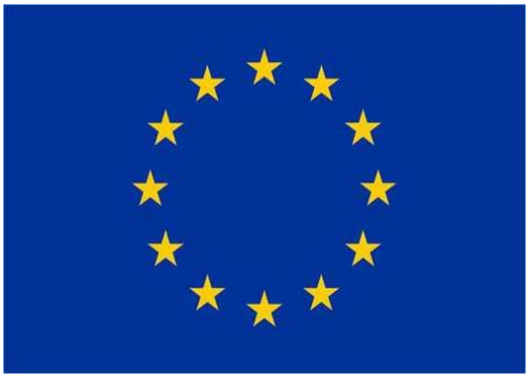

# Horizon Europe (HORIZON)

## HORIZON-WIDERA-2021-ACCESS-03-01
## Twinning

## Progress Report

Project GAIN, GA: 101078950

# Deliverable D.6.5 Progress Report

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# Contents

# 1. Explanation of the work carried out and overview of the progress

## 1.1. Executive Summary

The project aims at 6 primary objectives:

**O1. To implement the Twinning Research and Innovation Programme (TRIP) covering the period of 3 years with potential extension in the most promising and fruitful areas up to 5 years.**

The objective is the part of WP 2, Twinning Research and Innovation Programme (TRIP). The document, defined by the *Task 2.1 TRIP detailed planning*, underpins all research capacity building activities of the project. The corresponding deliverable *D2.1 Define and agree the framework parameters of the TRIP* (submitted in the reporting period) sets out the following basic parameters:

1. In the field of Artificial Intelligence (AI), 6 research thematic research groups (sub-tasks) supervised by the researchers from DFKI and INRIA were composed.
2. 18 Georgian researchers were assigned to the sub-tasks.
3. Weekly webinars in thematic groups were held aimed at supervising the Georgian researchers, giving them opportunities to discuss the challenges and progress of their projects and benefiting from the experience of the DFKI and INRIA researchers.
4. Tenure-track Positions were defined, 4 young Georgian researchers from GAIN-MICM team selected for these positions.
5. The recruitment plan for young researchers at MICM was announced.
6. The Staff Exchange Scheme was agreed upon – DFKI and INRIA will host 4 Georgian students with Tenure-track Positions.

Conclusion: Corresponding Milestone 1 is achieved (due date month 3): TRIP detailed planning was completed and agreed upon. Joint research activities have started. Project websites (public and restricted) are online. Corresponding deliverables D 2.1, D 5.1, D 6.1 were submitted. Joint research activities are in progress, where several new scientific results are anticipated in the near future.

**O2. To implement the targeted Scientific Excellence and Networking Capacity Building programme, which supports and enables the TRIP's implementation focused on young researchers. Enable young researchers to carry out internationally competitive research within international teams of their peers. Creation of opportunities for the researchers from MICM and its European partners to present obtained results to a broader research community, network and build research partnerships, shape new research directions and application areas.**

This objective is the part of two tasks of WP 2, Task *2.2 TRIP Implementation and Coordination* and *Task 2.3 Staff Exchange Programme*. To foster scientific excellence and networking capacity building at MICM, it was expedient to lay the groundwork for strengthening the research potential of MICM in the field of AI. To overcome the aging problem at MICM, a problem of not only for MICM but for the whole research community in Georgia as well, the first step would naturally be the recruitment of young researchers. By the support of the GAIN project, four new research positions were created within the research departments of the institute: one position of a researcher at the department of Computational Methods and 3 positions of an assistant researcher at the Computational Centre. Four Georgian students with Tenure-track hold the newly created positions. Currently, out of 28 researchers and 8 IT specialists at MICM, 9 are young holding research and software engineer positions, and 8 of them are the researchers of GAIN. They form the core of a new research unit, the "MICM AI Lab", which acts as a focus team for the development and design of new research directions in the field of AI at MICM. The AI Lab will be supported by the project throughout its duration with a strong perspective on future institutional development and growth with the help of governmental funding and other sources as well, like grant projects etc. It will be part of the "Joint Virtual Laboratory" which, according to the DoA (Task 2.4) of the project, will be composed in 2024.

Joint research conducted in the project is a unique opportunity for young Georgian researchers to get deeper

insight in the state of the art in the field of AI, acquire relevant knowledge and research skills. According to the Staff Exchange (mobility) scheme, four Tenure-track Position students will visit DFKI and INRIA in Spring, 2024. Thus, the young Georgian researchers will acquire highly useful experience and skills due to the direct collaboration with renowned European scientists as well as with their peers and due to the time spent in the excellent research environment of INRIA and DFKI. These skills will prepare the ground for Georgian researchers to carry out internationally competitive research in the near future.
It is important to note that the selection process was preceded by the weekly webinars supervised by the European partners at INRIA, DFKI and EXO, where the Georgian counterparts were introduced to the contemporary problems of AI and relevant research tools. Nearly 1 year of joint research in groups (sub-tasks) resulted in 11 research papers (5 already published) and 16 conference talks (see details in section „Research Component"). Presentation of the obtained results to a broader research community will be supported by the travel grants.

Conclusion: Milestone 3 is almost achieved (due date month 18): First scientific evaluation is completed and documented. The first scientific workshop was organized. Corresponding deliverable D 2.2 First Joint Research Report, will be submitted in March 2024. Other activities are in progress.

**O3. To radically improve the long-term prospects of research excellence at MICM by investing in young talents. The system of research workshops, webinars, conference and summer schools will create a forum and breeding ground for young researchers in order to build research reputation and establish networks for future partnerships. The pragmatic goal is to foster at MICM 3 new research groups led by young leaders (age under 35) with the potential and perspective to be Principal Investigators in European R&I projects.**
Currently, there are 25 scientists in the GAIN-MICM team and 18 of them are young researchers (PhD, Master and Bachelor students). As the project has aroused vast interest in the research community, even more students, not yet affiliated to GAIN and MICM formally, attend our weekly seminars at MICM and are involved in the research process.
The main permanent tool for the research collaboration, the weekly webinars of the thematic groups supervised by the European partners, started already in the beginning of the project in 2022 and continue to this day. Researchers of the GAIN consortium are actively involved in this process. These weekly webinars were supplemented by larger project events (many of them in person). More specifically, during the reporting period, the GAIN project has organized 6 meetings:

1. Kick Off Meeting at MICM (October 2022),
2. MEPHESTO & GAIN meeting at INRIA, Sophia Antipolis (January 2023),
3. On-the-job training for Research Administrators and Managers organized by EXOLAUNCH at Technical University of Berlin, (August 2023).
4. The First GAIN Summer School at INRIA, Sophia Antipolis (September 2023).
5. Web-based training on European innovation tools (online, December 2023).
6. Innovation training workshop for researchers and managers at MICM, Tbilisi (January 2024).

These events, focused on the young researchers, together with the intensive research collaboration enabled the project consortium to establish close personal relations among the partners, especially in the thematic groups and built the fundament for future partnership. The first impression of the research abilities of Georgian counterparts was generated at the Kick Off Meeting, were they presented an example of AI application for a specific medical problem. At the MEPHESTO & GAIN meeting and On-the-job training for Research Administrators and Managers organized by EXOLAUNCH, GAIN-MICM team members had an opportunity to meet with various research teams, attend the workshops on different topics, visit various research departments and labs to feel the flavour of European research environment of the highest level. Moreover, at the GAIN First Summer School at INRIA, Georgian students presented 5 talks about the results of joint research. A total of 27 person/trips was spent for young Georgian researchers for those 3 visits.
Via the networks of INRIA, DFKI and EXOLAUNCH, Georgian researchers also collaborate with German and French scientists who are not part of the GAIN consortium. For example, a talk at the first GAIN Summer School

of the Georgian PhD student about a neuropsychological fMRI experiment conducted at the RWTH Aachen, Germany, sparked the idea to apply AI methods in that study within the joint GAIN - RWTH project. Furthermore, Prof. Lonneke van der Plas, who is affiliated with the "Institut Dalle Molle d'intelligence artificielle perceptive (Idiap)", Switzerland, is a collaborating researcher in the NLP[1] sub-task of the GAIN project.
One of the important achievements of the project during the reporting period is the identification of talented young Georgian researchers with additional leadership skills. As set out in the project, 3 groups are composed at MICM leaded by 3 distinguished students:

1. PhD student Teimuraz Saghinadze (Sub-Task Action detection/recognition)
2. Master student Rapael Kalandadze (Sub-Task Emotions)
3. PhD student Beso Mikaberidze (Sub-Task NLP).

Teimuraz Saghinadze is working on his PhD thesis and plans to defend it in 2025. He has a broad knowledge in the field of Machine Learning (ML) but also a strong mathematical background, which is important to handle theoretical problems of AI as well as practical. Although he is assigned to the sub-task *Action detection/ recognition*, he additionally participates in the research of the *Emotion recognition* from EEG[2] and NLP groups. Rapael Kalandadze, though a master student yet, has vast experience and knowledge in AI technologies and is a co-author of several practical experiments and inventions. He has introduced two talented students as new members to the GAIN-MICM team 2 talented students. One of them, Natia Kukhilava, now an employee of MICM, holds a Tenure-track position and she participates in the Staff Exchange scheme as well. PhD student Beso Mikaberidze works on NLP problems for the Georgian language, which is regarded as low resourced that makes the task quite difficult and specific. Worthy to note that the research, conducted by all Georgian students during the reporting period is highly assessed by the European partners.

Conclusion: Corresponding Milestone 2 (due date month 12) is fully achieved: First Summer School was organized and evaluated (Section 1.2.3). The on-the-job training have started (Section 1.2.4). The first scientific publications were obtained (Section 1.2.0).

**O4. To build a new quality of innovation and research management skills for the MICM research staff through implementing a targeted Innovation and Research Management Capacity Building Programme.**
This objective is mainly part of the WP 4, Innovation and Research Management/Administration Capacity Building. The overall aim is to extend research networking and capacity building activities into the domain of innovation and research administration.
To this end, an innovation training workshop for researchers and managers (Task 4.1), an on-the-job training for research administrators and managers (Task 4.3) and a web-based training on European innovation tools (Task 4.2) were organised. The training addressed topics such as competitive RTD proposal writing, technology transfer, principles of spinning-off, etc.
According to the Pilot Innovation Project (Task 4.4), which starts in autumn 2024, the most appropriate, mature and market-relevant results suitable for commercialisation will be identified based on the results of the TRIP.

Conclusion: The tasks related to this objective, as part of Milestone 2, for the reporting period are fully achieved. The planned activities are in progress.

**O5. To significantly improve the visibility and image of MICM in local, regional and European communities by positioning it as a cross-disciplinary R&I Excellence Centre with a complete portfolio of competences related to the area of AI and Computational Methods, as well as in various application domains. The promotional campaign will address primarily the European audience aiming at establishing MICM as a cooperation partner to the European research community.**
This objective is the part of WP5 Visibility and Social Impact. During the reporting period the following tasks

[1] Natural language processing.
[2] Electroencephalogram.

have been performed[3]:

The project website (Task 5.1; D5.1. Project website, version 1) is functioning and is constantly updated https://www.gain-twinning.eu/ . Facebook and LinkedIn accounts are linked to the GAIN website. Open data repository (Zenodo Platform) for the scientific publications and data sets is integrated.

Different kinds of dissemination activities towards research (Task 5.2) have been conducted. These include presentations about the project at various scientific events and meetings, collaboration with EU-funded projects, research visits to European universities and institutions; MICM was invited to the EDU AI consortium as a partner of the project proposal; 16 conference talks were delivered at international conferences and 11 research papers were written.

Regarding the dissemination activities towards society (Task 5.3), the set of the project promotional materials (D 5.3, version 1), business cards and a rollup were designed and printed; a promotional video was recorded, which is available at the project website and the YouTube channel.

The project has been disseminated via web-publications, presentations, and journal articles.

Towards the integration with European AI communities (Task 5.4), working contacts have been established with 7 European and 11 local institutions and companies. The first steps to establish working contacts to AI-related European networking initiatives such as AI4EU, CLAIRE, ELLIS, etc., have been undertaken.

Conclusion: The tasks related to this objective (part of Milestones 1, 2), for the reporting period are fully achieved. The planned activities are in progress.

**O6. To continuously evaluate the impact of the project activities on the R&I capacities of MICM and design the subsequent follow-up measure to ensure the sustainability and organic development of the project results. Organizational changes in MICM aiming at building modern research administration and management capacity and introducing effective governing principles and processes typical for European research organization.**

This objective is mainly part of the WP 6 Coordination and Management, but, evidently, its successful realization depends on other tasks and the work packages as well.

Internal evaluation of MICM based on the system of KPIs[4] has been performed continuously. Tables 2 and 3 in the Appendix show the target and current values of Institutional KPIs to monitor the evolution of MICM capacities and the KPIs for the GAIN project respectively. Diagram 1 shows the dynamics of growth of research performance indicators of MICM in 2023 with respect to 2022. These indicators enable us to predict the sustainable and organic development of the project results with high expectation.

One of the main objectives of the GAIN project is the introduction of modern research management practices at MICM. To achieve the proposed objective, during the reporting period deliverable D6.1 Strategic Development & Sustainability Plan was prepared and will be submitted at the end of March 2024.

The administrative reforms will be presented in the “Institution Development Plan” to be suggested to Georgian Technical University and the Georgian Ministry of Education and Science at the end of the project.

Conclusion: The tasks related to this objective for the reporting period are fully achieved. The planned activities are in progress.

[3] See the details in section 1.2.5

[4] Key performance indicators

# 1.2 Explanation of the work carried out per WP.

## *1.2.0 Research component*

According to the DoA of the project, the research component does not exceed 30% of the total Horizon Europe grant amount. More than 70% of the budget for research activities is allocated to the coordinator MICM.

### 1.2.0.1. Framework parameters of the programme

The basis for all research capacity building activities of the project is the Work Package 2 - **Twinning Research and Innovation Programme (TRIP)**. The plan for future activities, which was agreed upon at the TRIP Steering Board meeting on December 27, 2022, is described in the corresponding deliverable, D 2.1 Framework parameters of the programme (see section 1.2.2 Work Package 2, Task 2.1 TRIP detailed planning).
According to this plan:

- For joint research, 3 topics (Sub-Projects), focused on applications in health (namely psychiatry), were defined.
- After the series of webinars organized by INRIA and DFKI, 6 research thematic groups (sub-tasks), were composed.
- 18 Georgian researchers were assigned to the specific research topics, sub-tasks (see Appendix, Table 1).
- MICM, consulted by DFKI and INRIA, has selected 4 students (2 PhD and 2 Master students) for the project duration with the conditions of a tenure-track positions.

