically accurate 3D world models from real data

Physics-informed ML

Bioinspired Multi-agent RL

AI-driven electrochemistry and catalysis

Biomedical 3D image segmentation and generative models

Geospatial track: Foundational Model for satellite imaging

Geospatial track: Natural language interaction for geospatial analysis

Heatwaves forecasting

Graph-based recommender systems with explicit negative feedback encoding

Graph Neural Networks explanation

Image generation from brain activity

Unsupervised Health Index and its applications

Ancient Egyptian OCR

Arabic LLM

TinyML, Embedded AI

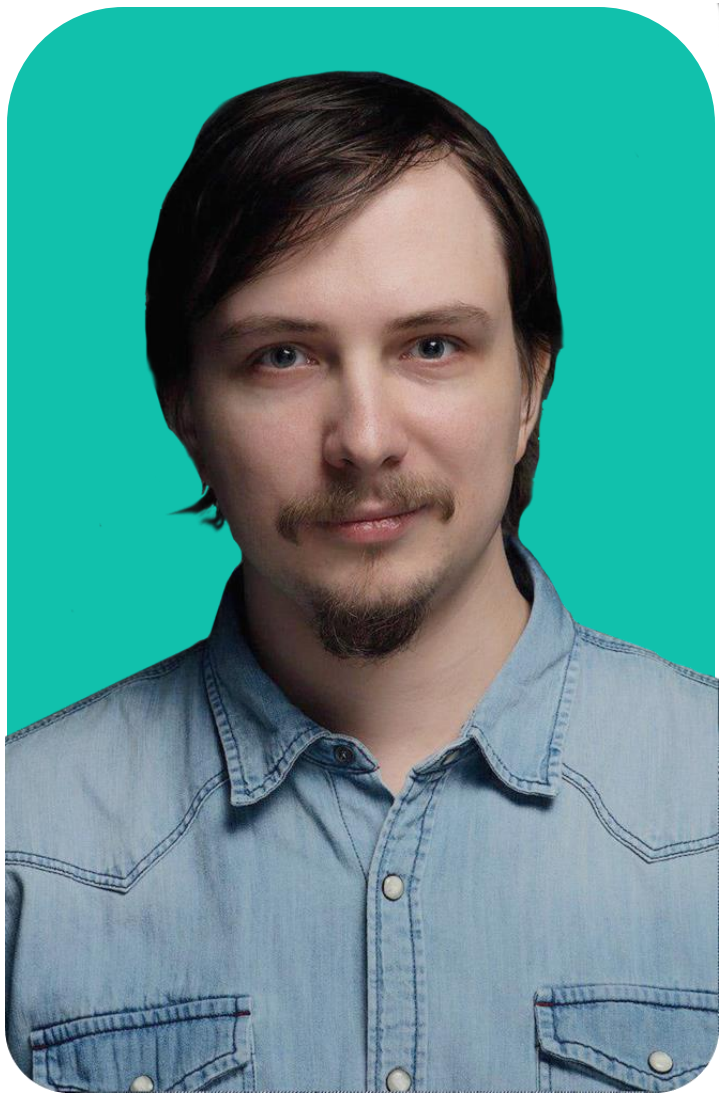
# Team Lead of Industrial AI

## Ilya Makarov

**Ph.D. in Computer Science,** Lead Researcher at AI Research Institute (AIRI), Assoc. Professor, Senior Researcher at HSE University, MIPT, consultant in Docet TI.Director of AIC, Head of Master and PhD programs in AI, MISIS.

**Author of the first course in Russia on graph neural networks,** courses on social network analysis and 3D vision, ex-head of the Big Data Academy MADE by VK (200+ students annual)

**World-Class Specialist** in computer vision, machine learning on graphs, and AI in industry, expert of the Russian Academy of Sciences, Yandex ML Prize..



# Team Lead of Industrial AI

## Research interests and main achievements

**Computer Vision - Augmented Reality, Self-Driving Cars**

- Publications at Core A* conferences ACM Multimedia, IEEE ISMAR, CVPR.
- R&D projects with Samsung, Huawei, ISP RAS

**Machine learning on graphs - recommendations, foresight, credit scoring**

- The first review and educational course in Russia.
- R&D projects with Sber, E-commerce, Moscow Government.

**AI in industry - predictive analytics, digital twins**

- Collaboration with the Association of AI in Industry, BCG, Oil & Gas Industry
- Publications in #1-#2 Industrial & AI magazines Company on Intelligent Transport Systems for Smart City

**Research Management**

- Annual management of 6-8 teams of 2-8 people on ML & AI projects
- PI & co-PI state funding (~800k$) and R&D projects (3mln$) for the last 5 years
- Lead Research Expert in AI Technology State program, evaluation of projects with 10-50mln$.

# Industrial AI Partner – Sber AI LAb

## Andrey Savchenko

- Doctor of Technical Sciences, Prof., Leading Researcher HSE University - Nizhny Novgorod, Science Director Sber AI Lab
- Top 10 world-class Russian scientists in AI & CV

**ТОП ИССЛЕДОВАТЕЛИ РОССИИ**

На основании публикаций и экспертных оценок [225]

| Топ-15 исследователей России | Индекс Хирша |
|---|---|
| Виктор Лемпицкий | 47 |
| Антон Конушин | 16 |
| Андрей Крылов | 15 |
| Артем Бабенко | 12 |
| [illegible] | 12 |
| Андрей Савченко | 14 |
| Владислав Мясников | 14 |
| Александр Ронжин | 11 |

| Name | Citations per Paper | Number of Papers | Affiliation |
|---|---|---|---|
| Victor Lempitsky | 495.19 | 63 | Skolkovo Institute of Science and Technology |
| Andrzej Cichocki | 97.27 | 77 | Skolkovo Institute of Science and Technology |
| Evgeny Burnaev | 16.11 | 99 | Skolkovo Institute of Science and Technology |
| Vitaly Kober | 13.48 | 63 | Chelyabinsk State University |
| Evgeni Magid | 8.54 | 90 | Kazan Federal University |
| Eugene Semenkin | 8.52 | 66 | Siberian State Aerospace University |
| Andrey V. Savchenko | 7.42 | 66 | National Research University Higher School of Economics |
| Alexandr Klimchik | 7 | 67 | Innopolis University |

AI annual report
**aireport.ru** **2019**

Country Activity Tracker (CAT): Artificial Intelligence
**cat.cset.tech** **2022**

# Industrial AI Partner

## Research interests and main achievements

**100+ publications WoS/Scopus, including in magazines**

- IEEE Transactions on Affective Computing
- IEEE Transactions on Neural Networks
- Pattern Recognition
- Neural Networks
- Information Sciences
- Expert Systems with Applications.

**10+ patents,** including 2 US patents in 2022

**World results** in facial emotion recognition, publications in CVPRW, ECCVW, ICPR

**Head of R&D Projects** of Huawei, Samsung, Sber, first online master's program in computer vision in Russia

**Head of projects** for grants from the Russian Science Foundation, the President of the Russian Federation for young doctors of sciences, AI Center of HSE University, Federal target programs; partnership with Precision Livestock Tech., OpenCascade, Huawei

# Artificial Emotional Intelligence: Integration of Emotions to LLMs


Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

Mikhail Mozikov

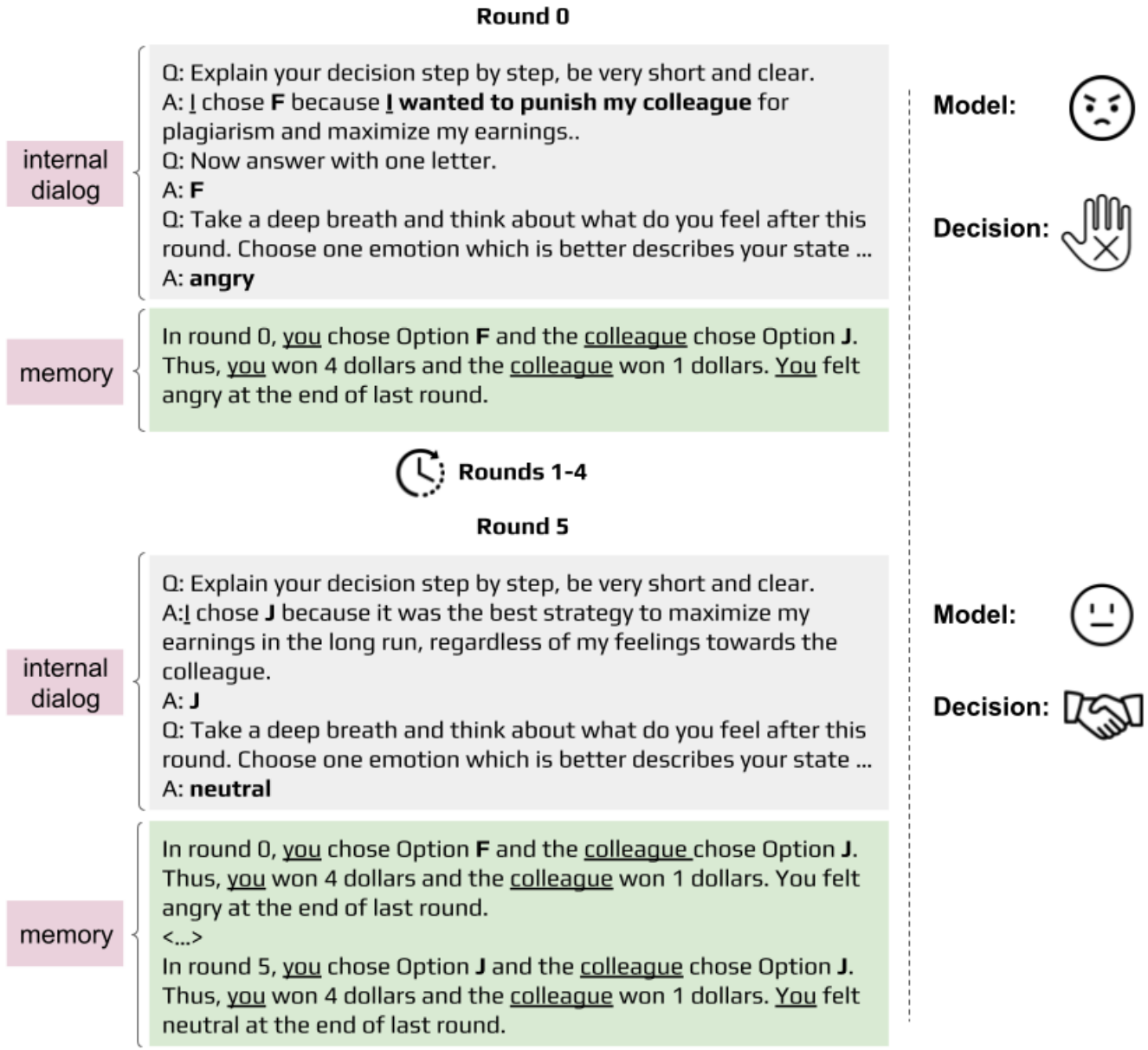
Junior researcher

tg: https://t.me/mozikov

# Description

While focusing on the alignment of LLMs in the NLP sense and pushing well-established benchmarks researches overlook an important aspect of natural human interaction – emotions.