Among 25 Georgian researchers of the GAIN-MICM team, 18 are young scientists, PhD, Master and Bachelor students mostly from MICM and GTU[5] but also from I. Javakhishvili Tbilisi State University, International Black See University, Tbilisi State Medical University, Tbilisi Centre of Mental Health, Caucasus University, AI start-ups "Helio.AI" and "Tbilisi AI Lab", the software company "EPAM Georgia" and a medical centre „Mrcheveli". Other students, not yet affiliated to GAIN and MICM formally, attend the weekly seminars at MICM and are involved in the research process.
The Sub-tasks are supervised by scientists from DFKI and INRIA. Five PhD students from INRIA and DFKI are involved in joint research as well.
To lay the groundwork for strengthening the research potential in the field of AI, MICM has created 4 new employee positions within the research departments of the institute, which are held by the young researchers with the tenure-track position.

### 1.2.0.2. Research results

The GAIN weekly research webinars within the thematic groups, which started right in the beginning of the project and continue to this day, are the main tools for research collaboration. At the same time, the GAIN workshops and the First Summer School (see below Section 1.2.3, WP 3, Tasks 3.1 and 3.4) significantly advanced the progress of the project participants towards their first research results.
In this respect, the first GAIN summer school collocated with the INRIA-DFKI European Summer School on Artificial Intelligence was an important milestone. At this event, the results of 10 months (since the beginning of the project) of joint research were reviewed and evaluated based on 5 presentations delivered by young Georgian scientists. The talks elaborated on the progress of the students in in their respective sub-tasks. At the meeting

- The Staff Exchange (mobility) Scheme for the Georgian researchers was agreed upon (see Section 1.2.2, Task 2.3).
- Specific methods and means to solve the research problems posed within the thematic groups were outlined.

As a result of project planning and collaboration, in the reporting period, 5 research papers have been published in peer reviewed, open access journals, 1 paper is published in conference materials, 1 is accepted for publication, 2 are submitted and 2 papers prepared. 16 conference talks have been delivered at international scientific

[5] Georgian technical university.

conferences.

**Research results in thematic groups**

Due to the regular webinars organised by INRIA and DFKI and the permanent exchange between Georgian researchers and the partner institutions, progress in the research groups is subject to continuous change. Below we describe the state of research at the end of January 2024.

**Group 1** (Sub-task 1: AI Technologies for Human Behaviour Understanding, Emotions (face crop video, biosignals) is working on 2 projects initiated and suggested by INRIA and DFKI researchers.

- **Project 1** (**participant**s: N. Kukhilava, T. Tsmindashvili, R. Kalandadze (master students, MICM), L. Ferrari (Post-doctoral researcher, INRIA), V. Strizhkova (PhD student, INRIA)) is focused on emotion recognition from video. Scale is the primary ingredient in attaining generalizable video representations. While scaling model capacity and data size for video masked autoencoders (VideoMAE) has been explored for large generic datasets of short videos, it is still unknown how to scale the VideoMAE pre-training for more specific cases such as small datasets of long face videos. Does increasing model size improve recognition performance when pre-training data is limited? Does VideoMAE scale as well for long videos as it does for short ones? Does pre-training on non-face videos improve performance on face-related tasks? The project addresses these questions by exploring VideoMAE scaling for the task of emotion recognition. The project uses the challenging AMIGOS and DEAP affective datasets with long face videos (1-2 minutes) and scale VideoMAE in both model and data, experimenting with transformer models ranging from 87 million to 305 million parameters and using datasets ranging from 600 to 300 thousand training videos. The project also shows the effect of progressive learning, which consists of self-supervised pre-training followed by supervised pre-training on datasets with mixed labels. This contribution is the first study on how to scale VideoMAE for the task of emotion recognition using small datasets with long face videos. The code will be available at {https://github.com/EmotionLab/EmotionVMAE}. Regarding this project, a joint research paper is submitted, and a conference talk is given at an international conference (see Appendix, Publications, [10]; Conference talks [2]).
- **Project 2** (**participants**: N. Kukhilava, T. Tsmindashvili, R. Kalandadze (master students, MICM), S. Katamadze (PhD, MICM), L. Ferrari (post-doctoral researcher, INRIA), P. Müller, B. E. Wirth (senior researchers, DFKI)) deals with the problem of emotion recognition from EEG signals, which has become a rapidly growing area of research in recent years. To fairly compare proposed approaches and to track the field's progress, commonly agreed-upon evaluation protocols are essential. In a comprehensive literature review of EEG-based emotion recognition articles published between 2018 and 2023, the authors uncover that the field lacks such protocols, making it impossible to reliably determine the state-of-the-art approach. Analyzing 231 papers, it is shown that inconsistencies between evaluation protocols of published approaches commonly arise from different choices of datasets, inconsistent ground truth discretisation, evaluation metrics, and data pre-processing. To overcome these challenges to the field's progress, recommendations for a unified evaluation protocol are given and EEGAIN, a novel open source software framework which allows researchers to efficiently evaluate their approaches with a unified protocol is presented. EEGAIN includes standardized methods for data pre-processing, data splitting, evaluation metrics, and the ability to load the 5 most relevant datasets in EEG emotion recognition with only a single line of code. In addition, EEGAIN offers a convenient way to execute recent state-of-the-art models, thereby providing baseline results and allowing comparison to novel user-defined models and datasets. EEGAIN is first used to evaluate recent state-of-the-art models on all the 5 most relevant EEG emotion datasets, namely Mahnob-HCI, DEAP, SEED, AMIGOS, and DREAMER. As such, this work is a significant step to make research on EEG emotion recognition more reproducible and comparable, thereby accelerating the overall progress of the field.
  The results of this project are reflected in the joint research paper, which is almost ready for publication, and 2 conference talks, given at international conferences (see Appendix, Publications, [11]; Conference talks [3, 4, 16]). Moreover, a workshop proposal is submitted to ACII2024. The workshop issues a challenge where participants are asked to use the EEGAIN framework in order to maximise emotion recognition performance across different datasets.

**Group 2,** Sub-task 2: AI Technologies for Human Behaviour Understanding, Emotions (full body video). **Participants:** I. Katchiashvili (master, MICM), L. Tabagari (master student, MICM), P. Müller, B. E. Wirth (senior researchers, DFKI), M. Balazia (Research scientist, INRIA).

Group 2 is currently in the process of developing new approaches to recognize emotions from body movmements. More specifically, the group aims to recognize emotions from videos with partly challenging camera angles. The multi-object tracking computer vision model ByteTrack is used for tracking objects (humans) in videos, getting their bounding boxes, IDs and coordinates.

The primary issue identified was the inconsistent size of bounding boxes for each detected person, resulting in suboptimal cropped output videos. In this respect, the idea of obtaining the centre of each detected bounding box and applying padding was suggested. Following code modifications, the process now functions as follows:

- Specify the desired size of the bounding box.
- The code retrieves coordinates from the ByteTrack-generated txt file.
- Frame by frame, it detects the centre based on these coordinates and adds padding accordingly.

The final output video is regarded satisfactory, further improvements could be made to the bounding box cropping method.

For the aim of emotion recognition, Group 2 also delved into feature extraction methods with a focus on Dino V2, which is created by Meta AI with the assistance of INRIA researchers. Michal Balazia (INRIA) also recommended CLIP, developed by Open AI, suggesting the idea of initially implementing one and then the other in order to compare the results. This approach would enable showcasing two different results with Dino and Clip in the eventual paper.

In summary, the group outlined plans to refine the bounding box methodology, explore feature extraction methods, and tackle the challenges of server-based experiments. The next steps involve connecting to the server, setting up the environment, and testing code execution. The subsequent phase includes installing ByteTrack and DINOv2 on the server, acknowledging the anticipated challenges in this process. A Related research paper and a conference talk will be ready by the second half of 2024.

**Group 3,** Sub-task 3: Action detection/recognition (AI Technologies for Human Behaviour Understanding).

**Participants:** T. Saghinadze (PhD student, MICM), D. Datuashvili (PhD, IBSU[6]), F. Bremond (Research Director DR1 at INRIA), T. Agraval (PhD student, INRIA).

The group has been investigating and implementing new methods for action recognition from video. French partners proposed the main components of the architecture. The backbone of the architecture is Dinov2 by Meta, with adapters used for fine-tuning. However, the first and last adapters serve a dual purpose in this model, as they also function as memory units, utilizing the absolute difference of attention maps as an additional input. The new variant, developed by the team in Georgia, incorporates TCN as a temporal comprehension mechanism. Said architecture has been implemented and is ready to be trained, which most likely will start soon. Since the model is on the larger side and multiple datasets ought to be checked, it will require a non-trivial amount of computation. In the meantime, the Georgian side has been developing a couple of possible fine-tuning schemes that have Dinov2 as its backbones as a possible next step.

Collaboration with the team working on EEGain (Group 1) resulted in the first model being ready to be trained with CNN adapters (Rebuffi and Chapter adapters) and bitfit. TSception is the first CNN-based model that is intended to check. Preliminary experiments show relatively good results for the bitfit technique, but a proper hyperparameter search would be preferable since the smaller size of the model and lesser number of epochs allow to run it on a local machine.

Paper [2] is inspired by the research carried out in the GAIN project. It deals with a well-known fact that the convolutional layer has the property of translational equivariance. However, it's non-obvious how to expand the symmetry group associated with the said layer. Employing key definitions adopted in deep geometric learning (see e.g. *[Bronstein, M. M., Bruna, J., Cohen, T., & Veličković, P. (2021). Geometric deep learning: Grids, groups, graphs, geodesics, and gauges. arXiv preprint arXiv:2104.13478]*, the set of filters that induce 90-degree rotational equivariance without modifying the convolutional operator is constructed. This work is primarily intended as a

[6] International Black Sea University

theoretical exercise, beginning with a predefined symmetric group in mind and producing a convolutional layer with the desired equivariance.

**Group 5**, Sub-task 5: AI Methods for Deep Speech Analysis in Health, NLP.
**Participants:** B. Mikaberidze, T. Saghinadze (PhD students, MICM), H. Lindsay (PhD student, DFKI), P. Müller (senior researcher, DFKI).
The group has developed a benchmark dataset specifically for evaluating the sentiment analysis performance of models trained on the Georgian language. A Georgian sentence tokenizer based on NLTK by compiling a list of nearly 1,000 abbreviations and enhancing the base tokenizer with several additional rules is developed as well. The Initial stage of pre-processing is completed and construction of pipelines for the training and fine-tuning of Georgian language models is in process. It should be noted that the group actively collaborates with Dr. Lonneke van der Plas from Idiap Research Institute, Switzerland. Modification of the method of investigation of a low-resourced Maltese language is used for Georgian language within the GAIN project. A related research paper and a conference talk will be ready in 2024.

**Group 6** (Sub-task 6: AI Methods for Deep Speech Analysis in Health - NLP-fMRI).

**Participants:** T. Giorgobiani (PhD student, TSU[7]), S. Tsagareishvili (master, TSU), P. Müller (senior researcher, DFKI).
An fMRI experiment is currently being conducted at the RWTH - Aachen, Germany, to study functional reorganization patterns after transient suppression of Broca's area, a vital region for language production. Within the GAIN project it is planned to apply NLP methods to this research. For this purpose, RWTH – Aachen University shared research data with DFKI. Joint research is in progress. A related research paper and a conference talk will be ready in the second half of 2024.

**Research at European Partner Institutions supported by GAIN**

Automatic analysis of human behaviour is a fundamental prerequisite for the creation of machines that can effectively interact with and support humans in social interactions. In MultiMediate '23, researchers from INRIA and DFKI address two key human social behaviour analysis tasks for the first time in a controlled challenge: engagement estimation and bodily behaviour recognition in social interactions. For the challenge, the researchers introduced novel sets of annotations for both tasks. For engagement estimation,novel annotations on the NOvice eXpert Interaction (NOXI) database were collected. For bodily behaviour recognition, test recordings of the MPIIGroupInteraction corpus were annotated with the BBSI annotation scheme. In addition, the researchers provided baseline results for both challenge tasks. The corresponding challenge paper [1], co-authored by senior scientists from DFKI and INRIA, is supported by the project GAIN.
PhD student Tanay Agrawal from INRIA, supervised by Professor Francois Bremond, together with other students at INRIA, works on parameter efficient transfer learning techniques, which plays a pivotal role in advancing the fields of artificial intelligence and multimodal learning. Traditional machine learning models often require extensive amounts of data for training, which can be impractical or even infeasible in many real-world scenarios. Parameter efficient transfer learning mitigates this issue by allowing models to leverage pre-trained knowledge from related tasks or domains, enabling them to adapt to new tasks with limited data. This not only significantly reduces the data requirements for training, but also accelerates the development of sophisticated AI systems. Moreover, in the context of multimodal learning, where information is integrated from diverse sources such as text, images, and audio, parameter efficient transfer learning facilitates the effective fusion of these modalities by providing a framework to leverage knowledge gained from one modality to enhance performance in others. This promotes the creation of more robust and versatile AI systems capable of handling complex, real-world tasks across multiple input modalities. Therefore, the development and refinement of parameter efficient transfer learning techniques represent a critical area of research with far-reaching implications for the

[7] I. Javakhishvili Tbilisi State university

advancement of artificial intelligence and multimodal learning.

In paper [9] a new model agnostic architecture for cross-learning, called CM3T, applicable to transformer-based models is presented. Challenges in cross-learning involve inhomogeneous or even inadequate amounts of training data, and lack of resources for retraining large pretrained models. Inspired from transfer learning techniques in NLP (adapters and prefix tuning), the authors introduce a plugin architecture that makes the model robust towards new or missing information. It is also shown that the backbone and other plugins do not have to be finetuned with these additions which makes training more efficient, requiring less resources and training data. Two adapter blocks called multi-head vision adapters and cross-attention adapters for transfer learning and multimodal learning respectively are introduced. Through experiments and ablation studies on three diverse datasets - Epic-Kitchen-100, MPIIGroupInteraction and UDIVA v0.5 - with different recording settings and tasks, the efficacy of this framework is shown. With only 12.8% trainable parameters as compared to the backbone for video input and 22.3% trainable parameters for two additional modalities, comparable or even better results as compared to the state-of-the-art are achieved. Compared to similar methods, this result is achieved without any specific requirements for pretraining/training and is a step towards bridging the gap between research and practical applications for the field of video classification.