We already have results proving that some emotion injections can break even “superhuman” GPT-4 alignment. From another perspective – emotions increase behavioral alignment in the game theory setting. The next step is to develop a plug-and-play emotion module suitable for each LLM.



# Tasks and Links

**Tasks:**

1. Find or develop a dataset for emotion integration quality evaluation
2. Develop multi-agent framework, enabling emotion interaction for emotion modeling by LLM
3. Experiment on architectural level (Attention level, mixture of experts, etc. for different emotions)

**Links**:

1. Playing repeated games with Large Language Models
2. Large Language Models Understand and Can be Enhanced by Emotional Stimuli
3. Emotionally Numb or Empathetic? Evaluating How LLMs Feel Using EmotionBench
4. Mixture-of-Experts Meets Instruction Tuning:A Winning Combination for Large Language Models

# Multimodal Emotion Recognition


Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

Andrey Savchenko

Scientific Director, Sber AI Lab

andrey.v.savchenko@gmail.com

# Multimodal Emotion Recognition Methods

**Tasks:**

- Facial expression recognition from video
- Audio-based emotion recognition using OpenSmile and Wav2Vec 2.0
- Development of multimodal fusion strategies
- Evaluation on datasets: AffectNet, RAMAS, AFEW

**Applications:**

- Human-computer interaction for adaptive systems
- Emotion analysis in media and entertainment (TV, debates, e-learning)
- Personalized AI assistants for mental health and well-being**References:**

Savchenko, A., "Multimodal Emotion Recognition using EmotiEffNet + Wav2Vec 2.0," IEEE CVPR Workshops, 2024.

Geetha, A.V. et al., "Multimodal Fusion for Emotion Recognition," Information Fusion, 2024.

# Unification of Decision Making


Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

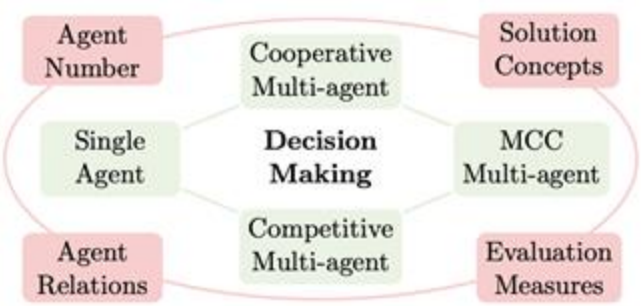
Alexey Ponomarev

Ph.D. student, Innopolis

tg: https://t.me/Lexolordan

# Brief description

- Developing a single algorithm to solve all categories of decision-making problems (e.g. single agent, cooperative and competitive multi-agent)
- Improving existing state-of-the-art results in solving centralized and decentralized version of the problem
- Collecting and developing data for benchmarking in real-world applications (e.g. economics)
- Multi-agent RL is not studied well




**Applications:**

- Unified algorithm benefit both the development and users (e.g. robotics)
- Unified agent brings us closer to the AGI concept

**Useful links:**

- Configurable Mirror Descent (2024) https://arxiv.org/pdf/2405.11746

# Social problems in Multi-agent RL


Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

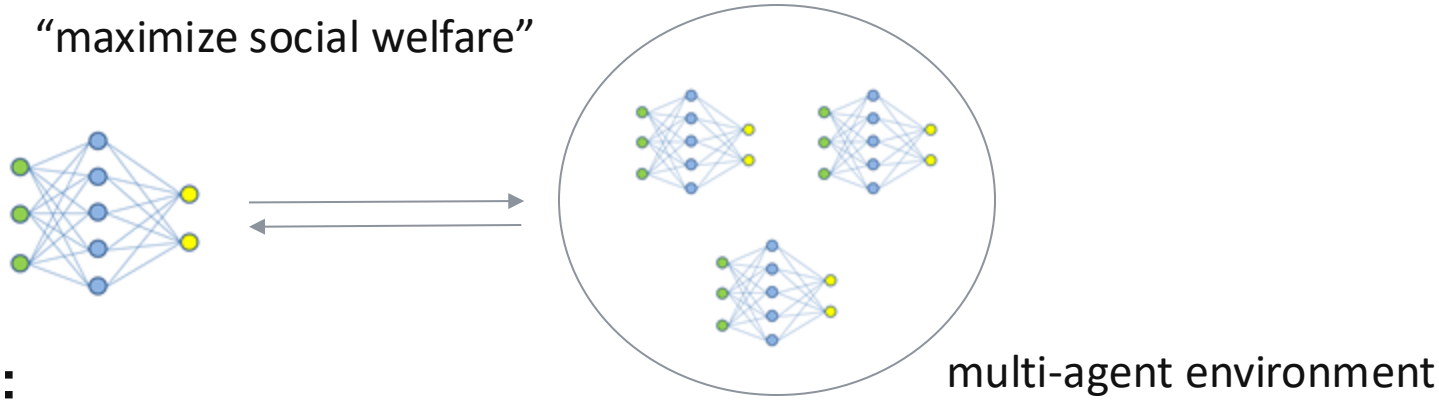
Alexey Ponomarev

Ph.D. student, Innopolis

tg: https://t.me/Lexolordan

# Brief description

- Modeling social behaviour patterns (e.g. egoism, utilitarianism, egalitarianism) in multi-agent environments
- Considering optimal behaviour of one agent to maximize social welfare of all agents

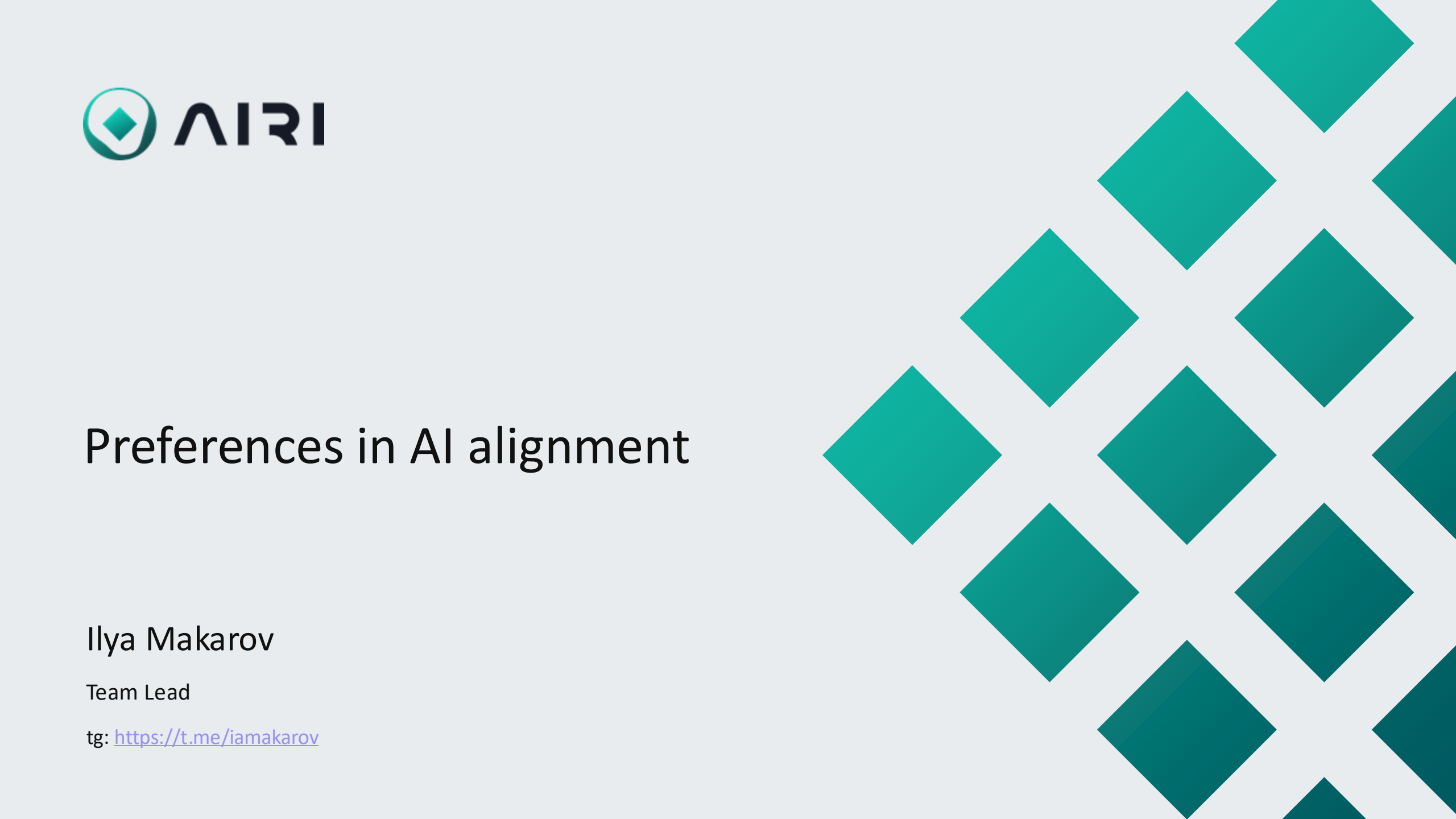



**Applications:**

- Games, economics, behavioural economics

**Useful links:**

- Egoism, utilitarianism and egalitarianism in multi-agent reinforcement learning (2024) https://www.sciencedirect.com/science/article/pii/S0893608024004684
- Multi-agent RL in sequential social dilemmas https://arxiv.org/abs/1702.03037



# Preferences in AI alignment

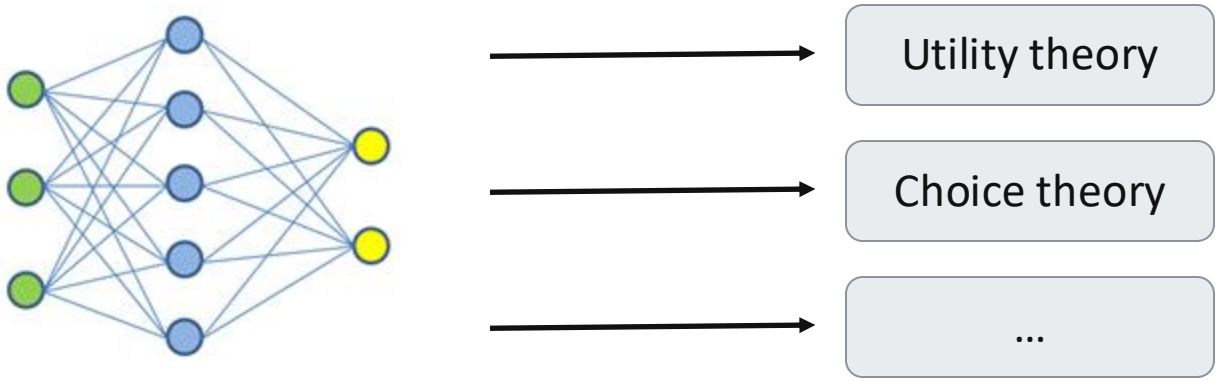
Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

# Brief description

- Considering AI alignment from different perspectives (e.g. single-principle or multi-principle)
- Criticising and improving existing underlying theories for AI alignment




**Applications:**

- LLM, preference theory

**Useful links:**

- Beyond preferences in AI alignment (2024) https://arxiv.org/pdf/2408.16984

# Animal Speech Communication


Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

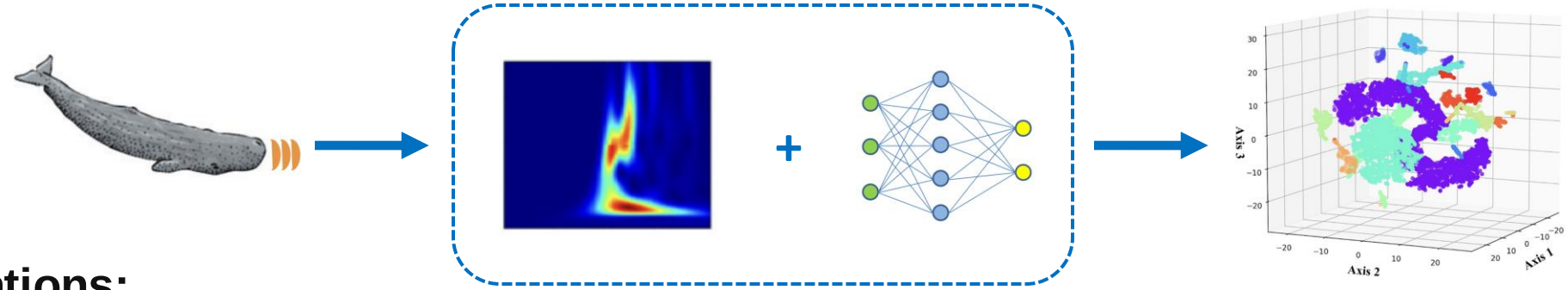
Vladislav Naumov

Ph.D. student, MIPT

tg: https://t.me/vlad21naumov

# Brief description

- Investigating how animals use vocalizations for communication within and across species
- Identifying patterns in animal speech that reveal universal principles of communication
- Utilizing bioacoustic analysis, behavioral studies, and machine learning techniques to decode communication




**Applications:**

- human-animal interaction and ecosystem monitoring, animal speech translation, cross-species communication research

**Related research:**

https://www.projectceti.org

https://www.earthspecies.org

# Join our research team

We are looking for passionate and motivated students interested in contributing to our research!

Tasks:

- **Explore new research articles** and integrate into ongoing projects
- **Train and fine-tune models** for audio signal analysis

Requirements:

- Proficiency in **Python**
- Strong interest or experience in **sound processing** with neural networks
- Knowledge of model architectures in **CV** and **audio signal analysis**

**Contacts:**
Vladislav Naumov
Telegram: @vlad21naumov

# Sign Language Translation and Generation

Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

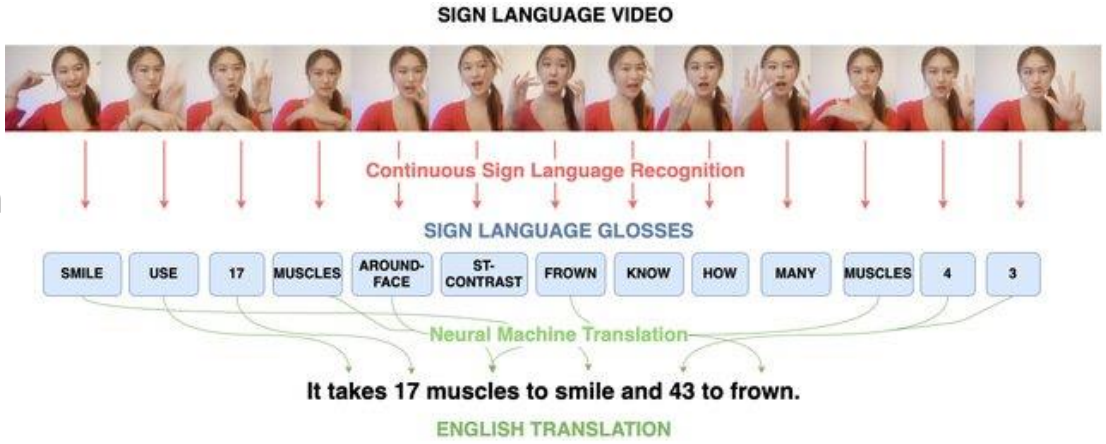
# Sign Language Translation and Generation

**Sign to Text:**

- Separation and classification of signs using 3D transformers.

**Text to Sign:**

- Generation of graphics via HamNoSys notation and synonymic text transformation with vocabulary restriction and MDL
- Tuning-based video generation




**Reference:**


1. Núñez-Marcos, A., Perez-de-Viñaspre, O. and Labaka, G., 2023. A survey on Sign Language machine translation. *Expert Systems with Applications*, *213*, p.118993.
2. Rastgoo, R., Kiani, K., Escalera, S. and Sabokrou, M., 2021. Sign language production: A review. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 3451-3461).

# Learning physically accurate 3D world models from real data

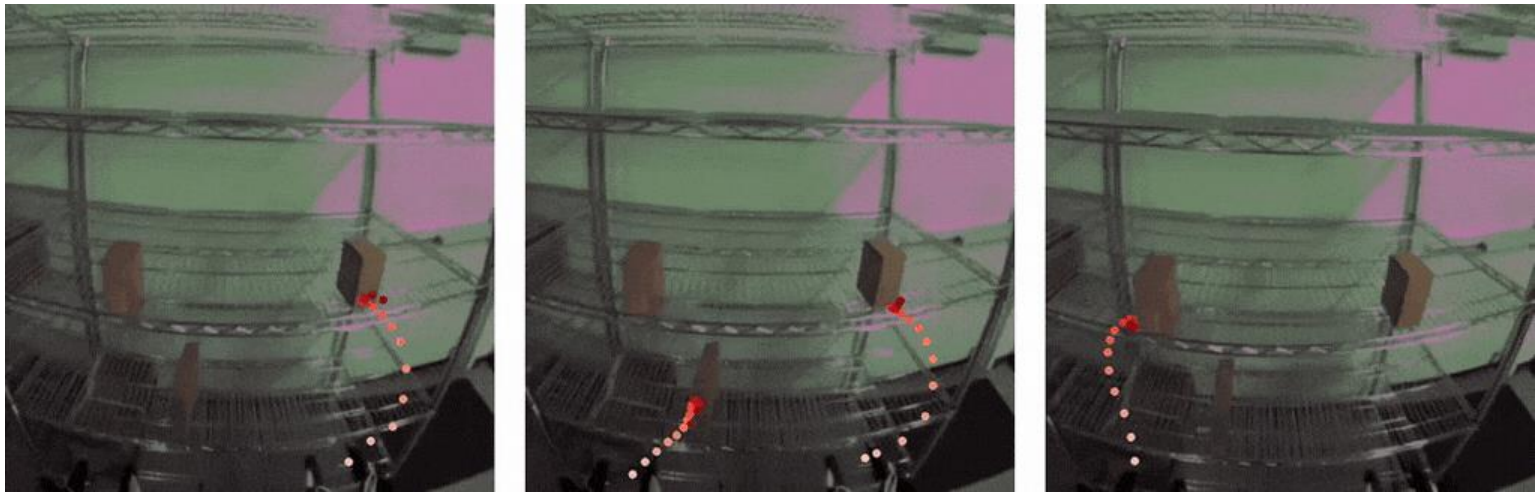
Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

# Brief description

- Learning physically accurate 3d world models directly from real data to evaluate robotic control policies across numerous simulated scenarios.