Future work would involve extending adapters and other parameter efficient techniques to optimize the finetuning and even transferring pretrained models across different fields of AI. It would be also interesting to explore their efficacy in the field of explainable AI owing to their property of decoupling different aspects to be learnt in a task. For example, adapters can be used to separate spatial and temporal reasoning in the field of video understanding.

PhD student Mansi Sharma from DFKI is working on her PhD thesis "Adapters for Calibration of EEG Classifiers"[8]. The adapter modules are inserted between pre-trained network layers. This involves copying parameters from pre-training, keeping them fixed, and adding a few task-specific parameters for each new task without impacting previous ones. The adapter module's design strategy achieves parameter efficiency in a single model without compromising performance. In contrast to traditional fine-tuning, which adds and co-trains a new layer, the adapter tuning strategy introduces new layers (randomly initialized) into the original network, supporting parameter sharing between tasks while keeping the original network's parameters frozen. This adapter-based tuning architecture introduces a minimal number of parameters, aiming to preserve the original network and maintain training stability. The approach initializes adapters close to an identity function, influencing activation distribution during training (which can be optionally excluded). Adapter-based tuning is applied to Transformers, known for achieving state-of-the-art performance in various NLP tasks like machine translation and text classification. There are very few research works that have used adapter-based tuning for cross-subject analysis in EEG. Our idea is to use the data from the target subject in the most efficient way to predict the target subjects' unlabeled samples. Adapter Networks *[Houlsby, N., Giurgiu, A., Jastrzebski, S., Morrone, B., De Laroussilhe, Q., Gesmundo, A., ... & Gelly, S. (2019, May). Parameter-efficient transfer learning for NLP. In International Conference on Machine Learning (pp. 2790-2799). PMLR.]* can be investigated in both the scenario where we have ground truth, and the scenario where we don't.

1. Supervised Calibration. We have ground truth: use the standard Adapter formulation.
2. Unsupervised Calibration. We don't have ground truth: use a meta-network to predict the adapter weights based on unlabeled EEG input (as discussed e.g. in *[Sung, Y. L., Cho, J., & Bansal, M. (2022). Vl-adapter: Parameter-efficient transfer learning for vision-and-language tasks. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 5227-5237)]*).

Adapters are expected to be especially helpful in this scenario, because we only have very few samples for the calibration. Recent work in NLP indicates that adapters have advantages especially in data-scarce situations *[He, R., Liu, L., Ye, H., Tan, Q., Ding, B., Cheng, L., ... & Si, L. (2021). On the effectiveness of adapter-based tuning*

[8] Research is performed in collaboration with the "Adapter Group of GAIN" composed of researchers from DFKI, INRIA and MICM

*for pretrained language model adaptation. arXiv preprint arXiv:2106.03164]*.

As a baseline model, BENDR would be fitting as adapters were introduced in the context of transformers previously. The principle can be applied to other networks as well. The project makes use of the common publicly available EEG emotion recognition datasets like SEED and DEAP dataset.

**Research at MICM supported by GAIN**

Traditionally, research at MICM comprise various fields of applied mathematics, such as probability and statistics, mathematical modelling, computational methods, optimization etc.

One of the main goals of the GAIN project is to adjust the research profiles of MICM to AI problems. GAIN has elicited an interest of scientists at MICM to the field of Machine Learning. Conference talk [1] is about the various mathematical methods applied in this field and research problems posed in the frames of the project.

Professor K. Katchiashvili, a member of the GAIN-MICM team, is the author of 2 textbooks „The methods and algorithms of machine learning (2021)" and "Machine learning (2023)". Within the GAIN project, aside from the consultations of young researchers in ML[9] topics, Professor K. Katchiashvili is investigating the problem of automatization of diagnosis of lung diseases (pneumonia, cancer) based on an X-Ray image of patients by use of statistical and ML methods. The research group includes 2 young members of the GAIN-MICM team. On these topics, one paper [8] is submitted and 3 conference talks are delivered [8 – 10].

The problems related with permutations (rearrangements) in different settings has been investigated by the group of mathematicians at MICM for a long time. It occurs that permutations are the object of interest in many ML problems as well. Note that some of our recent papers are cited by the authors working in this field (see e.g. *[Yucheng Lu, Wentacited byristopher De Sa. GraB: Finding Provably Better Data Permutations than Random Reshuffling. 36th Conference on Neural Information Processing Systems (NeurIPS 2022)], [Harvey N., Samadi S. Near Optimal Herding. JMLR: Workshop and Conference Proceedings. 35, 1-18, 2014]*). In 2023 two papers were devoted to this topic. In [3], a polynomial algorithm for finding the near-optimal rearrangement in the Steinitz functional for the vectors in the finite dimensional normed space is established. Maximum inequality and a Transference theorem, obtained by the authors, as well as a Monte-Carlo method are applied. This algorithm can be useful in ML problems as well as for some longstanding classical mathematical problems. The GAIN-MICM team intends to design a software for this algorithm. Another paper [7] (which is accepted for publication) deals with trigonometric Fourier series. The so called „permutation sign convergence" condition is considered, which may be interesting in applications. In the conference talk [11], rearrangements of a famous Dirichlet type series are considered, which are related to the Laplacian eigen values of the Heat Equation and corresponding spectral zeta function. Aside from the pure mathematical problems, the mentioned objects are applied to the Shape Recognition problems (see e.g. *[Mohamed Ben Haj Rhouma, Mohamed Ali Khabou, Lotfi Hermi. Shape Recognition Based on Eigenvalues of the Laplacian. Advances in Imaging and Electron Physics, V. 167, 2011, pp. 185–254]*). The corresponding paper is in preparation and will be submitted for publication in 2024.

Paper [4] aims to develop methods for increasing knowledge and model tracing capabilities of intelligent tutoring systems (ITS) designed for teaching mathematics and informatics. From different areas of mathematics and computer science, based on the strategy of self-explanation, the authors consider the cases where the solution of a problem can be achieved as a result of generalization of results found at previous stages. In using the holistic approach and appropriate methods of ontology engineering this can become the basis for building an e-learning environment, where students naturally move through the subject based on effective feedback from the ITS.

Paper [9] describes the process of constructing a solution to the Initial Value Problem for a quasi-linear non-strictly hyperbolic equation. Using a general integral, the non-linear version of the Cauchy problem is investigated. The structure of domain where the solution is defined is depicted. AI approaches are not new in pure mathematics, these are e.g. multi-agent learning of numerical methods for hyperbolic partial differential equations, physics-informed neural networks (PINNs), etc. Motivated by this, the authors of the paper plan to use AI methods in their research.

As noted above, probability and statistics as well as computational methods are the traditional research fields at MICM. The GAIN project supported the research in these fields as well. The moment of a random variable is an essential statistical concept in data science and is important in statistical machine learning. Conference talk [7], which deals with the connections between the moments of random variables, was delivered at CSIT 2023 (Computer Science and Information Technologies). Corresponding extended journal publication is in preparation

[9] Machine learning

and will be ready in 2024 (see also paper [5], conference talks [12, 14]). The conference talks [5, 6] deal with numerical calculations of engineering constructions and of electrostatic fields. Conference talk [13] is about the sub-Gaussian random variables.

#### 1.2.0.3. Datasets

In the Gain project the generation of various research datasets is planned. GAIN follows Open Science and FAIR data principles as given in the Grant Agreement and DoA of the project. Digital research data generated in the project, according to the Data management plan (DMP) (deliverable _D 6.3), is handled in line with these principles.

During the reporting period, the Gain researchers worked on generating the following datasets:

1. EEG dataset: Two types of experiments were conducted at MICM, which involve the recording of Event Related Potentials (ERP) with a commercial Unicorn Hybrid Black EEG device purchased by the GAIN project. The device has 8 active electrodes and a recording frequency of 250 Hz, covering 10-20 system positions FZ, C3, CZ, C4, PZ, PO7, OZ and PO8. Both experiments recorded auditory evoked potentials (AEP), which measure the electrical activity of the brain responding to sound stimuli, and both involve target/oddball tasks, although in the second experiment subjects were required to make a certain response depending on the type of stimulus. The recording is still in progress. The dataset will be uploaded to the Zenodo platform and the website of the project and will be open access.
2. Georgian language corpus: it is planned to use the GTU library's electronic documents to create Georgian language corpus. The work is in progress. The dataset will be uploaded to the Zenodo platform and the GTU and the project's websites and will be open access.
3. Records of doctor – patient interviews: 2 interviews have been recorded at the Tbilisi Mental Health Centre. This data, containing medical and personal information, is subject to the Ethics Requirements and, consequently, is restricted. Data is encrypted and stored at the GAIN-MICM server. The work is in progress.

#### 1.2.0.4. Research Infrastructure at MICM

**MICM AI Lab**

Due to the support of the GAIN project, "MICM AI Lab" started working in November 2022 and includes 25 researchers, the members of the GAIN-MICM team. The lab will be supported financially as well as scientifically by the project for 3 years. The MICM administration plans to maintain created research capacities after the project ends with budgetary help of the Georgian government and/or by seeking other funding opportunities, like research grants, commercialization etc. MICM AI Lab will be a part of the "Joint Virtual Laboratory" to be created in 2024 (see Task 2.4).

MICM AI Lab conducts the weekly GAIN workshops at MICM on various topics of ML and research problems posed by the project. The workshop series started in the beginning of the project in 2022 and continues.

The lab possesses 4 Microsoft Azure Kinect DK cameras (for the doctor-patient interviews' recording) and an EEG device, Unicorn Hybrid Black (for biosignals recording), which were purchased with the financial support of the GAIN project.

**Computing Centre at MICM**

A high-performance computing server is launched at MICM with the financial support of the GAIN project[10].

Specifications of the computer:

- Model: HPE Proliant dl385 Gen10 Plus
- CPU: 2 x AMD EPYC 7713
- RAM: 256 GB DDR4
- HD: 7.2 TB
- GPU: 2 x Nvidia A100 40GB.

The server is primarily used for the machine learning problems of the project. It will be used as well for computational purposes in other areas of sciences such as mathematics, physics etc., societal challenges, e.g. in healthcare, etc.

[10] Partially supported by the Shota Rustaveli National Science Foundation grant

**Recording the interviews at Tbilisi Center for Mental Health**

Azure Kinect Cameras were installed at the Tbilisi Centre for Mental Health to make audio-video recordings of the doctor-patient interviews according to the MEPHESTO study protocol. "Empatica" wristbands are used to collect the biosignals. (https://www.gain-twinning.eu/?p=814). Up to now, two interviews have been recorded (see Datasets).

### 1.2.0.5. Other activities and indicators

**International project proposals**

MICM was invited to be a member of the EDU AI consortium. Researchers Proposal # 101120027, Call: HORIZON-CL4-2022-HUMAN-02, was submitted on November 15, 2022, but was not accepted for funding. In this project, MICM would have played the role of a quality assurance provider (internal).

**Conferences and workshops organized at MICM**

During the reporting period, 1 scientific conference and 6 research seminars with invited speakers have been organized at MICM (see Appendix). At 4 departments of MICM weekly seminars are conducted.

**Institutional KPIs**

According the DoA of the project, Institutional Key Performance Indicators (KPI) are set out to monitor the evolution of MICM capacities. Tables 2 and 3 in the Appendix show the target and current values of Institutional KPIs to monitor the evolution of MICM capacities and the KPIs for the GAIN project respectively. Diagram 1 shows the growth dynamics of research performance indicators of MICM in 2023 relative to 2022.

## *1.2.1 Work Package 1 – Ethics requirements (Lead Beneficiary – MICM).*

This work package sets out the ethics requirements that the project must comply with. In the reporting period two deliverables have been prepared and submitted.

### D1.1. OEI[11] - Requirement No. 1

At the Kick-Off meeting of the project, which was held on 18 – 19 October 2022 in Tbilisi, Georgia, at MICM, the project Steering Board has appointed Professor Eka Chkonia as an independent Ethics Advisor (EA) of the project GAIN.
Professor Eka Chkonia is a Doctor of Medicine from Tbilisi State Medical University, the Head of the Society of Georgian Psychiatrists and clinical director at the Central Psychiatric Hospital.

Corresponding deliverable D 1.1 OEI - Requirement No. 1 (Appointment of Ethics Advisor) has been submitted.

### D1.2. NEC-POPD-Requirement No. 2

One of the vehicles for the GAIN project is the bilateral (INRIA-DFKI) large-scale project MEPHESTO (Digital Phenotyping for Psychiatric Disorders from Social Interaction).
The Pilot Research Project at MICM with the same title "Digital Phenotyping for Psychiatric Disorders from Social Interaction" will be conducted in Georgia. The main responsible institution of the task is the Central Psychiatric Hospital (Tbilisi Mental Health Centre), where the clinical data is collected. The data is stored on the computer server at MICM for further investigation by the project partners and is handled in accordance with the Consortium Agreement, GDPR and the Ethics Protocol.
The Ethics Protocol of the Pilot Research Project at MICM "Digital Phenotyping for Psychiatric Disorders from Social Interaction" is an adapted version of the Ethics Protocol of the INRIA-DFKI joint research with the same title conducted within the project MEPHESTO.
The GAIN version of the Ethics Protocol was adapted and translated into Georgian by the Ethics Advisor of the GAIN project, Prof. Eka Chkonia with consultancy of Dr. Alexandra König (INRIA) and Dr. Philipp Mueller (DFKI), one of the authors of the MEPHESTO version.
The study plan was assessed and approved without changes by the Biomedical Research Ethics Committee of Tbilisi State Medical University on March 2, 2023.