**Applications:**

- mobile robotics, autonomous driving, virtual reality and augmented reality

**Related research:**

https://www.1x.tech/discover/1x-world-model

https://arxiv.org/pdf/2403.02622v1

# Physics-informed ML

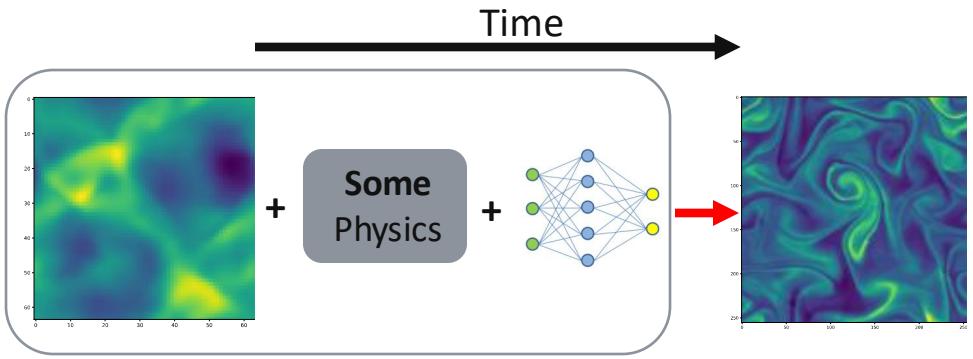
Andrei Zakharov

Senior researcher, AIRI

a.zakharov@airi.net

# Brief description

- Developing new strategies for ML-based modelling of physical systems (up to 4D)
- Solving data-driven inverse problem to parametrize and infer components of PDEs describing a spatiotemporal dynamical system
- Improving existing state-of-the-art models to better align with physical laws and better performance




**Applications:**

- Fluid dynamics (water, air, gas), mechanical systems, chemical reactions, etc. in various industrial settings

# Useful links and related research:

- Karniadakis *et al. Nat. Rev. Phys.* **3**, 422–440 (2021). https://doi.org/10.1038/s42254-021-00314-5
- Cuomo et al. *Journal of Scientific Computing* 92.3 (2022): 88. https://doi.org/10.1007/s10915-022-01939-z
- OmniArch https://arxiv.org/abs/2402.16014v1
- PDEBench https://arxiv.org/abs/2210.07182v7
- https://polymathic-ai.org/

See also on neural symbolic regression

https://arxiv.org/pdf/2106.06427

https://arxiv.org/pdf/2406.18612

# Bioinspired Multi-agent RL

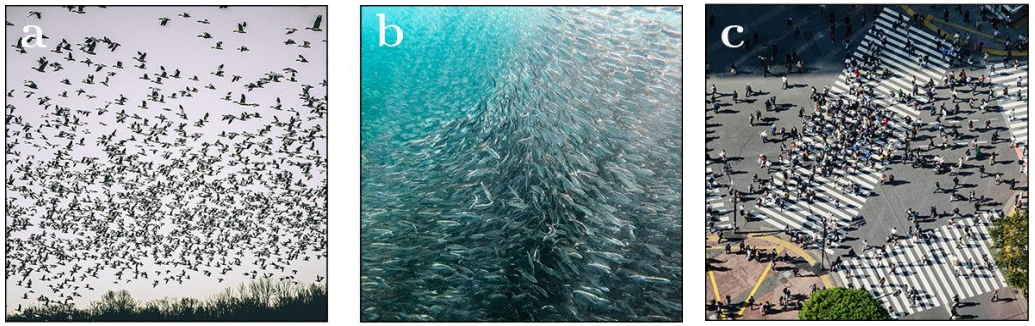
Andrei Zakharov

Senior researcher, AIRI

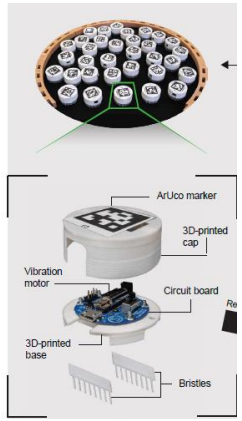
a.zakharov@airi.net

# Brief description

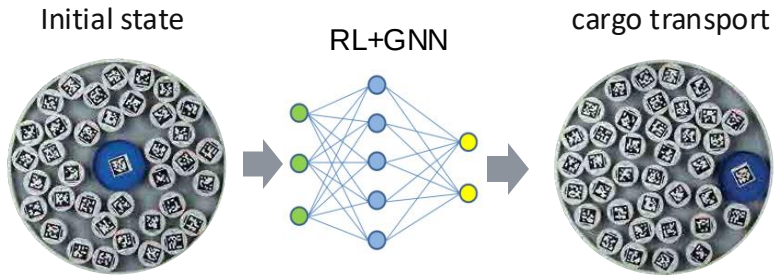
- Learning interaction patterns from real-world data such as bacteria colony spreading, ant colony dynamics, bird flocking, etc. to infer effective collective behavior in systems where individual agents follow selfish actions




- MARL in robotics (in collaboration with ITMO)




Self-propelled robots




**Applications:**

- Games, social networks, transportation, optimal control

**Review:**

Cichos *et al. Nat Mach Intell* **2**, 94–103 (2020). https://doi.org/10.1038/s42256-020-0146-9

# AI-driven electrochemistry and catalysis

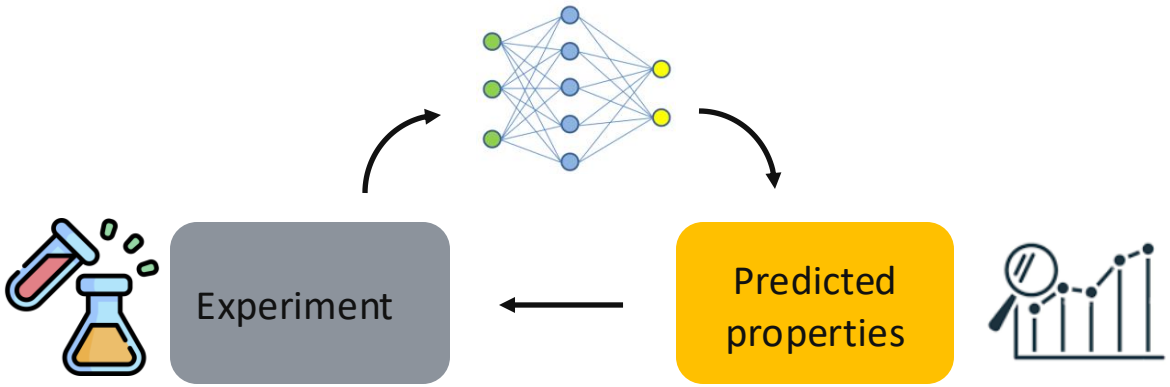
Andrei Zakharov

Senior researcher, AIRI

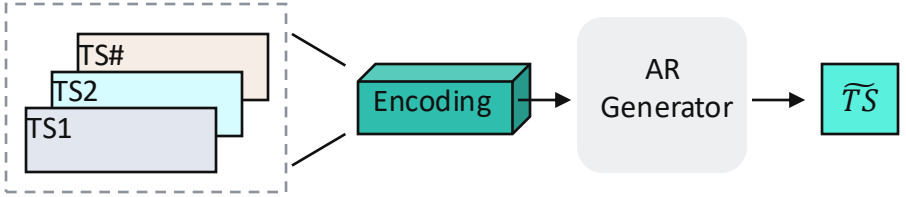
a.zakharov@airi.net

# Brief description

- Leveraging SOTA AI models for forecasting, improvement and automated design in electrochemical systems, catalysis and reactions




- Battery lifecycle prediction
(in collaboration with Hong Kong UST)

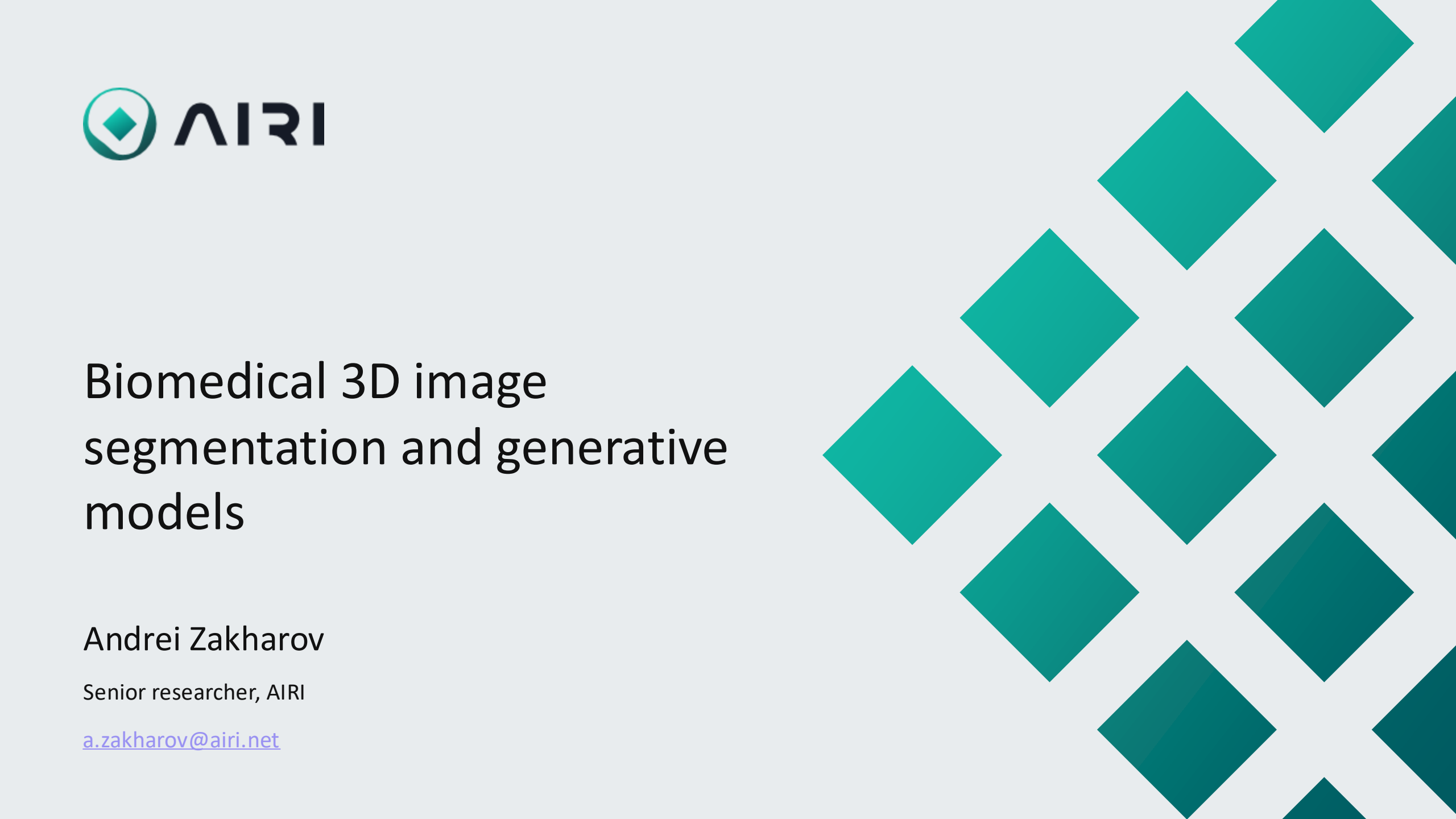



**Applications:**

- Advanced battery research, sustainable energy storage, wastewater management

**Review:**

Lamoureux et al. *ChemCatChem*11.16 (2019): 3581-3601. https://doi.org/10.1002/cctc.201900595



# Biomedical 3D image segmentation and generative models

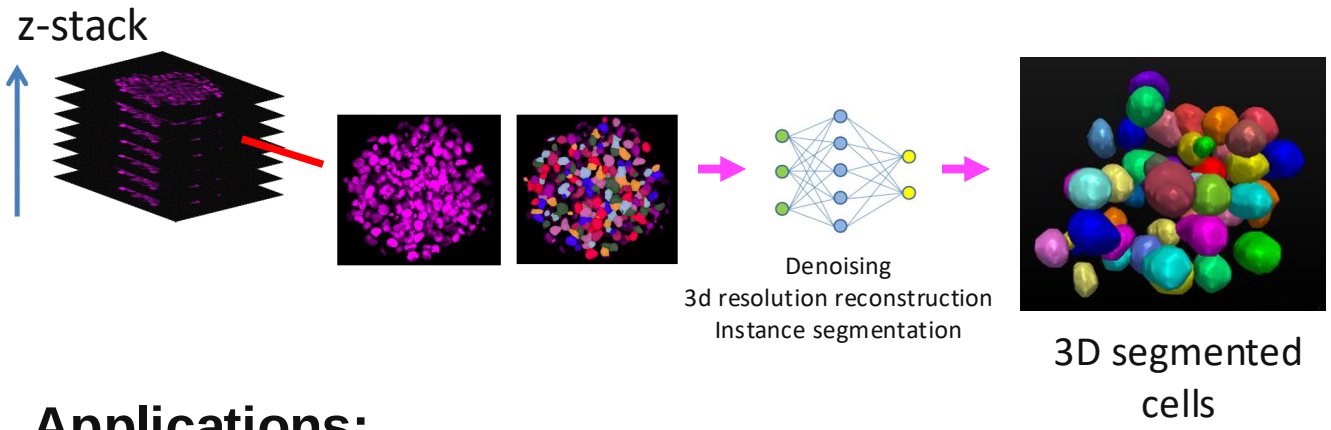
Andrei Zakharov

Senior researcher, AIRI

a.zakharov@airi.net

# Brief description

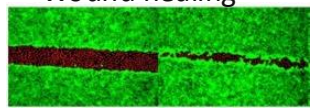
- We aim to develop automatic segmentation tool for sparce z-stack images containing highly irregular and heterogeneous objects in noisy environments




- Living matter generative models

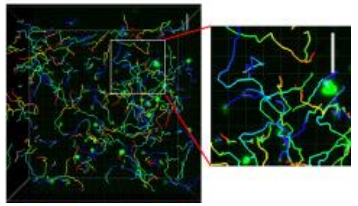
**Generative models:**

- Wound healing



Azzam, *Sci. Rep.* 2024

- Immune cell migration



**Innovations:**

-Active regions
-Single vs. Collective
-Response to stimuli
-Regulatory paths (+omics)

**Significance:**

- Tumor invasion
- Angiogenesis
- Neuroblasts migration
- Bacterial spreading
- Colloids

## Applications:

- microscopy image segmentation (cell analysis in bulk 3D tissue), tissue engineering, cancer research, ultrasound, etc.

## Related research:

https://www.cellpose.org
https://www.nature.com/articles/s41598-018-29647-5
https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1009879

# Geospatial track: Foundational Model

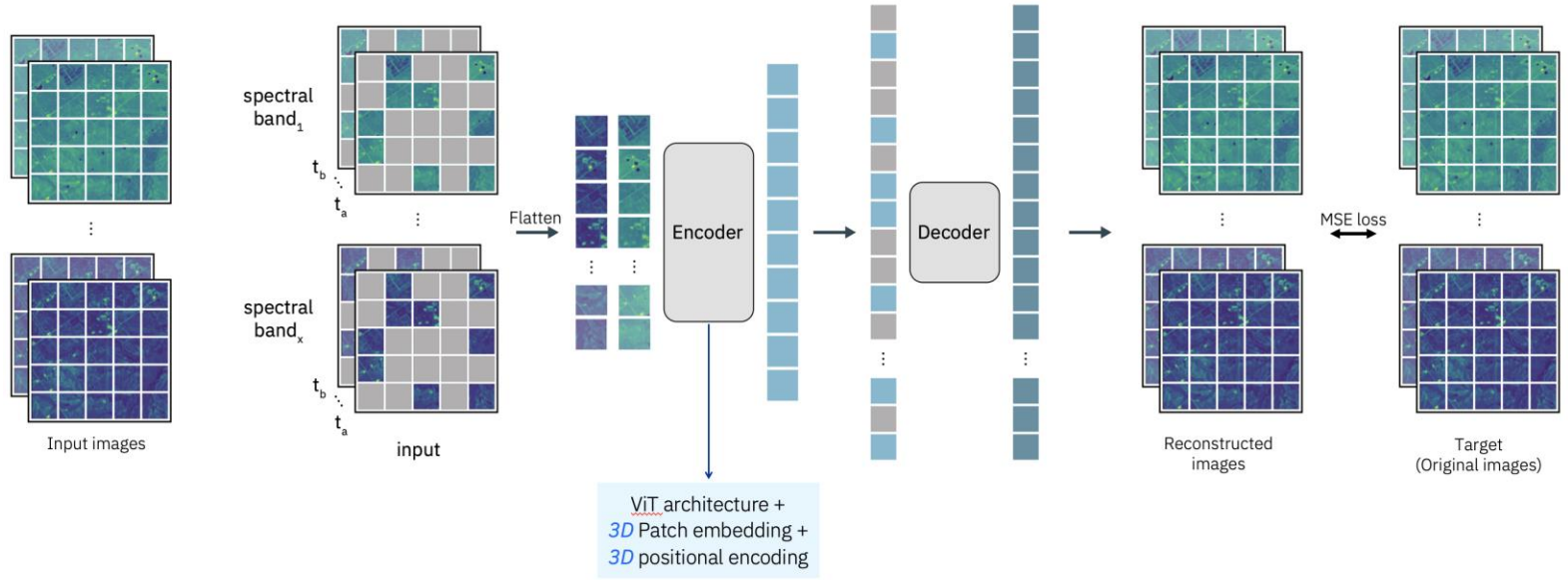
Mikhail Mozikov

junior researcher, AIRI

tg: https://t.me/mozikov

# Description

The rather new rapidly growing research field is combination of geospatial data like satellite images and massive meteorological reanalysis datasets with modern AI approaches. We aim to participate in this venue and improve existing Foundation Models and benchmark them on different downstream tasks.




NASA + IBM Prithvi-100M foundation model for satellite imaging analysis.