[11] Other Ethics Issues

As the study protocol was approved, deliverable D1.2. NEC[12] – POPD[13] - Requirement No. 2 (first report of ethics advisor), was prepared and submitted (see also deviations in Section 3.1).
Later, in January 2023, a new ethics advisor, Dr. Maya Roinishvili has been selected. The reason for this decision was that in the best interests of the project, Professor Eka Chkonia will be involved in the research carried out within the GAIN project at the Tbilisi Mental Health Centre. Thus, the GAIN consortium has decided to assign an independent expert as an ethics advisor, which was agreed upon with the project officer as well.

The next deliverable D 1.3. NEC-POPD-Requirement No. 3 (mid-term report of ethics advisor) will be submitted at the end of March 2024.

### *1.2.2 Work Package 2 - Twinning Research and Innovation Programme (TRIP) (Lead Beneficiary – MICM).*

This work package plays a fundamental role in all capacity building activities of the project. Its overall objective is a sustainable and lasting building of research and networking capacities among the project partners and thus creating conditions for better integration of MICM into the relevant European research community. The approach chosen for that is the joint research activities structured in the form of joint projects enabling long-term collaboration and partnership between Georgian and European researchers.
The operational objectives are as follows:

- To design and implement joint research activities cantered around 3 Topics (see Section 2.1 below) involving key staff of the partner research organizations.
- To support the project implementation with an effective and efficient mobility scheme.
- To build a joint research capacity by spreading research excellence in the partner organizations and beyond.

Out of 4 tasks of the WP 2, the implementation of 3 of them is in progress, where all the project partners are involved.

#### Task 2.1. TRIP detailed planning (MICM – Leader)

The first TRIP detailed planning workshop was collocated with the Kick-Off meeting of the project.

**1. TRIP Steering Board was set up:**

- DFKI – Jan Alexandersson, Philipp Müller
- INRIA - Alexandra Konig, Francois Bremond
- EXO – Svetlana Jasich
- MICM – George Giorgobiani.

**2. Framework parameters of the programme:**

TRIP Steering Board has defined and agreed the framework parameters of the programme:

**2.1. To implement joint research activities, 3 topics were defined with the titles:**

1. **Topic 1.** AI Methods for Deep Speech Analysis in Health (Leader: DFKI).
2. **Topic 2**. AI Technologies for Human Behaviour Understanding (Leader: INRIA).
3. **Topic 3**. Pilot Research Project at MICM, based on (but not limited to) the bilateral (INRIA-DFKI) large-scale project MEPHESTO.

**2.2. The webinar series.**

**2.2.1. Two webinars were organized by INRIA and DFKI in November 2022**

The purpose of these meetings was to present ongoing research projects at DFKI and INRIA relevant to the GAIN project. Subsequently, Georgian researchers had the opportunity to choose one (or several) projects to be involved in, according to their interests and expertise.
After the meetings it was decided:

1. To organise webinars with presentations of Georgian researchers showing their experience and interests in order to find potential areas for further collaboration.

[12] National Ethics Committees
[13] Protection of Personal Data

2. That Georgian researchers would complete the special mapping form between researchers and projects in the excel sheet at the "Project online management platform" (Deliverable D.6.2, WP 6) expressing their interests in specific topics.

### 2.2.2. Webinars with presentations of Georgian researchers

About 15 webinars were held in November – December 2022. The webinars were organized by the scientists of INRIA and DFKI. After the presentations and discussions 6 thematic research groups (sub-tasks) were composed:

1. G1. EEG/EDA/ECG (Unimodal EEG/Multimodal [RGB+EDA+EEG]/Implicit Intent Recognition)
2. G2. Face (Emotion RGB or Multimodal [RGB+audio+Text])
3. G3. High-Level Behaviour Analysis (Personality)
4. G4. High-Level Behaviour Analysis (Behaviour disorders: Alzheimer, Schizophrenia, Bipolar, Depression)
5. G5. NLP
6. G6. NLP-fMRI.

Researchers have been divided into groups based on their interests and specialties and the meetings were prolonged in groups.

Finally, 17[14] Georgian researchers were assigned to 3 Sub-Projects (in its turn containing different specific research topics, Sub-Tasks). The technical Support and the Management and Coordination groups at MICM were also composed (see Table 1 below). Among the 25 Georgian researchers, 18 are young scientists, PhD and Master students mostly from MICM and GTU but also from Tbilisi State University, International Black See University, Tbilisi State Medical University, Caucasus University, AI start-ups "Helio.AI" and "Tbilisi AI Lab", the software company "EPAM Georgia" and a medical centre „Mrcheveli". The Sub-Projects are supervised by the researchers from DFKI and INRIA, Francois Bremond, Michal Balazia, Laura Ferrari, Alexandra Konig, Philipp Muller, Benedikt Wirth. PhD students from DFKI and INRIA, Valeriya Strizhkova, Tanay Agrawal, Abid Ali, Hali Lindsay, Mansi Sharma are involved in the joint research as well.

The final mapping document between the Georgian researchers and the Sub-Projects (and Sub-Tasks) was agreed upon at the TRIP Steering Board meeting on December 27, 2022 (see Table 1 in Appendix).

### 2.3. Selection for the tenure-track position

MICM, consulted by DFKI and INRIA, has recruited 4 students (2 PhD and 2 Master students) for the project duration with the conditions of a tenure track. At the end of the project, post-contract evaluation and, in case of fulfilment of declared KPIs, a tenure position will be granted. Tenure-track Positions were assigned as follows:

1. PhD student Teimuraz Saghinadze (Sub-Task Action detection/recognition)
2. Master student Rapael Kalandadze (Sub-Task Emotions)
3. Master student Natia Kuchilava (Sub-Task Emotions)
4. PhD student Beso Mikaberidze (Sub-Task NLP).

In the reporting period, deliverable D2.1 Twinning Research and Innovation Programme, related to the Task 2.1 has been prepared and submitted.

## Task 2.2 TRIP Implementation and Coordination (MICM – Leader)

Implementation of the research projects described in the TRIP is going according to plan. Georgian team members of the project continue research collaborations with the European researchers from INRIA and DFKI via weekly webinars in the thematic groups and have already reached some achievements.

In the reporting period: 11 research publications have been prepared, out of which 6 are published [1 – 6], one is accepted for publication [7], two are submitted [8, 9] and 2 prepared for submission [10, 11]; 16 conference talks have been delivered at international conferences; 5 presentations were delivered by Georgian students at the project's First Summer School (see Appendix).[15]

MICM, aiming at recruiting young researchers has created 4 new employee positions within the research departments of the institute:

- 1 competitive position of a researcher at the department of „Computational Methods "
- 3 positions of an assistant researcher at the „Computational Centre ".

[14] Later, one more Georgian researcher was included in the mapping scheme.

[15] See more details in section "Research Component" above.

Above mentioned 4 young researchers with the tenure-track position, have applied to these positions. As a result, PhD student T. Saghinadze (who was an Assistant Researcher at MICM before) now holds the position of a researcher; the other 3 students hold the positions of assistant researchers. Note that 2 master students plan to start their PhD thesis in 2024.
As set out in the project, 3 groups are composed at MICM leaded by 3 distinguished students:

1. PhD student Teimuraz Saghinadze (Sub-Task Action detection/recognition).
2. Master student Rapael Kalandadze (Sub-Task Emotions).
3. PhD student Beso Mikaberidze (Sub-Task NLP).

Possibility of a double supervision (second supervisor from INRIA or DFKI) for Georgian students is being considered. GAIN will support this possibility in the frames of the DoA of the project.
Five students from INRIA and DFKI are involved in the project GAIN. They work on their PhD thesis, which are directly related to the research topics of the GAIN project.
Aside from the GAIN project, research of T. Giorgobiani is supported by a scholarship of the Advanced Research Opportunities Program (AROP) at the RWTH Aachen, where an fMRI experiment is currently conducted to study functional reorganisation patterns after the transient suppression of the Broca's area, a vital region for language production. In the GAIN project it is planned to apply NLP methods to this research. In this respect, the possibility of a joint project with RWTH is under consideration.
With the support of the GAIN project, "MICM AI Lab" has started functioning in November 2023 and includes the 25 researchers mentioned above. The lab will be supported financially as well as scientifically by the project for 3 years. MICM administration plans to maintain the created research capacities after the project ends with the budgetary help of the Georgian government and/or by seeking other funding opportunities, like research grants, commercialisation etc. MICM AI Lab will be a part of the "Joint Virtual Laboratory", which will be created soon (see Task 2.4).

### Task 2.3. Staff mobility programme (MICM – Leader)

The Staff Exchange (mobility) Scheme is necessary to carry out collaborative research. In the GAIN project, task-specific trips with clearly identified purposes from one partner organization to another are planned. Each of these visits is linked to the 6 research Sub-tasks of the 3 Sub-Projects given above and the Tenure-track Positions defined by the TRIP.
The Staff Exchange Scheme was discussed and agreed upon at the project meeting after the evaluation of the presentations held by the Georgian students at the First Summer School. The mobility list was composed as follows:

1. Master student Rapael Kalandadze (Sub-Task Emotions, G1) – visit to INRIA in Paris.
2. Master student Natia Kuchilava (Sub-Task Emotions, G1) - visit to DFKI in Saarbrücken.
3. PhD student Teimuraz Saghinadze (Sub-Task Action detection/recognition, G3) – visit to INRIA in Sophia Antipolis.
4. PhD student Beso Mikaberidze (Sub-Task NLP, G5) – visit to DFKI in Saarbrücken.

The visits will start in Spring 2024, and the duration of each visit will be approximately 3 months.

More details of WP 2 will be presented in the deliverable D 2.2 First joint research report, to be submitted in March 2024.

## *1.2.3 WP3. Scientific Excellence and Networking (Lead Beneficiary DFKI).*

This work package integrates the event-based research capacity building and networking measures representing the visible part of the TRIP. It includes the GAIN scientific workshop series, training courses offered by the European partners (face-to-face and as webinars), summer schools, as well as the final conference.
During the reporting period, the following events were organized:

### Task 3.1 GAIN workshop series (Leader DFKI)

**MEPHESTO & GAIN meeting at INRIA**
The meeting, organized by DFKI and INRIA, was held in January 2023, at INRIA, Sophia Antipolis, France, and was attended by the project MEPHESTO team and the representatives of the GAIN partner organizations. MICM was represented by 9 young researchers and a coordinator of the project.

The MEPHESTO clinical team presented an overview of the data corpus. Use cases/research questions, annotations, and events of interest were discussed. The Use-case demonstrators & infrastructures section included the presentations about "SEMLA a Secure Machine Learning Architecture" and "F2F and telemedical solutions". Synergies of projects MEPHESTO and GAIN as a continuation of MEPHESTO were discussed.
The GAIN technical team had meetings at INRIA with different research teams, where prospective data analysis plan, annotations etc. were discussed. The clinical team had meetings with different teams at the "Institute Claude Pompidou", Nice. Prospective data analysis plans, annotations, protocol issues/improvements, future studies, and the implementation of the planned study in Georgia, etc. were discussed.
The GAIN team visited the "Institut Pasteur" in Nice, department of psychiatry, where the doctor-patient interviews of MEPHESTO are recorded and analysed.
See more details at https://www.gain-twinning.eu/?p=581

**Workshop at ACII 2024**

In the context of sub-task 1 (EEG-based emotion recognition), young Georgian researcher (N. Kukhilava, T. Tsmindashvili) as well as researchers from DFKI (P. Müller, B. E. Wirth) and INRIA (L. Ferrari, F. Bremond) have submitted a workshop proposal entitled "EmoRec EEG: Generalizability of Emotion Recognition from EEG signals" to the International Conference on Affective Computing and Intelligent Interaction (ACII) 2024. If accepted, the workshop will announce a challenge with the goal to maximise emotion recognition accuracy across the six most used datasets in the field in order to foster comparability and generalizability of EEG-based emotion recognition approaches.

## Task 3.3 GAIN webinar series (Leader DFKI)

Throughout the duration of the project, researchers from DFKI and GAIN held weekly webinars with the groups from the sub-tasks. Initially, the aim of the seminars was to impart knowledge to the young Georgian researchers and present them with possible project ideas. In the meantime, however, the weekly meetings mainly serve to supervise and monitor the progress of the young Georgian researchers' projects.

## Task 3.4 GAIN Summer Schools (Leader DFKI)

**GAIN First Summer School at INRIA[16]**

The GAIN First Summer School (WP 3, Task 3.4) was collocated with the 3rd INRIA-DFKI EUROPEAN SUMMER SCHOOL ON ARTIFICIAL INTELLIGENCE, IDESSAI 23. It took place at INRIA, Sophia Antipolis, France on 4 – 8 September 2023. The summer school was attended by 10 young Georgian researchers.
The programme was divided into 2 tracks, Track A: Simulation & AI and Track B: AI for Agriculture and the Environment (see entire programme at https://idessai.eu/files/2023/09/Booklet-rev.pdf).
Young Georgian researchers were present at INRIA every day during the summer school and attended numerous presentations, mostly of Track A.
The GAIN workshop was scheduled in parallel at the Euler Violet room on 5 September. The workshop included presentations by the young Georgian researchers and the GAIN steering board meeting.
The topics and titles of the presentations have been elaborated and coordinated with the partners from INRIA and DFKI during the joint weakly webinars in different research groups defined by the TRIP. Five presentations[17] were delivered by the members of the Groups 1,2,3,5,6 (see the abstracts of the presentations in the Appendix, Section 4.3). Group 4 will present their progress after the doctor-patient interviews have been recorded and analysed.
The presentations were followed by discussions, questions, comments, and recommendations by the audience. Taken together, the presentations and research achievements of all the groups were assessed positively. Remarkably, it was noted that the Georgian researchers have made tangible progress during the first stage of the collaboration with their European colleagues. Consequently, the Staff Exchange (mobility) Scheme for the Georgian researchers was agreed upon (see Section 1.2.2, Task 2.3). Specific methods and means to solve the research problems posed within the thematic groups were outlined.
The GAIN First Summer School succeeded in dissemination and networking. It provided a platform for young researchers from MICM and the consortium as a whole to build their research capacity and networking skills in an international environment.

[16] Deliverable D.3.4 GAIN Summer Schools' Report will be submitted in 2025.
[17] Full versions of the presentations are available at https://www.gain-twinning.eu/?page_id=302

The achieved goals of the First Summer School were (a) transferred organizational experiences to MICM and developed blueprint for the organization of future summer schools (b) experience gained by the young researchers for presenting their research in front of an international audience.
The main topics of the Project Steering Board Meeting concerned the Key Performance Indicators (KPI). It was noted that they are quite achievable during the remaining 2 years of the project.
Information about the First Summer School with visual material is available at the project website[18], Facebook[19] and LinkedIn[20] as well as in a Promotional video[21].