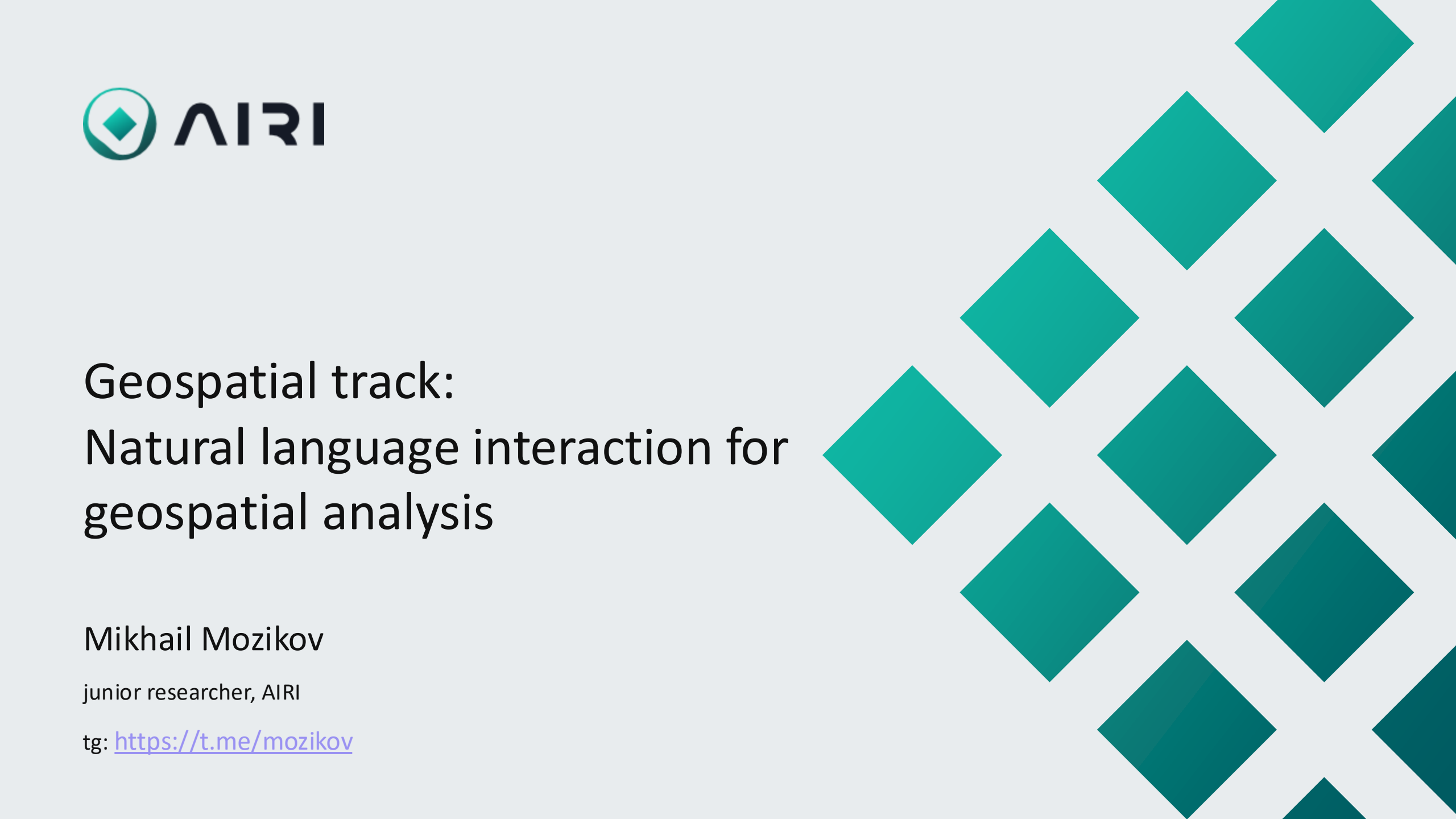
# Tasks and Links

**Tasks:**

1. Find and adapt existing geospatial datasets to the format suitable for finetuning Foundation Models
2. Finetune and benchmark FMs
3. Improve the performance of FM by architecture modifications and retraining.

**Links**:

1. Prithvi-100M hugging face
2. Foundation Models for Generalist Geospatial Artificial Intelligence
3. satellite-image-deep-learning github



# Geospatial track: Natural language interaction for geospatial analysis

Mikhail Mozikov

junior researcher, AIRI

tg: https://t.me/mozikov

# Description

Currently, the process of geospatial data analysis requires a lot of theoretical expertise and specific soft. We aim to democratize this process by building versatile LLM interface to geospatial soft and AI models.

Hey, Siri! Where are the undiscovered oil deposits closest to Dolgoprudny?

# Tasks and Links

**Tasks:**

1. Develop an LLM interface. (Done)
2. Select and benchmark geospatial models.
3. Build the full pipeline and iteratively improve it.

**Links**:

1. Prithvi-100M hugging face
2. Foundation Models for Generalist Geospatial Artificial Intelligence
3. satellite-image-deep-learning github

# Heatwaves forecasting

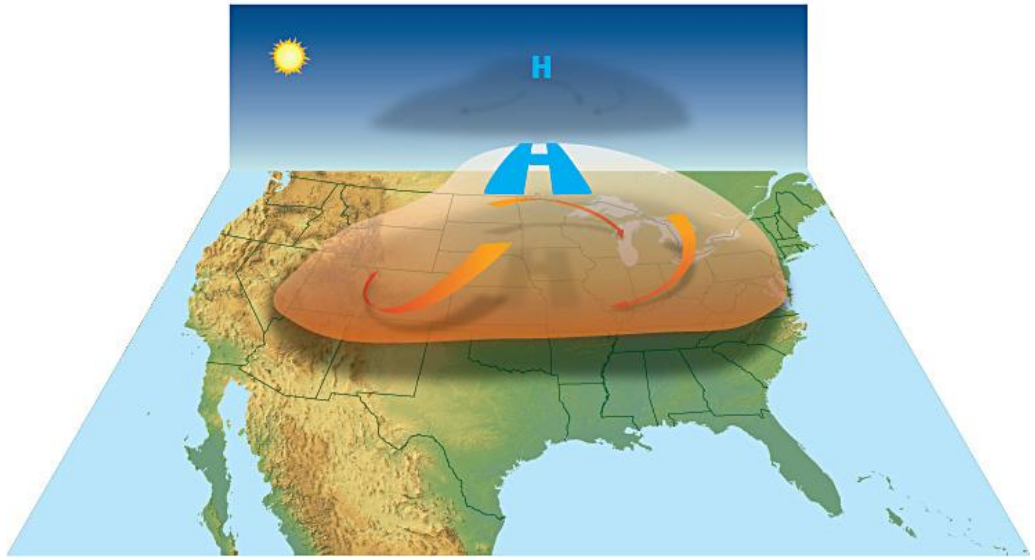
Mikhail Mozikov

junior researcher, AIRI

tg: https://t.me/mozikov

# Heatwaves forecasting

A heatwave is an extended period of excessively hot weather, that significantly exceeds the average temperatures for a given region. Forecasting heatwaves is crucial because they can lead to severe health risks, economic impacts, and strain on infrastructure.




**Task:**

- Heat wave prediction in the context of climate change

**Key features:**

- Geospatial data
- Class imbalance
- Huge space to experiment with different models

# Heatwaves forecasting

**What to read:**

1. Prediction and projection of heatwaves – an overview of heatwaves as an atmospheric phenomenon and ways to forecast it
2. Introducing ClimaX: The first foundation model for weather and climate – transformer based on geodata from Microsoft
3. Climate Q&A - chat about climate (chat bot, additionally trained on articles on climate)

**Contacts:**

Mikhail Mozikov– tg: **@mozikov**

# Graph-based recommender systems with explicit negative feedback encoding

Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

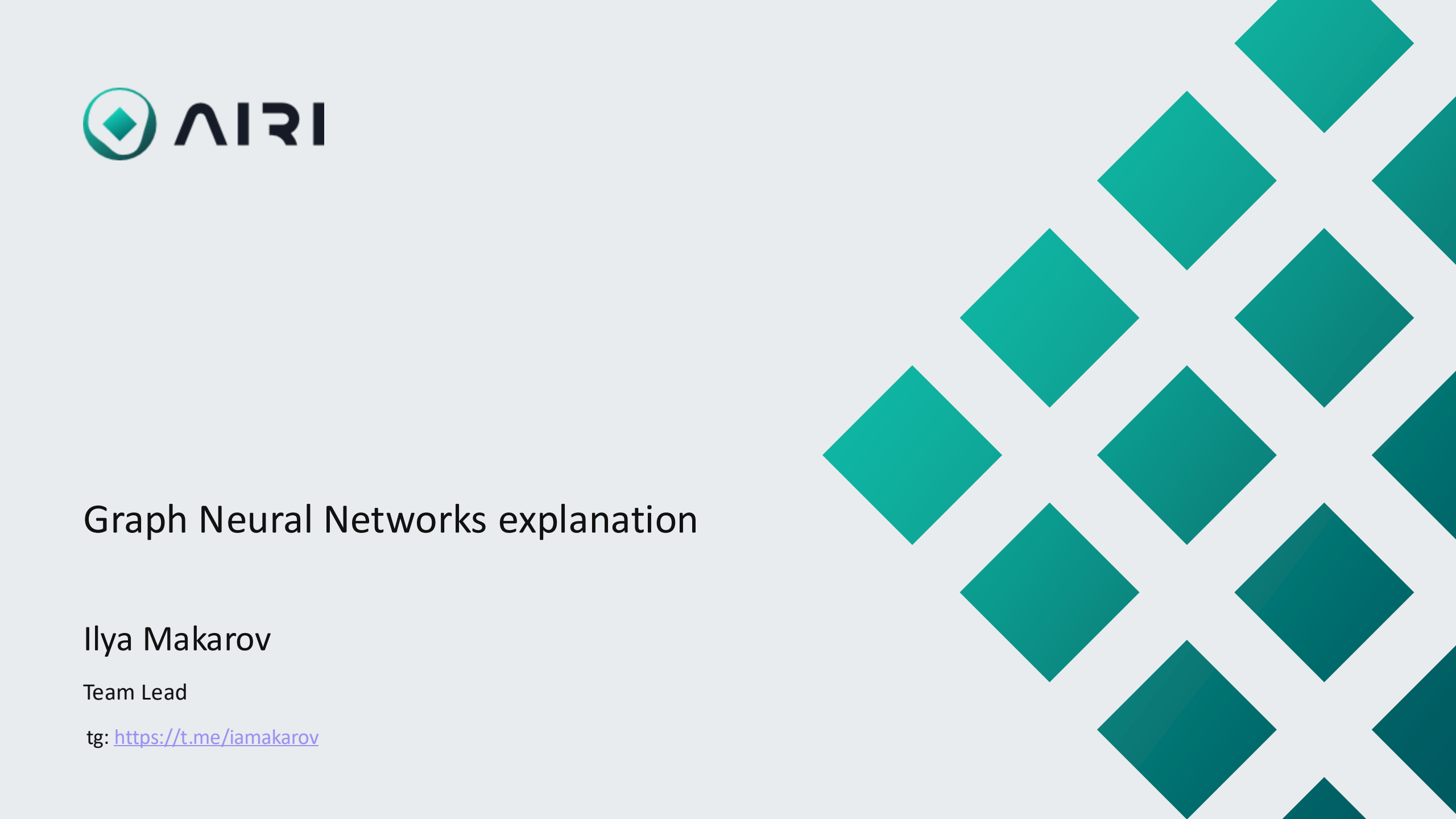
# Description

Classic recommender systems usually handle negative feedback only in the loss for better classification, ranking, or rating prediction. The project aims to develop a graph-based recommender system that can directly handle negative items to improve recommendation performance.

**Task:**

- Handle negatives as additional graph and encoder
- Encode negatives with logical negation operation for a better recommendation

**Links**: https://github.com/sisinflab/Graph-RSs-Reproducibility/ , https://snap.stanford.edu/betae/



# Graph Neural Networks explanation


Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

# Description

Graph Neural Networks are prominent models for different businesses because many data can be represented as graphs: transactions, user-content interactions or purchases, social networks, etc. Reliable usage requires understanding why the model makes specific decisions. Most explanation methods for graphs are limited to particular cases and are hard to use from scratch. So, the project aims to develop a Python package that wraps explanation methods in user-friendly API to ease analysis.

**Task:**

- Review existing methods in the explainable GNNs for link prediction problems (LPP), temporal LPP, or recommender systems.
- Implement prominent methods and create wrappers to use different techniques in a similar interface
- Develop visualization tools for explainers.

**Links**: http://proceedings.mlr.press/v139/yuan21c/yuan21c.pdf, https://proceedings.neurips.cc/paper_files/paper/2019/file/d80b7040b773199015de6d3b4293c8ff-Paper.pdf

# Image generation from brain activity

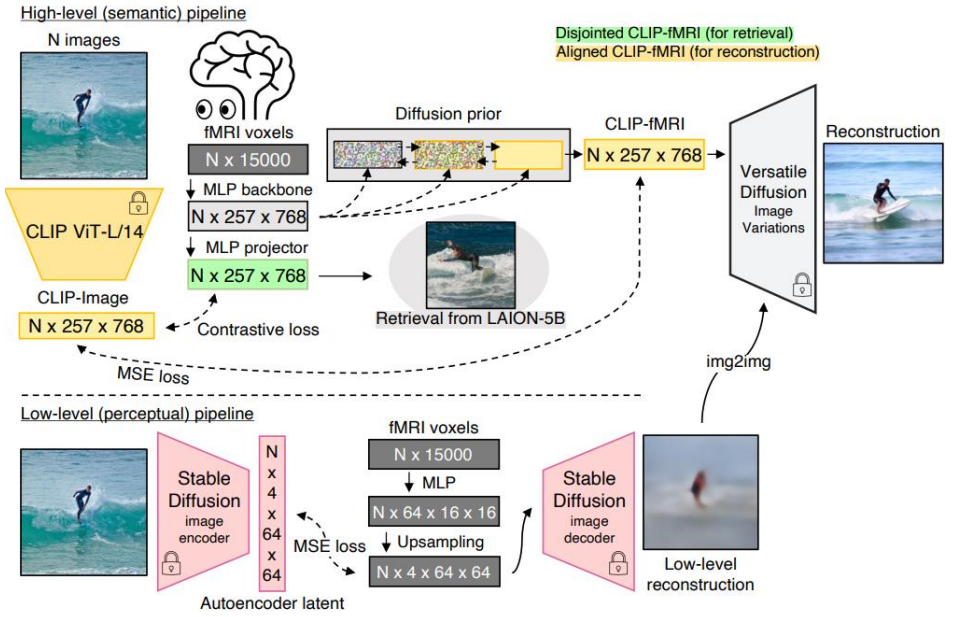

Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

# Short description

- A person looks at images (stimuli)
- During this process their brain activity is being recorded (fMRI, potentially EEG)
- Need to recover an image similar to the one a person was looking at only using their brain activity
- Huge space for experimenting with various models




Pipeline example

Scotti P. S., et al. Reconstructing the Mind's Eye: fMRI-to-Image with Contrastive Learning and Diffusion Priors. arXiv:2305.18274

## Available:

- Large open benchmark dataset of 7T fMRI while people were looking at image from COCO dataset (every COCO image also has captions; additional modality can be used): Allen E.J., et al. A massive 7T fMRI dataset to bridge cognitive neuroscience and artificial intelligence. Nat Neurosci 25, 116–126 (2022).
- Multiple research results which utilize diffusion models and have open-source code

## Potential tasks:

- Train a subject-specific model which can generate high-quality images using 7T fMRI dataset
- Analyse various fMRI preprocessing techniques and find the best for the generation task
- Train a subject-independent model which can generate high-quality images using 7T fMRI dataset

## Materials:

- Allen E.J., et al. A massive 7T fMRI dataset to bridge cognitive neuroscience and artificial intelligence. Nat Neurosci 25, 116–126 (2022). - fMRI dataset
- Scotti P.S., et al. Reconstructing the Mind's Eye: fMRI-to-Image with Contrastive Learning and Diffusion Priors. arXiv:2305.18274 - potential approach, GitHub available
- Ozcelik F., VanRullen, R. Natural scene reconstruction from fMRI signals using generative latent diffusion. Sci Rep 13, 15666 (2023). - potential approach, GitHub available
- Ferrante M., et al. Brain Captioning: Decoding human brain activity into images and text. arXiv:2305.11560 - potential approach

# Unsupervised Health Index and its applications


Zhevnenko Dmitry

head of the laboratory, MERI
researcher, AIRI

Contact me via: https://t.me/DmitryZhev

# Description

## Task

Unsupervised methodology for system health index (HI) estimation based on the sensor readings.

## Methods

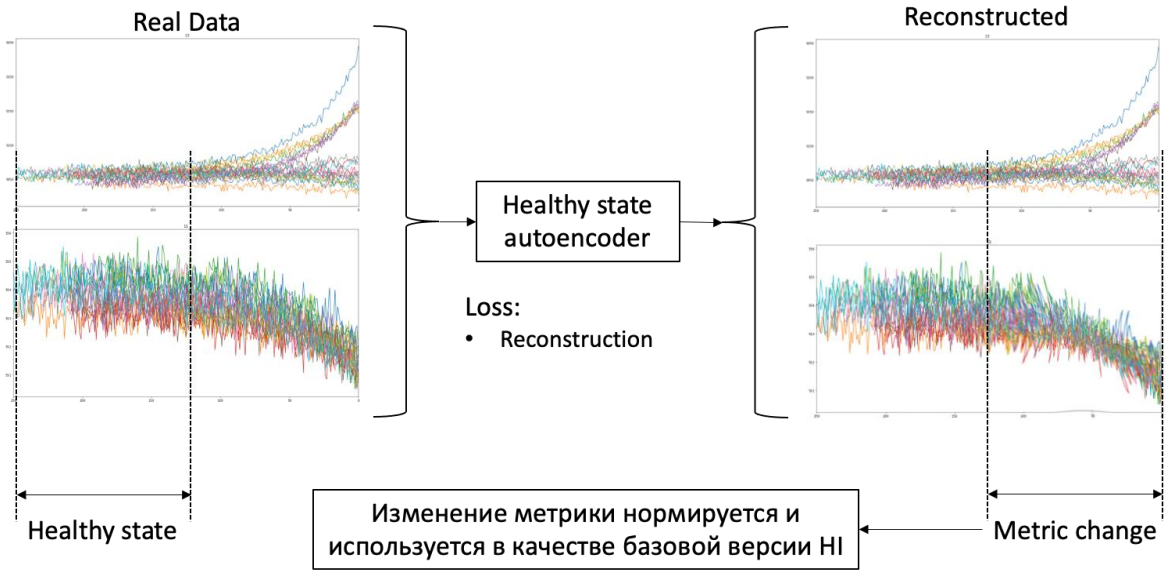
Deep learning architectures based on input sequence recovery.

## Additional tasks

New methods of health index application for equipment condition monitoring

## Expected result

Repository with: unsupervised model, training and testing pipelines, supporting methods




Example of base architecture for the HI modeling

# HI problem in NASA milling dataset

**Problem**

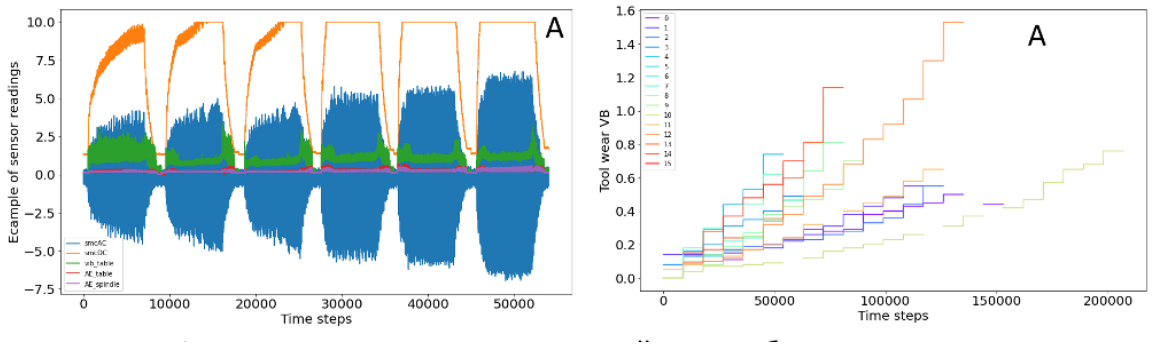
Examining the condition of the saw blade requires microscopy and cannot be done at every point in time during operation.