**Second Summer School at MICM**
The Second GAIN Summer School is planned to take place in August 2024 at MICM in Tbilisi, Georgia. The topic of the second summer school is set to be "AI-empowered cognitive vision". As the first summer school, the second summer school will include presentations by the young Georgian researchers in order to be able to monitor the progress of their projects. Furthermore, researchers of the partner institutions will give presentations about their most recent projects in order to find further areas for future collaborations.

A complete report on the summer schools will be present in deliverable D 3.4. GAIN summer school report, to be submitted in 2025.

### *1.2.4 WP4. Innovation and Research Management Capacity Building (Lead Beneficiary EXO).*

#### Task 4.1 Innovation training workshops for researchers and managers (Leader EXO)

The first innovation training workshop was organized by EXO on January 16, 2024, in Tbilisi. The topic of the workshop was "Competitive RTD proposal writing" and the workshop was aimed at building research fundraising capacity at MICM. The workshop was attended by 24 people, including tenure-trackers, young researchers and the management of the Institute. The training included the following tasks:

- General acquaintance with the structure of the EU funding programmes for RTD (focus on Horizon Europe Programme), major information sources.
- Reading and understanding the Call for proposals text (the practical task included the HEP call HORIZON-CL4-2023-HUMAN-01-01, reading the text, collaborative brainstorming about the background, potential activities to be funded, selection of consortium partners, etc.). The choice of the call was based on the fact that this topic is very relevant to the scientific objectives of GAIN's pilot research project.
- Detailed analysis of the successful proposal submitted in response to the call. The topics covered: presentation of the project objectives, presentation of the relevance and ambition, writing the methodology and impact sections, design of the work plan, allocation of resources. The participants have been asked to provide their evaluation of the presented proposal.
- The proposal evaluation and selection process. The presentation was based on the real Evaluation Summary Report received for the proposal presented earlier. The participants had a chance to compare their assessment of the evaluation criteria with the one provided by the external experts.

Informal feedback received after the event confirmed that the provided information was appreciated by the participants, and they obtained a better understanding of the collaborative proposal writing process.

It was decided that the subsequent workshops will cover the following topics:

- Economics of Research (planned for autumn 2024).
- Innovative Business Development (planned for winter 2024/2025).

[18] https://www.gain-twinning.eu/?p=689
[19] https://www.facebook.com/people/GAIN-twinning/100087895163991/
[20] https://www.linkedin.com/in/george-giorgobiani-33310a48/recent-activity/all/
[21] https://www.gain-twinning.eu/?page_id=302

### Task 4.2 Web-based training on European innovation tools (Leader EXO)

The first webinar in the series was organized by EXO on December 21, 2023. The event addressed the topic of Technology Transfer. The presentation covered the following sub-topics:

- Intellectual property management in research projects (example of default IP regime in Horizon Europe based on the Model Grant Agreement and DESCA Consortium Agreement template provisions. The GAIN documents have been used as illustrations)
- Licensing IP for the project implementation and results exploitation.
- Spinning-off as the most common method of Technology Transfer. The examples included EXOLAUNCH (spin-off of TUBerlin) and ki elements (ki-elements.de, spin-off of DFKI). The choice of ki elements was based on the fact that the company business model is based on innovative technology very close to the one under development within the GAIN pilot research project. The innovative business offer and business models have been presented.

As the topic related to research spin-off companies drew high attention of the audience, as well as because some of the participants have already had the start-up experience, it was decided that the next webinar will be dedicated to the topic of Research start-ups business modelling with the practical work sessions on drafting the Business Model Canvas for a potential GAIN spin-off company. The next webinar is scheduled for summer 2024.

### Task 4.3 On-the-job training for Research Administrators and Managers (Leader DFKI)

In August 2023 the group of MICM's Research Administrators and Managers visited Berlin and have been provided with the opportunity to get acquainted with the management of an innovative start-up company (EXOLAUNCH). The short stay allowed to improve awareness about the financial aspects of spinning-off (including management of IP), personnel management, balancing technology maturation and commercial activities, managing relations with external stakeholders, etc.
The further activities planned within this task include administrative and managerial skills development for the young research leaders who are selected for longer stays at DFKI and INRIA (3-4 months starting from spring 2024). This will include the direct participation in organizing such activities as e.g. regular research planning and synchronization meetings, monitoring and planning a research group's finances (incl. personnel planning).
Depending on the availability of funds at MICM, further on-the-job training (short stays) will be planned for the 3rd project year.
Information about the training event with visual material is available at the project website[22], Facebook[23] and LinkedIn[24] as well as in a promotional video[25].

Report on training workshops, deliverable D 4.1 Training workshops report and training materials, will be submitted in March 2024.

### Task 4.4 Pilot Innovation Project (Leader MICM)

This task will start in autumn 2024 and will run during the 3rd project year. At the same time, the project capacity building activities implemented within the earlier tasks prepare the ground for this task implementation. The basic idea is that the project team will consider the options of setting up the company to mature further and commercialize the software developed by the project in the healthcare system of Georgia. The entire cycle of business analysis and planning will be implemented (e.g. the Business Model Canvas and initial Business Plan will be developed) to provide the evidence for the decision making. If it is considered feasible and there are team members willing to take a risk, the company will be registered already within the lifetime of the project. As an alternative option, the transfer of technology to one of the existing spin-off companies will be considered.

Deliverable D 4. 3 Pilot Innovation Project Report, will be submitted in 2025.

[22] https://www.gain-twinning.eu/?p=689
[23] https://www.facebook.com/people/GAIN-twinning/100087895163991/
[24] https://www.linkedin.com/in/george-giorgobiani-33310a48/recent-activity/all/
[25] https://www.gain-twinning.eu/?page_id=302

### *1.2.5 WP5. Visibility and Social Impact. (Lead Beneficiary MICM)*

During the reporting period the following tasks have been performed:

#### Task 5.1 Project website (Leader MICM)

- The project website is ready and is constantly updated https://www.gain-twinning.eu/ . Facebook and LinkedIn accounts are linked to GAIN website. Civil society; social media; Public activities shared at the GAIN project website are liked and shared via Facebook and LinkedIn
  https://www.facebook.com/people/GAIN-twinning/100087895163991/
  https://www.linkedin.com/company/gain-twinning/
- An open data repository (Zenodo Platform) for the scientific publications and data sets is integrated in the project website.

Corresponding deliverable D5.1 Project website, version 1, was submitted (see deviations in Section 3.1).

#### Task 5.2 Dissemination activities towards Research (Leader MICM)

The following activities have been conducted:

1. October 18 – 19, 2022, MICM, Kick-Off Meeting of the GAIN project. Audience – researchers, Georgian policy-makers and authorities (about 70 guests).
2. November 2022. MICM was invited to the EDU AI consortium. Project proposal (no: 101120027, Call: HORIZON-CL4-2022-HUMAN-02) was submitted (not funded).
3. From December 2022. Collaboration with EU-funded projects - Sister Twinning Projects Focus Group, initiated by the project EPIBOOST - BOOSting excellence in environmental EPIgenetics (GA no. 101078991); funded by the European Union within the call HORIZON-WIDERA-2021-ACCESS-03 – Twinning. Sister Twinning Projects Focus Group Survey 1 was submitted.
4. May 22, 2023. Survey on "Reflecting the experiences in Horizon Europe projects" was submitted. Survey contains overall functioning, efficiency, relevance for beneficiaries and expected outputs and impacts of the GAIN project. The survey is part of the ongoing Evaluation of the European Framework Programmes for Research and Innovation.
5. June 4-11, 2023, the members of the MICM-GAIN research team, Vakhtang Kvaratskhelia, Kartlos Kachiashvili and Marine Menteshashvili were in France, at the National Institute of Applied Sciences (INSA), Rennes. V. Kvaratskhelia and K. Kachiashvili were supported within the framework of the ERASMUS+ exchange program. M. Menteshashvili was supported by the GAIN project. Meetings and mutually interesting discussions were held at the Departments of Computer Sciences, Computer Engineering and of Applied Mathematics. The MICM-GAIN research team presented the GAIN project main goals and objectives. The French colleagues expressed their interest in the prospect of future cooperation with the grantees.
6. GAIN has been disseminated at 3 project events held in Europe, which were attended by the researchers outside the GAIN consortium as well:
   - ✓ January 19 – 20, 2023, MEPHESTO & GAIN meeting, INRIA, Sophia Antipolis, France.
   - ✓ August 21 – 25, 2023, On-the-job training for Research Administrators and Managers (collocated with the Summer School), organized by EXOLAUNCH, Technical University of Berlin, Germany.
   - ✓ September 4 – 8, 2023, The GAIN First Summer School (collocated with the 3rd INRIA-DFKI EUROPEAN SUMMER SCHOOL ON ARTIFICIAL INTELLIGENCE, IDESSAI 23), INRIA, Sophia Antipolis, France.
7. GAIN has been disseminated at 3 project training events, which were also attended by the Georgian researchers outside the GAIN consortium as well:
   - ✓ December 21, 2023, Web-based training on European innovation tools 1: IPR in HEP projects.

- ✓ January 16, 2024, MICM, Tbilisi, Georgia. Innovation training workshop for researchers and managers.

8. 16 conference talks were delivered[26]. Presentations contain the logos of the EU and GAIN and the relevant acknowledgements. See the presentations at https://www.gain-twinning.eu/?page_id=300
9. 11 research papers were prepared[27] (6 – published, 1 – accepted, 2 – submitted, 2 – in preparation).
10. 5 presentations were delivered at the First Summer School.

### Task 5.3 Dissemination activities towards Society (Leader MICM)

Project's promotional materials were prepared:

- Business cards and rollups were prepared.
- Promotional video was recorded and is available at the project website:
  https://www.gain-twinning.eu/?page_id=302
  https://www.youtube.com/watch?v=Bgi9Ju_VJeU&ab_channel=GainTwinning

Corresponding deliverable D 5.3 Set of the project promotional materials, version 1, was submitted on due date.

**Publications**

1. *IPN* Interpressnews - https://www.interpressnews.ge/ka/article/734014-sakartvelos-teknikuri-universitetis-gamotvliti-matematikis-institutis-proekti-horizonti-evropas-sagranto-konkursis-gamarjvebulia
2. GTU website news - https://gtu.ge/News/20899/
3. MICM website - http://micm.edu.ge/en/project-gain-first-meeting/
4. D. Gurgenidze, V. Kvaratskhelia. Muskhelishvili Institute of Computational Mathematics at the Georgian Technical University. Georgian Electronic Scientific Journal: Computer Science and Telecommunications. No.1(61), 2022, p. 3-6. ISSN 1512-1232
   https://gesj.internet-academy.org.ge/en/list_artic_en.php?b_sec=comp&issue=2022-08

**Presentations**

1. February 6, 2023. Horizon Europe Proposal Writing Camp for Georgia. Trainer: Mattias Wurch & Anneli Rose (Global Service Facility of the EC). Success Story from Georgia: MICM in EC Projects. Speaker: G. Giorgobiani. Objective: Raise awareness about the GAIN project towards researchers, innovators, industry, business partners, EU institutions, Civil society. Venue: Tbilisi State University, Tbilisi, Georgia.
2. Jun 13, 2023. A short survey of the goals of the GAIN project (Story of a Successful Applicant) was published at the website of Horizon Europe National Office of Georgia
   http://horizoneurope.org.ge/en/news/46

### Task 5.4 Integration with European AI communities (Leader DFKI)

Working contacts (outside the GAIN consortium) have been established:

1. Since November 2022, MICM is a member of EDU AI consortium, Proposal number: 101120027, Call: HORIZON-CL4-2022-HUMAN-02. Proposal was submitted.
2. From December 2022. Collaboration with EU-funded projects - Sister Twinning Projects Focus Group, initiated by the project EPIBOOST - BOOSting excellence in environmental EPIgenetics (GA no.

[26] See Appendix: Conference talks.
[27] See Appendix: Publications.

101078991); funded by the European Union within the call HORIZON-WIDERA-2021-ACCESS-03 – Twinning. Sister Twinning Projects Focus Group Survey 1 was submitted.

3. Saarland University, Germany.
4. National Institute of Applied Sciences (INSA), Rennes, France.
5. RWTH – Aachen University, Germany.
6. Idiap Research Institute, Switzerland.
7. RAIT 88, Defence engineering centre, Italy – expressed interest in collaboration.
8. Helio.AI – recruiting software company (Georgia).
9. I. Javakhishvili Tbilisi State University.
10. International Black See University.
11. Tbilisi State Medical University.
12. Caucasus University.
13. Medical centre „Mrcheveli".
14. R. Agladze Institute of Inorganic Chemistry and Electrochemistry.
15. V. Chavchanidze Institute of Cybernetics.
16. International Centre for Advancement of Research, Technology and Innovation (ICARTI).
17. Georgian AI Association (membership).
18. Tbilisi AI Lab.

All the partners of the GAIN consortium have been notified and given information about the dissemination results 15-20 days prior to making it publicly accessible.

Deliverable D 5.5. Dissemination, impact and sustainability Plan, version 1, was submitted on the due date. Deliverable D 5.7. Dissemination, impact and sustainability Plan, version 2, will be submitted in March 2024.

### *1.2.6 WP6. Coordination and Management (Leader MICM).*

During the reporting period, the following activities have been performed:

#### Task 6.1: Institutional reforms at MICM (Leader MICM)

The main objective of this task is the introduction of modern research management practices at MICM. The administrative reforms will be presented in the Institution Development Plan to be suggested to Georgian Technical University and the Georgian Ministry of Education and Science at the end of the project.
During the reporting period, a Strategic Development & Sustainability Plan was prepared (corresponding deliverable D6.1, will be submitted in the end of March 2024).

#### Task 6.2. Project evaluation and quality control (Leader MICM)

Progress with respect to the milestones and deliverables was considered and discussed at two project steering board meetings.
In the reporting period of 17 months, the planned milestones have been achieved:

1. M1 (due date month 3): TRIP detailed planning completed and agreed upon. Joint research activities started. Project websites (public and restricted) are online. Corresponding deliverables D 2.1, D 5.1, D 6.1 were submitted.
2. M2 (due date month 12): First Summer School was organized and evaluated (Section 1.2.3). The on-the-job training for RAM[28] started (Section 1.2.4). The first scientific publication was obtained (Section 1.2.0).
3. M3 is almost achieved (due date month 18): First scientific evaluation is completed and documented. First scientific workshop was organized. Corresponding deliverable D 2.2 First Joint Research Report, will be submitted in March 2024.

Deliverables D1.1, D1.2. D 5.3, D 5.5, D 6.2, D 6.3 were submitted as well. An internal review procedure was employed for each deliverable before submitting.
Internal evaluation of MICM based on the system of KPIs has been performed continuously. All project partners

[28] Research Administrative and Managerial Staff

were involved in the process. Tables 2 and 3 in the Appendix show the target and current values of Institutional KPIs to monitor the evolution of MICM capacities and the KPIs for the GAIN project respectively. Diagram 1 shows the dynamics of growth of research performance indicators of MICM in 2023 with respect to 2022.

### Task 6.3. Coordination, communication and administration infrastructure (Leader MICM)

Three project meetings have been conducted:

**1st Project meeting.**

The Kick-Off meeting was held MICM on October 18 – 19, 2022. The first day meeting was attended by the representatives of partner organizations, the representatives of GTU[29] and other universities and research organizations (up to 70 guests). The participants of the meeting were addressed by the project officer (online), Dr. Silvia Bozhinova (Team leader NCP countries at the European Commission DG R&I), and the head of the Horizon Europe Georgia office. The first day of the meeting was dedicated to presentations and welcome addresses.

The first project meeting was held on the second day. Decision-making bodies and decision-making processes in line with the Grant Agreement and the Consortium Agreement were established.

Composition of the Project steering board and TRIP (Work package 2) steering board were agreed upon. It was decided that both boards include the same representatives of all four partners:

- DFKI – Jan Alexandersson.
- INRIA - Alexandra Konig, Francois Bremond.
- EXOLAUNCH – Svetlana Jasich.
- MICM – George Giorgobiani.

The Project Steering Board has decided:

- According to the Grant Agreement, project coordination meetings will be held annually. TRIP (Work package 2) steering board meetings will be held quarterly. Exceptional meetings will be organized when necessary. The next meeting was scheduled for January 2023, at INRIA.
- Initial design and functionality of the Project Website (D.5.1) will be designed by the researchers of MICM with participation of all the partners.
- Project online management platform (D.6.2.) for the development and maintenance of the internal project information will be structured in Google Drive.

Project GAIN proposes to extend the scope of the MEPHESTO project. This includes digital phenotyping of various mental and mood disorders pathological evidence such as executive dysfunction or inadequate emotional distress. As the medical data will be collected in Georgia, appointment of an independent Ethics Advisor (Deliverable 1.1) was recommended by the Project Officer during the Grant Preparation process in order to ensure that the participants are protected. In this regard, Doctor of Medicine from Tbilisi State Medical University, the Head of the Society of Georgian Psychiatrists, and research director at the Tbilisi Mental Health Centre, Professor Eka Chkonia was invited on the second day of the Kick-Off meeting. The Project Steering Board has appointed Professor Eka Chkonia as an Ethics Advisor of the project (see also section 1.2.1).

**2nd Project Steering Board meeting**

The second Project Steering Board meeting was held at INRIA, Sophia Antipolis, France, 4 – 8 September 2023. It was a part of the GAIN First Summer School (WP 3). The main topics of the Project Steering Board meeting concerned the KPIs and the mobility scheme.

It was noted that there is progress in: publications and conference talks, established contacts with potential collaborators outside of the GAIN consortium, European organizations expressing interest in cooperating.

Regarding the human capital – right after the start of the project, MICM has created 3 positions of "Research Assistants" to which 3 young researchers from the GAIN-MICM team applied. The GAIN-MICM team consists of 25 researchers, among them 18 young researchers. Institutional KPIs were also reviewed. It was noted that they are quite achievable during the remaining time of the project.

At the meeting, the mobility scheme for the Georgian young researchers was agreed upon and composed (see Section 1.2.2, Task 2.3. Staff mobility programme).

[29] Georgian Technical University

**3rd Project Steering Board meeting**

The 3rd Project Steering Board meeting was held online, December 7, 2023. The following decisions were made:

- March 1, 2024, was chosen as the date for the Progress Report. The plan for the preparation of the corresponding deliverable D. 6. 5 was discussed and agreed upon.
- The plan for the preparation of 5 deliverables D1.3, D 2.2, D 5.7, D 6.1, D 6.4, which should be submitted on March 31, 2024, was discussed and agreed upon.
- Updated KPIs were reviewed.
- Some details of the Staff Exchange (mobility) scheme were considered and adjusted.
- The Critical risks & risk management strategy, set out in the DoA was reviewed. It was concluded that at this stage, the risks for the project implementation are evaluated as low.

**Deliverables:**

Deliverable 6. 2 Project online management platform (submitted) is the part of Task 6.3. It was developed as the fast and effective communication, coordination and management system of the project. This is the internal project information platform, a documents repository (for documents with uncritical privacy status) and a ticketing system for the task management. The platform is structured in the Google Drive at:
https://drive.google.com/drive/u/1/folders/1KV23IIPtgtLtFpiaVWasLB0XyojKvZdp

Deliverable 6. 3 Data Management Plan, Version 1 (submitted), is part of Task 6.3. The Plan is based on the 4 principles of FAIR Data: **F**indability, **A**ccessibility, **I**nteroperability and **R**eusability. GAIN addresses open science and research data principles which is in line with the open dissemination strategy. In this respect, the project has reserved funds for covering the open access publications in journals with high impact factor and coverage (see more details in Section 2, Open Science).
In the project, the creation of a multimodal corpora (speech, video, biosensors) of social patient-clinician interactions is planned. Technical tools and organizational methods for the management of this kind of data and the personal data include the aspects of ethical, legal and social implications (ELSI), GDPR requirements compliance, Consortium Agreement of GAIN and the Ethics Protocol (Deliverable 1.2) created within the project. For sharing the results "Project's Online Management System", the project website and the Zenodo Platform is being used. According to the DoA of the project, the data management plan will be updated at the middle of the project as version 2 (Deliverable 6.4, to be submitted in March 2024).

## Task 6.4: Management and administration (Leader MICM)

In the Grant preparation process, some changes were requested by the project officer: In part A, WP 1 "Ethics Requirements", D 5.7, D 6.4, and D 6.5 (Progress report, Month 17) were added. In part B the Gantt-Chart was modified and Subsection "3.3. Gender equality plans and gender mainstreaming" was added (see the history of Changes, part B). The Grant Agreement was signed by all partners.
The Consortium Agreement has been reviewed and signed by all partners.
During the period of the first 17 months of the project, a clear reporting structure and effective reporting process were established. Deliverables of the project are processed through consultations with partners. Reports provided by the partners are discussed and reviewed before submission. For this purpose, the project online management platform is applied. In this way, the overall quality of the project reports is ensured. Eight deliverables have been submitted (see deviations in Section 3).
The management and administration activities comprised the preparations of 45 trips to various project meetings and conferences (purchase of plane tickets, allocating accommodation and daily costs), preparation of technical documentation for the tenders to purchase the goods for MICM (computers, special video cameras, EEG device, computer accessories, business cards, roll-up), organization of the events and receptions, etc.

## 1.3 Impact

The project GAIN is designed in compliance with the following expected impacts given in the Work Programme's Destination:

### 1.3.1. Increased science and innovation capacities for all actors in the R&I system in widening countries.

The GAIN project is set to deliver a radical increase of capacities for a central R&I actor, MICM, in a key thematic domain (AI) in Georgia (a widening country). As Georgia is a small country, through GAIN, the entire science system is expected to show a significant growth.

To build a new quality of research capacities at MICM in the field of AI, 3 topics for joint research activities were defined with the help of the project partners, leading European RTD performers in the field: INRIA and DFKI (see Section 1.2.2, WP 2). After an initial series of research webinars, 6 Research Thematic Groups (sub-tasks) were composed, to which 18 Georgian researchers were assigned. The Research Thematic Groups are supervised by researchers from DFKI and INRIA. Collaboration with European partners enables Georgian researchers to raise their professional qualification in the field of AI, publish in prestigious journals and to present at leading conferences. Thus, MICM as a whole increases its scientific reputation.

One of the vehicles for the GAIN project is the joint INRIA-DFKI large-scale project MEPHESTO. The Pilot Research Project at MICM "Digital Phenotyping for Psychiatric Disorders from Social Interaction", which is based on the ideas developed in the MEPHESTO project, is conducted in Georgia. The main responsible institution for this task is the Tbilisi Mental Health Centre, where the clinical data is collected and investigated afterwards by use of AI methods. This research, which is the first of its kind in Georgia, will foster science and innovation capacities in the field of psychiatry and will attract the stakeholders from the broader field of medicine and beyond.

To foster the joint research capacity building, in the reporting period, 3 project meetings have been conducted in France and Germany: MEPHESTO & GAIN meeting at INRIA, On-the-job training for Research Administrators and Managers organized by EXO at Technical University of Berlin and the GAIN First Summer School at INRIA. The GAIN-MICM team members had an opportunity to meet with various research teams, attended workshops on different topics and visited the research departments and labs.

The joint research in the reporting period resulted in 11 prepared research publications, out of which 5 are already published in peer-reviewed, open access journals. Georgian students delivered 16 conference talks at the international conferences and 5 presentations at the project's First Summer School.

To support the increase of research capacities in the field of AI, MICM has created 4 new research positions within the research departments of the institute. These positions are held by the students of GAIN-MICM team, whose research is focused on AI technologies.

Since November 2023, a new research unit „MICM AI Lab" has been operating at MICM. 25 Georgian researchers of GAIN- MICM team are united in this lab, which will be part of the project's "Joint Virtual Laboratory" to be composed in 2024.

One of the key aspects of the joint work is the research co-creation methodology, which is widely accepted among the advanced research partners. In the GAIN project, this is realized by involving all relevant stakeholders, such as clinical and technical personnel of partners, potential patients in the planned research. This will result in better research outcomes and higher acceptance of research-based technologies. The project research and capacity building activities provide a supportive environment regarding the mobility of the research and supporting personnel. In this respect, during the reporting period, 4 person/trips were spent for clinical and technical personnel of GAIN-MICM team.

One of the goals of the project is to strengthen research management capacities and administrative skills of the staff working at MICM. The project activities involve the managerial and administrative staff of MICM, who are offered various forms of training (events, on-the-job) to facilitate and support the research excellence at MICM. Moreover, the respective practices at MICM will be modernized based on the vast experiences of the European project partners. The goal is to make the managerial and administrative structures of MICM responsive to the evolving environment, capable of competitive fundraising, and supportive towards innovation. In this respect, during the reporting period, 3 training workshops were conducted: On-the-job training for Research Administrators and Managers in Berlin, Innovation training workshop for researchers and managers in Tbilisi, and a Web-based training on European innovation tools.

### 1.3.2. Reformed R&I systems and institutions leading also to increased attractiveness and retention of research talents. Placing focus on young researchers, equipping them with cutting-edge skills and giving new career prospects.

The project will tackle one of the major problems in science systems of Widening countries – brain drain.
Among the 25 Georgian researchers of GAIN, who are mostly from MICM and GTU but also from other universities, institutions and companies, 18 are young scientists, PhD, master and bachelor students. Five PhD students from DFKI and INRIA are involved in the joint research as well.
Four Georgian students (2 PhD and 2 master students) were selected for the created tenure-track position. The above-mentioned 4 new employee positions are being held by these students. Currently, out of 28 researchers and 8 IT specialists at MICM, 9 are young, and 8 of them are researchers of GAIN.
Four students from MICM with tenure track position will be supported by the Staff Exchange (mobility) Scheme to visit DFKI and INRIA. The visits will start in Spring 2024 and last for about 3 months.
Three research groups related with the abovementioned 3 topics for joint research activities will be leaded by the young Georgian scientists at MICM after acquiring relevant knowledge and skills through the TRIP activities.
The overall mobility plan of the project is focused on young researchers. To attend the above-mentioned 3 project meetings abroad, 27 person/trips were spent for young Georgian scientists.
Young Georgian researchers collaborate with European scientists outside the GAIN consortium as well. These include the RWTH, Aachen, Germany and the Idiap Research Institute, Switzerland.
Young researchers are supposed to compose the core of the future project proposals. This was the case, when in November 2022, MICM was invited to the EDU AI consortium. Project proposal was submitted (not funded). In November 2023, impressed by the presentation on the GAIN research problems at the conference in Tbilisi (see Appendix, conferences [1]), the representative of "RAIT 88, Defence engineering centre", Italy, has expressed an interest in collaboration. The possibility of research collaboration, involving our young researchers, is now negotiated e.g. in the forthcoming NATO projects, Large Language Models (LLMs) for text production, etc. It is planned as well to write a project proposal for the local SRNSF[30] grant contest, where the participation of young researchers is highly welcomed.

MICM plans to retain created research potential by the governmental funding and by seeking for other sources as well, like grant projects, commercialization of scientific results, collaboration with business and industry, etc.

### 1.3.3. Improved outreach to international scale for all actors.

Using GAIN as a vehicle powered by the capacities of the European partners, MICM will extend its capacity to conduct internationally competitive research.
The project dissemination and communication activities are designed to maximally contribute to attaining the overall project goal – the integration of MICM into the community of leading European research organizations in the field of AI. Therefore, the project dissemination is focused on spreading the research results obtained through pursuing the TRIP and address the research audience, while the communication activities will address the wider audience of stakeholders, such as policy-makers, authorities, businesses, and the general public in Europe and in the South Caucasus region, in order to shape an image of MICM as a regional centre of excellence.
In the reporting period, various dissemination and communication activities have been conducted:

- The project website is designed and linked with the Facebook and LinkedIn accounts.
- Towards research, 8 dissemination activities have been performed, 5 research papers were published in peer-reviewed, open access journals, 1 paper in conference materials, 16 conference talks at the international conferences and 5 presentations at the GAIN First Summer School were delivered.
- GAIN has been disseminated at 3 project events, which were attended by the European researchers outside the GAIN consortium.
- Project follows the Open Access and FAIR data principles. Thus, all research publications will be open access and obtained scientific data will be managed according to the 4 principles of FAIR Data: Findability, Accessibility, Interoperability and Reusability. The open data repository, the Zenodo Platform, is integrated in the project website.
- 6 dissemination activities towards society as a whole have been performed.
- GAIN has been disseminated at the Kick-Off Meeting of the project, which, aside from the participating researchers was attended by the Georgian policy-makers and authorities from universities, institutions,

[30] Shota Rustaveli National Science Foundation of Georgia

Academy of Sciences etc., by the Senior Policy Officer and the ENP Team leader at the European Commission DG R&I and representatives of Horizon Europe Office Georgia.
- As part of communication activities, business cards and rollups were prepared, a promotional video was recorded and is available at the project website.
- 18 working contacts have been established with universities, institutions and companies outside the GAIN consortium, among them 7 are European organizations.