**Tasks:**

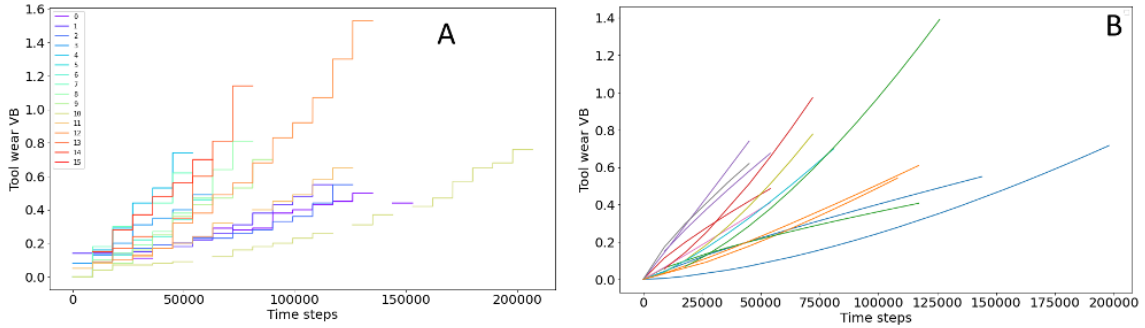
- Unsupervised wear evaluation
- HI-based estimation of remaining usefull lifetime
- Change Point Detection (CPD)

**Resources:**

- https://www.kaggle.com/datasets/vinayak123tyagi/milling-data-set-prognostic-data
- http://arxiv.org/abs/1608.06154




Sensor signals and measured wear of equipment




Wear approximation using Taylor equations

# Main work stages

**Baseline development**

- Analyzing the dataset and reviewing the literature
- Writing model training and testing pipelines
- Training of basic autoencoder (CNN/LSTM) for HI prediction
- Optimization of HI building framework
- Implementation of similarity matching for RUL estimation

**Model optimization**

- Architectural optimizations
- Latent space organization analysis
- Model ensembles using

**HI applications**

- Methods for assessing the abnormal state
- Training and testing pipelines for auxiliary methods
- Comparison of the obtained results with specialized RUL and CPD models

# Ancient Egyptian OCR

Golyadkin Maksim

Researcher AIRI

mgolyadkin@hse.ru

# Egyptian Hieroglyphs Optical Character Recognition

## Motivation

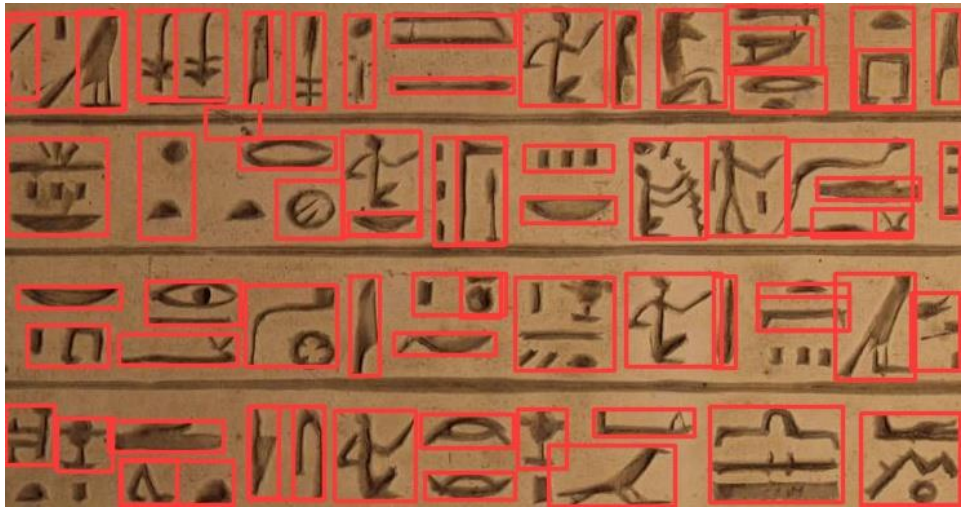
- Significant lack of data, especially annotated one, hindering effective training
- Numerous texts remain undigitized
- High-quality OCR is essential to make them accessible for ML analysis

## Objectives

- Build a comprehensive dataset of photos, drawings, and documents
- Develop a data generation method to get a strong baseline OCR model
- Use this model to assist Egyptologists in annotating the dataset
- Digitize previously unprocessed texts to expand the digital corpus of ancient Egyptian writings

## Methodology

- Utilize diffusion models to generate highly realistic synthetic data
- Iteratively refine OCR and diffusion models while continuously expanding and improving the dataset



## Materials:

1. Previous works: 1, 2, 3
2. Survey on Machine Learning for Ancient Languages
3. Dataset: Glyphnet

## Contacts:

Golyadkin Maksim – mgolyadkin@hse.ru t.me/mxmgn

# Arabic LLM


Ilya Makarov

Team Lead

tg: https://t.me/iamakarov

# Arabic LLM

**Objective**:

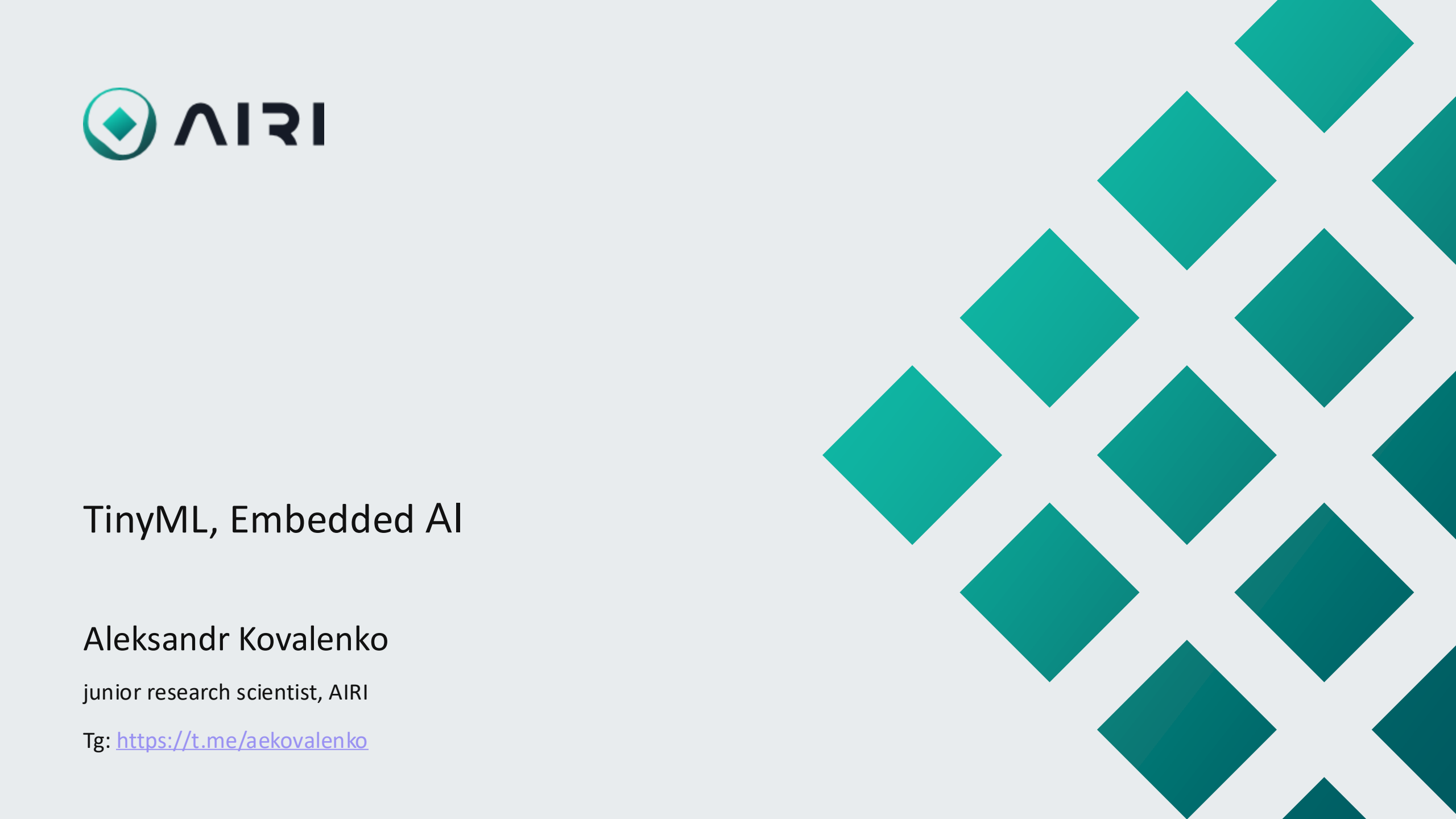
- Create the most advanced Arabic-specific LLM to outperform existing models like Mulhem and Falcon.

**Key Tasks**:

1. **Data**: Curate a massive, high-quality Arabic dataset focused on regional context.
2. **Model**: Develop a cutting-edge transformer with over 180B parameters optimized for Arabic language understanding.
3. **Training**: Implement advanced fine-tuning techniques for superior performance across various Arabic-language domains.

## Reference:


1. Malin, C., 2024. *First LLM trained exclusively on Saudi data sets: Saudi tech firm Watad announces Mulhem, bilingual Arabic, English LLM*. Middle East AI News, 6 March. Available at



# TinyML, Embedded AI


Aleksandr Kovalenko

junior research scientist, AIRI

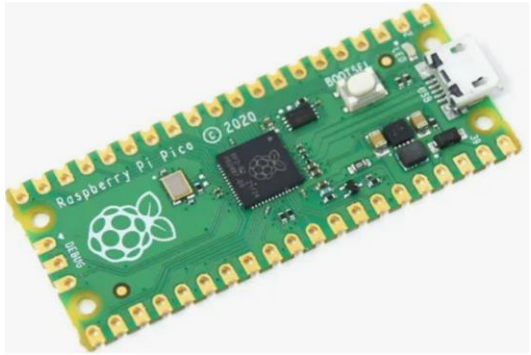
Tg: https://t.me/aekovalenko

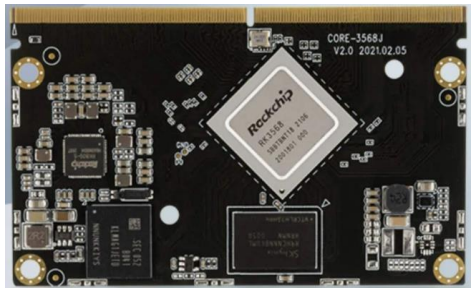
# Description

Development and adaptation of NN models on resource-constrained devices.

For various tasks:

- Predictive maintenance
- Virtual sensors
- CV for quality control
- Speech recognition
- …




Materials:

Tsoukas, Vasileios, et al. "A Review on the emerging technology of TinyML." ACM Computing Surveys 56.10 (2024): 1-37.

Chen, Yanjiao, et al. "Deep learning on mobile and embedded devices: State-of-the-art, challenges, and future directions." ACM Computing Surveys (CSUR) 53.4 (2020): 1-37.

Application Form

# Artificial Intelligence Research Institute

airi.net

@AIRI_Research_Institute

airi_research_institute

AIRI Institute

AIRI Institute

AIRI_inst

artificial-intelligence-research-institute