Please see more details in Section 1.2.5.

### 1.3.4. Greater involvement of regional actors in R&I process. Exploitation of results.

GAIN will contribute to building applied research and innovation capacities in MICM and in Georgia as a whole. This is an important structural and cultural change to the science system, which still bears the consequences of isolation of science from economy.

MICM has been founded in 1956 as the "Computational Centre" of the Academy of Sciences of Georgia. The first computer in the country was deployed here to tackle the optimisation of problems in the fields of economy, agriculture, energy, engineering, healthcare etc. Related research has been conducted by scientists of high esteem in the fields of probability and statistics, programming (software), analysis, computational methods, operations research, approximation theory and others. Currently, MICM maintains high potential in the mentioned fields, but the research is still isolated from business and industry.

In this respect, the GAIN project brings new opportunities for the R&I process in Georgia. The importance of the project's specific focus on AI is justified by the common understanding that this area represents one of the greatest opportunities for global societal and economic progress. Artificial Intelligence represents a well-defined and dynamically developing area of research with various application domains. As noted above, the TRIP includes 3 strategic interrelated and overlapping research Topics, each of them focused on building a particular excellence niche at MICM as well as integrating this niche into the relevant European research communities. Within the GAIN project the joint work is conducted on several applied research topics addressing domains of medical applications (exemplary eHealth application for early detection and monitoring neuro-degenerative, mental and mood diseases) and other relevant application areas. All these application domains have socio-economic importance.

Though the research activities mainly play a facilitating and enabling role to integrate MICM into ERA, the project will also deliver research results with a potential to be exploited and transferred to economy and society. The project exploitation planning activities comprise:

- Identification of 2 topics with exploitation targets, namely potential application domains for all principal results, potential products/services which can be based on the results, degree of maturity, ownership, where appropriate IPR protection and sharing mechanism, time-to-market, other parameters important for exploitation planning.
- New knowledge (exploitable results) will be detected.
- During the 3rd project year MICM will implement the exploitation planning for all detected items of exploitable results. The resulting Exploitation Plan will be included in the final project report.

An important element of the project exploitation strategy will be the pilot innovation sub-project to be implemented during the 3rd project year. The project will select one of the most promising and high impact research results and implement a set of innovation activities to bring it closer to the market. This will include business case development and business modelling, market research, IP regime definition, initial marketing, etc. In addition to using the exercise as a training tool for innovation capacity building, it will also ensure the exploitation of some of the project results.

Within the project it is planned to establish a Joint Virtual Laboratory and a spin-off company at MICM to extend the research results beyond the project framework. In addition, the spin-off company is supposed to give them the shape appropriate to the market.

The attention of regional as well as global actors is assumed to be attracted based on the dissemination and communication activities, which has already yielded first results. These include several universities, institutions and 3 AI companies in Georgia, the Horizon Europe consortium and a company in Europe (see section 1.2.5).

To measure the Impact of the GAIN project, the consortium applies the system of KPIs as given by the DoA. Tables 2 and 3 in the Appendix show the target and current values of Institutional KPIs to monitor the evolution

of MICM capacities and the KPIs for GAIN project respectively. Diagram 1 shows the dynamics of growth of research performance indicators of MICM in 2023 with respect to 2022.

## 2. Open Science

GAIN follows open science and research data principles as given in the Grant Agreement and DoA of the project. In the reporting period, 5 papers have been published in peer reviewed, open access journals and a repository. One paper was published in conference materials. Electronic copies of each published paper (see Appendix, Publications [1 – 6]), at the time of publication were available at the websites of the journals and repositories and immediate open access was provided. All publications were free of charge.
Data management plan (DMP) to manage the digital research data generated in the project, which was prepared (see deliverable _D 6.3. Data Management Plan, version 1) in 2023, is in line with the FAIR data principles. The updated version (D 6.4. Data Management Plan, version 2) will be submitted at the end of March 2024.
The datasets generated by the project (see Section 1.2.0.3 above) will be handled according to the above principles.

## 3. Deviations from annex 1 and annex 2 (if applicable)

### 3.1 Tasks/objectives

**Deviation in WP 1.**
The version of Deliverable D.1.2 "First report of Ethics Advisor", was submitted by the due date on 31 Mar 2023. It was rejected by the European Commission on 29 September 2023. In fact, the submitted version contained the Ethics Protocol itself and the process of its preparation, but the "Annex 1: Declaration on independence and absence of conflicts of interest", to be signed by the ethics advisor, was missing.
It was agreed upon with the project officer to prepare the deliverable in accordance with the EC template and submit it in due time. An updated version of deliverable D.1.2 First report of Ethics Advisor was submitted on 11 of October 2023.
**3.1.2. Deviation in WP 5.**
Deliverable D 5.1 "GAIN project website version 1" was submitted on 19 December 2022, while the due date was 30 November 2022. The new due date, 19 December, was agreed upon with the project officer. The reason for the delay was the following: it was agreed by the Project Steering Board of the project that the website should have the domain "eu" (www.gain-twinning.eu). Later it became apparent that this is problematic for Georgian citizens. The project partner DFKI suggested providing the hosting and it took some extra time due to technical issues. Note that a fully operative demo version was available long before the due date.

### 3.2 Use of resources

There were no deviations between the planned and actual use of resources *(compared with Annex 1)* regarding:

- Unforeseen subcontracting.
- Unforeseen use of in-kind contributions.
- Person-months per beneficiary/WP.
- Research component.
- Transfers between beneficiaries.
- Transfers between cost categories.

# 4. Appendix.

Publications, conference talks and presentations contain references to the European Union and the GAIN project and relevant acknowledgements[31].

## 4.1. Publications

All publications below are free of charge and open access.

1. **Philipp Müller, Michal Balazia** et. Al. MultiMediate'23: Engagement Estimation and Bodily Behaviour Recognition in Social Interactions. 10.1145/3581783.3613851, https://arxiv.org/pdf/2308.08256.pdf
2. **T. Saghinadze**. Constructing Convolutional Neural Networks with 90 Degree Rotational Equivariance and Invariance. Georgian Electronic Scientific Journal: Computer Science and Telecommunications 2023|No.1(63), p. 39 – 43. ISSN 1512-1232. https://gesj.internet-academy.org.ge/en/list_artic_en.php?b_sec=comp
3. S. Chobanyan, L. Chobanyan, Z. Gorgadze and **G. Ghlonti**. An Algorithm for Finding a Near-Optimal Rearrangement in the Steinitz Functional. Bulletin of TICMI. Vol. 27, No. 1, 2023, 21–27. http://www.viam.science.tsu.ge/others/ticmi/blt/vol27_1/3.pdf
4. N. Abzianidze, N. Dogonadze, **G. Ghlonti**, Z. Kipshidze. About knowledge delivery strategies for intelligent tutoring systems in mathematics and computer science. Bulletin of TICMI. Vol. 27, No. 1, 2023, 29–37, ISSN 1512-0082 http://www.viam.science.tsu.ge/others/ticmi/blt/vol27_1/4.pdf
5. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On one connection between the moments of random variables. Computer Science and Information Technologies CSIT 2023, September 25 - 30, 2023, Yerevan, Armenia. Book of abstracts https://csit.am/2023/proceedings/DMCA/DMCA_5.pdf
6. G. Baghaturia, **M. Menteshashvili**. Application of general integral of quasi-linear equation to solving of non-linear Cauchy problem. Bulletin of TICMI. Vol. 27, No. 2, 2023, 59–65. ISSN 1512-0082. https://www.emis.de/journals/TICMI/vol27_2/2%20Bagaturia_Menteshashvili_23_TICMI.pdf
7. G. Chelidze, S. Chobanyan, **G. Giorgobiani**, V. Tarieladze. Trigonometric series and the permutation sign convergence condition. *Accepted for publication in Analysis Mathematica*.
8. **Kachiashvili K.J., Kachiashvili J.K., Kalandadze R. M., Kvaratskhelia V.V**. Automatic diagnosis of lung diseases (pneumonia, cancer) with given reliabilities on the basis of an irradiation images of patients. *Submitted to the journal "Cancer Investigation".*
9. **T. Agrawal.** Robust and Efficient Multimodal Multi-dataset Multitask Learning. Submitted to AAAI (Association for the Advancement of Artificial Intelligence), 2023.
10. **N. Kukhilava, T. Tsmindashvili, R. Kalandadze, L. Ferrari, V. Strizhkova**. Multimodal emotion recognition with physiological signals and video. *Prepared to submit*.
11. **T. Tsmindashvili, N. Kukhilava, S. Katamadze, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth** Evaluation in EEG Emotion Recognition: State-of- *Prepared to submit* the-Art Review and Unified Framework. *Prepared to submit*.

## 4.2. Conference Talks

The conference talks are supported by the GAIN project. Presentations contain the logos of the EU and the project and the relevant acknowledgements (see https://www.gain-twinning.eu/?page_id=300)

1. **G. Giorgobiani, V. Kvaratskhelia, T. Saghinadze.** Mathematics of Artificial Intelligence. 2nd Int. Conf.: Science, Education, Innovations and Chemical Technologies – From Idea to Implementation. Tbilisi, Georgia, 23 – 24 November 2023. https://conference23iice.ge/
2. **N. Kukhilava, T. Tsmindashvili, R. Kalandadze, L. Ferrari, V. Strizhkova**. VideoMAE for Emotion Recognition. Second CERN-GTU collaboration meeting PMBC2023, 6 – 10 November 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
3. **T. Tsmindashvili, N. Kukhilava, S. Katamadze, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth**. Evaluation in EEG Emotion Recognition: State-of-the-Art Review and Unified Framework. Second CERN-GTU collaboration meeting PMBC2023, 6 – 10 November, 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
4. **S. Katamadze , T. Tsmindashvili, N. Kukhilava, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth**. Enhancing Emotion Recognition: EEG Evaluation and AI Models. DataFest Tbilisi 2023. 9 – 11 November, 2023, Tbilisi, Georgia. www.datafest.ge

[31] The authors with bold letters are the GAIN consortium members.

5. M. Kublashvili, **Z. Sanikidze, T. Saghinadze**, M. Kublashvili. On the Mathematical Aspects of the Numerical Calculation of Engineering Constructions Weakened by Cracks. Second CERN-GTU collaboration meeting PMBC2023, 6 – 10 November, 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
6. M. Zakradze, **Z. Tabagari**. Numerical analysis of some problems related to the calculation of electrostatic fields. Second CERN-GTU collaboration meeting PMBC2023, 6 – 10 November, 2023, GTU, Tbilisi, Georgia. https://indico.cern.ch/event/1334518/timetable/
7. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On One Connection Between the Moments of Random Variables. Computer Science and Information Technologies CSIT 2023, September 25 - 30, 2023, Yerevan, Armenia. https://www.csit.am/2023/schedule.php
8. **Kachiashvili K., Kachiashvili J., Kalandadze R., Kvaratskhelia V**. Automatic Diagnosis of Lung Disease on the Basis of an X-Ray Images of a Patient with Given Reliability. XIII International Conference of the Georgian Mathematical Union, Batumi, September 4-9, 2023. p. 140. http://gmu.gtu.ge/conferences/wp-content/uploads/2023/09/Conference_GMU_2023_01.09.pdf
9. **Kachiashvili K., Kachiashvili J., Kalandadze R., Kvaratskhelia V**. Automatic Diagnosis of Diseases on the Basis of an Irradiation Images of a Patient with Restrictions Both Type of Errors. The 4th International Conference on Modern Management based on Big Data (MMBD2023), August 1-4, 2023, Seoul, South Korea. p. 19 http://www.mmbdconf.org/
10. **Kachiashvili K., Kachiashvili J., Kalandadze R., Kvaratskhelia V**. The automatization of the medical diagnosis on the basis of an X-ray image of a patient with the restrictions of both possible errors on the desired levels. The International Conference "Distributed Computing and Grid Technologies in Science and Education", 3-7 July, 2023, Dubna, Russia. JINR Meshcheryakov Laboratory of Information Technologies. https://indico.jinr.ru/event/3505/attachments/16120/27954/program_GRID2023.pdf
11. **G. Giorgobiani**, G. Chelidze, V. Tarieladze. Rearrangement universality of the Dirichlet type series in a complex field. 14th ISAAC Congress. Ribeirão Preto, University of Sao Paulo, Brazil, 17 – 21 July, 2023. https://dcm.ffclrp.usp.br/isaac/abstracts.pdf
12. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On One Connection Between the Moments of Random Variables. Int. Conf. Applications of Stochastic Processes and Mathematical Statistics to Financial Economics and Social Sciences. November 15 –16, 2023, Tbilisi, Georgia
13. **V. Kvaratskhelia, G. Giorgobiani,** V. Tarieladze. Subgaussian Random Elements in Infinite Dimensional Spaces. XIII International Conference of the Georgian Mathematical Union. September 4 – 9, 2023, Batumi, Georgia. Book of Abstracts, p. 116. http://gmu.gtu.ge/conferences/wp-content/uploads/2023/10/Conference_GMU_2023_7.10_last.pdf
14. **V. Kvaratskhelia, G. Giorgobiani, M. Menteshashvili.** On One Connection Between the Moments of Random Variables. Ninth International Conference on Statistics for Twenty-first Century - 2023 (ICSTC-2023). 15-18 December 2023, Kerala University, India. https://sites.google.com/view/icstc2023/home
15. **V. Kvaratskhelia, G. Giorgobiani,** V. Tarieladze. Subgaussian Random Elements in Infinite Dimensional Spaces. The Fourth International Conference "Modern Problems in Applied Mathematics" dedicated to the 105th Anniversary of I. Javakhishvili Tbilisi State University (TSU) & 55th Anniversary of I. Vekua Institute of Applied Mathematics (VIAM). September 13-15, 2023, Tbilisi, Georgia.
16. **S. Katamadze, T. Tsmindashvili, N. Kukhilava, R. Kalandadze, L. M. Ferrari, P. Müller, B. E. Wirth**. Enhancing Emotion Recognition: EEG Evaluation and AI Models. Online I En, Data Zen Community. December 20, 2023, Tbilisi, Georgia. https://wearecommunity.io/events/enhancing-emotion-recognition-eeg-evaluation-and-ai-models

## 4.3. Abstracts of Presentations at the First Summer School

1. Evaluation in EEG Emotion Recognition: State-of-the-Art Review and Unified Framework.
   *Sub-task 1: AI Technologies for Human Behaviour Understanding, Emotions (face crop video, biosignals). Group 1: R. Kalandadze, N. Kukhilava, T. Tsmindashvili, S. Katamadze. Supervised by: F. Bremond, L. Ferrari (INRIA), P. Muller, B. Wirth (DFKI). Presented by R. Kalandadze and S. Katamadze.*
   ***Abstract:*** *The biosignals group presented the main content of a nearly finalized paper centered on Emotion Recognition derived from EEG signals. Delving into research conducted between 2018 and 2023 on EEG-driven emotion recognition, the team researched various studies, highlighting prevalent inconsistencies, which they elucidated using detailed statistics. It became apparent that the majority of inconsistencies stem from differing data pre-processing methods, types of data splits (like leave-one-trial-out or leave-one-*

*subject-out), evaluation standards, dataset usage and label choices. Such discrepancies hinder accurate comparisons among various studies. Consequently, the team's paper advocates for a unified approach, established upon their comprehensive review, ensuring streamlined data pre-processing, data split techniques, metrics, and label choices. The group has developed a framework that connects a full model training cycle from pre-processing to evaluation. This intuitive pipeline supports the application of cutting-edge models to popular datasets, furnishing foundational results and encouraging the integration of unique models and datasets. All of the above mentioned topics are a part of the paper and will be a part of the presentation, too.*

2. The newest achievements of AI in Emotion Recognition from Human Body Movements. *Sub-task 2: AI Technologies for Human Behaviour Understanding, Emotions (full body video)*
   *Group 2: I. Katchiasvhili, L. Tabagari. Supervised by: P. Muller, B. Wirth (DFKI). Presented by I. Kachashvili.*
   ***Abstract:*** *The primary objective of the project is to utilize the MPIIEmo dataset for the creation of a novel method or the enhancement of an existing one, aimed at identifying human emotions through full-body recognition. The research team has conducted extensive investigations in this field, meticulously reviewing numerous publications and analyzing the MPIIEmo dataset, known for its challenging perspectives and uniqueness. The team aspires to employ the "Multi-View Action Recognition using Contrastive Learning" method, which has demonstrated superior performance compared to the current state-of-the-art (SOTA) techniques for full-body action recognition. They will brainstorm potential contributions to the project, explore innovative approaches to the task in order to implement new methods and models that have not been previously explored.*
3. Exploring Image Captioning with Parameter-Efficient Transfer Learning for Vision Transformers. *Sub-task 3: Action detection/recognition (AI Technologies for Human Behaviour Understanding). Group 3: T. Saghinadze. Supervised by: F. Bremond, T. Agraval (INRIA). Presented by T. Saghinadze.*
   ***Abstract:*** *With the widespread adoption of transformer architecture, big new models emerged that could be repurposed for many downstream tasks using transfer learning. Full finetuning is the method of choice for achieving this goal. Due to the ever-increasing number of parameters, this approach requires a proportional increase in computational resources. That's why one can see significant developments in the research of parameter-efficient transfer learning. Most of these methods were developed with NLP tasks in mind. Adapter-based and similar methods show great promise; they significantly reduce the number of parameters that are needed to be retrained for downstream tasks while keeping the original parameters of the pre-trained model untouched.*
   *The goal of the project is to apply parameter-efficient transfer learning to other tasks that are not necessarily bound to the paradigm of NLP. A pre-trained vision transformer seems like a good starting point. Image captioning was taken as a midway point between NLP and CV. A basic encoder-decoder architecture (ViT&GPT2) with prefixed and suffixed tunable prompts in conjunction with bitfit and adapters was explored using COCOCaptiions as the training dataset.*
4. Georgian Pretrained Language Understanding Model. *Sub-task 5: AI Methods for Deep Speech Analysis in Health, NLP. Group: B. Mikaberidze, B. Tepnadze. Supervised by: P. Muller, H. Lindsay (DFKI). Presented by B. Mikaberidze.*
   ***Abstract:*** *Our primary goal is to develop the Pretrained Language Understanding Model for Georgian. In other words, we're focusing on Contextual Word-Embeddings, a crucial component for moving forward and advancing Natural Language Processing. This model can further be applied to almost all downstream Natural Language Understanding tasks, including Text Classification, Token Classification, Semantic Similarity, Relation Extraction, etc. Remarkably, such a Pretrained Language Model (PLM) can benefit the field of healthcare. If we fine-tune it on the Sentiment Analysis task, it can be utilized to process patient-doctor communications and detect the patient sentiment expressed in the interaction. As a training corpus, we intend to collect up to 0.5 billion tokens from sources like e-books, Wikipedia, and selective media platforms and 1.5 billion tokens of relatively noisier data from broader web scrapes. Additionally, our team is currently developing a benchmark dataset specifically for evaluating the sentiment analysis performance of models trained on Georgian. Such benchmarks for different downstream tasks are the most reliable way to evaluate PLMs in general. We hope our research will significantly enhance Georgian NLP and benefit downstream applications, starting with healthcare.*

5. Studying neural correlates of speech production using fMRI and NLP. *Sub-task 6: AI Methods for Deep Speech Analysis in Health - NLP-fMRI. Group 6: T. Giorgobiani, S. Tsagareishvili. Supervised by: P. Muller, H. Lindsay, B. Wirth (DFKI). Presented by T. Giorgobiani.*

   ***Abstract:*** *In this project we will attempt to apply NLP methods to a functional Magnetic Resonance Imaging (fMRI) experiment currently being conducted to study functional reorganization patterns after the transient suppression of the Broca's area, a vital region for language production. In this, experiment participants will do a language production task in an fMRI scanner after real inhibitory and placebo stimulation of the Broca's region with Transcranial Magnetic Stimulation (TMS). For the elicitation of speech, picture stories depicting different everyday scenes will be used. The participants will be asked to describe them with simple and complete sentences in German. For the transcription of the narratives Google-Speech-to-Text will be used. Afterwards the results of the transcription will be checked manually. Our main question from the neuroimaging standpoint is to see how the brain adapts itself and how the language network will be reorganized to support the perturbated area and speech production processes. However, it is also of great importance to see how the stimulation affected the performance on the language production task. Broca's area is known to be engaged in lexical, grammatical as well as phonological processing. Since the offline TMS stimulation (also called virtual lesion approach) is usually not enough to cause any noticeable changes in speech production, NLP methods can potentially better delineate the subtle differences between the conditions. In our presentation we will discuss the possibilities of using mainly syntactic and semantic measures to answer our research questions.*

   ***Acknowledgments****. Aside from the GAIN project, research is supported by a scholarship of the Advanced Research Opportunities Program (AROP) at the RWTH-Aachen University. The experiment is conducted at the RWTH-Aachen University Clinic with the supervision of Univ.-Prof. Dr. med. Ferdinand C. Binkofski and his team of Clinical Cognitive Sciences.*

## 4.4. List of conferences and seminars organized at MICM

1. *2022, December 21 – Scientific conference dedicated to the academician N. Vakhania.*
2. *2023, 14 February – Seminar "About Lothar Collatz (3n+1) problem". Speaker Dr. T. Jaoshvili.*
3. *2023, 21 February – Seminar "Universality of Rademacher series". Speaker Prof. S. Tetunashvili (GTU).*
4. *2023, 21 March – Seminar "Convergence and divergence of Fourier series with respect to the systems of compact group characters". Speaker Prof. G. Oniani (Kutaisi International University).*
5. *2023, 28 March – Seminar "Necessary and sufficient conditions of existence of a singular integral with Cauchy kernel. Speaker Dr. I. Machavariani.*
6. *2023, June 27 – Seminar "Real-time decision support with distributed contextual intelligence". Speaker Professor of Distributed Systems & Security at Deakin University, Melbourne, Australia, A. Zaslavky.*
7. *2023, December 5 – Seminar "The Set Ordering Method for Scoring the Outcomes of Testing in Computerized Adaptive Testing". Speaker Dr. S. Razmadze.*

## 4.5. Table 1.

Table 1.

| Sub-Project Leader | Sub-Projet Title | Sub-tasks | Researchers from MICM | Group |
|---|---|---|---|---|
| DFKI | AI Methods for Deep Speech Analysis in Health | NLP | B.Mikaberidze, B.Tepnadze | 5 |
| | | NLP-fMRI | T.Giorgobiani, G.Giorgobiani, S.Tsagareishvili | 6 |
| INRIA | AI Technologies for Human Behaviour Understanding | Action detection/recognition | T.Saghinadze, D.Datuashvili | 3 |
| | | Emotions | I.Katchiashvili, L.Tabagari (full body video) | 2 |
| | | | R.Kalandadze, N.Kukhilava, T.Tsmindashvili, D.Datuashvili, K.Kachiashvili, Z.Tabagari (face crop video, biosignals) | 1 |
| DFKI - INRIA | Pilot Research Project at MICM based on Mephesto Project | Clinical interviews with patients | K.Sulaberidze, E.Chkonia | 4 |
| | | Clinical annotation | S.Tsagareishvili, T.Giorgobiani | |
| | | ECSI annotation | E.Gaprindashvili | |
| Technical support at MICM | Technical support of all the Sub-Projects | | L.Tabagari, B.Oikashvili, Z.Sanikidze, G. Ghlonti, I.Katchiashvili, V.Berikashvili, Ts.Javakhishvili | |
| Research Management and Coordination at MICM | Overall research management at MICM | | G.Giorgobiani, V.Kvaratskhelia, M.Menteshashvili, Z.Sanikidze, V.Berikashvili | |

## 4.6. Key Performance Indicators.

Table 2. Institutional KPIs of MICM

| Number | Key Performance Indicators | Target for the end of project | Current |
|---|---|---|---|
| **Scientific performance** | | | |
| 1 | Number of peer reviewed publications | 25 | 31[32] |
| 2 | Number of peer-viewed publications per researcher | 1 | 1.1[33] |
| 3 | Number of presentations at scientific conferences | 30 | 45 |
| 4 | Number of publications/presentations co-authored by young researchers | 40 | 12 |
| 5 | Number of scientific conferences, workshops, symposia organized | 10 | 7 |
| 6 | Number of MSc and PhD dissertations defended | 5/3 | N/A yet |
| 7 | Number of researchers affiliated with the Joint Virtual Laboratory | 25 | N/A yet |
| 8 | Number of international project proposals submitted/accepted | 10/3 | 1/0 |
| 9 | Combined h-index of MICM researchers (sum) | 40 | h=80 Scopus, h=148 google sch. |
| 10 | Average “time-to-depreciation” of the MICM research equipment | 30 months | 36 |
| **Innovation performance** | | | |
| 1 | Number of patents (by category: world-wide, European, national) granted | 1/1/3 | N/A yet |
| 2 | Number of other IPRs protected (copyright, industrial design, etc.) | 3 | N/A yet |
| 3 | Number of spin-off companies established | 1 | N/A yet |

[32] In addition, 9 papers were accepted.
[33] There are 28 researchers at MICM.

| | | | |
|---|---|---|---|
| 4 | Number of knowledge transfer agreements and other types of licenses provided | 3 | N/A yet |
| 5 | Number of new products/services based on research results brought to the market | 3 | N/A yet |
| **Economic performance** | | | |
| 1 | Volume of the research budget (annual) | 0,7 MEuro | 0.242 MEuro |
| 2 | Share of competitive funding in the research budget | 50% | N/A yet |
| 3 | Share of non-governmental funding in the research budget | 10% | N/A yet |
| 4 | Share of international project funding in the research budget | 30% | 68% |
| 5 | Volume of funding accumulated in the Joint Virtual Laboratory thanks to GAIN | 150,000 euro | N/A yet |
| 6 | Return on Investments (through equity in spin-off companies, licensing, etc.) | 10,000 euro | N/A yet |
| 7 | Research budget per researcher | 15,000 Euro | 3,200 Euro |
| **Human Capital** | | | |
| 1 | Percentage of staff members with doctoral degrees | 60% | 80% |
| 2 | Average age of research staff | 45 | 60 |
| 3 | Age balance (percentage of researchers in age groups) | 40% under 40 | 24% |
| 4 | Percentage of women in research staff | 30% | 16% |
| 5 | Percentage of staff members acquired new skills | 75% | 37% |

Table 3. KPIs for the GAIN project

| No. | Key Performance Indicator | Target value | Current |
|---|---|---|---|
| 1 | Number of consortium staff members participated in the research mobility | 60 | 38 |
| 2 | Number of established contacts (research leads) with potential collaborators outside of the GAIN consortium | 100 | 15 |
| 3 | Number of committed strategic supporters (local and international) | 10 | N/A yet |
| 4 | Number of European organizations expressed interest to cooperate (LoI) | 20 | 6 |
| 5 | Number of research proposals where MICM is invited to participate | 10 | 1 |
| 6 | Number of research events organized by the project | 11 | 6 |
| 7 | Number of research papers (non peer-reviewed/peer-reviewed) published on the basis of results received through the TRIP implementation | 45/25 | 1/5[34] |
| 8 | Number of PhD candidates submitted their theses under double supervision | 3 | N/A yet |
| 9 | Number of young researchers participated in the project activities and trained through the project | 15 | 19 |

[34] In addition, 1 paper was accepted, 2 – submitted, 2 prepared for submission.

Diagram 1. Dynamics of growth of research performance indicators of MICM