



MINE.IO

A Holistic Digital Mine 4.0 Ecosystem



KGHM



Łukasiewicz
Instytut Tele-
i Radiotechniczny



Łukasiewicz
Instytut Technik
Innowacyjnych
EMAG



AGH

Flotation froth content estimation on the basis of Machine Learning process

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Co-funded by
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SCPOC2024 29.06 – 03.09.2024 Strbskie Pleso, Slovakia

Agenda

- Mine.io EU Project
- **Digital Flotation System - Artificial Intelligence technology for monitoring and control of metal ore processing** – task of Ł-ITR, Ł-EMAG, AGH, KG
- Photonic-IT (PIT) System
- Linear Discriminant Analysis in the Machine Learning process
- Estimation of the flotation froth content



EU Project MINE.IO „A Holistic Digital Mine 4.0 Ecosystem”,

Technical solutions for strategic processing and waste management

Task: Artificial Intelligence technology for monitoring, control of metal ore processing

Ł-ITR, Ł-EMAG, AGH, KGHM



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Mine.io aims to provide solutions that will build a novel mining digital ecosystem and a systemic structure for the implementation of Industry 4.0 in mining industrial environments.

25 partners

7 pilot use cases

€14M budget

42 months



Increase of
energy efficiency
and production



Digitization of all
mine procedures



Waste
reduction and reuse



Workload
optimization



Application
marketplace



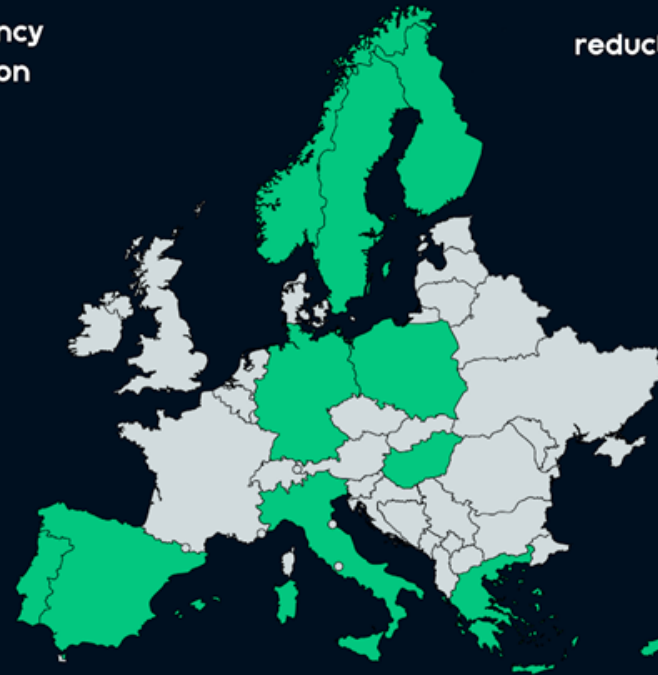
Environmental
footprint reduction



Workflow
automation



Electrification of
underground trucks



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Project focused on the technology pilots

- Mine.io I4.0 Asset Digitalization: Digitalizing Drill Operations, Advancing Digital Mining Maintenance (**Germany**)
- Digital Smelter - Demonstrating an array of digitalization techniques at pilot scale with regard to smelting processes (**Germany**)
- **Digital Flotation System - Artificial Intelligence technology for monitoring and control of metal ore processing (Poland)**
- Geochemical Mapping of Soils and Mining Wastes in Lavrion Historic Mine Site – Post Mining Environmental Management (**Greece**)
- Multi-Source Data Fusion and Interpretation for Surveillance of tailings embankments (**Finland**)
- Advanced Mobility (Autonomous and Electrified Vehicles) and Operational Excellence (**Germany**)
- In-Situ Underwater Exploration Technology Validation for Water-Filled Mines (**Portugal**)

Task: Artificial Intelligence technology for monitoring, control of metal ore processing

Łukasiewicz – Tele and Radio Research Institute

Łukasiewicz – EMAG

AGH

KGHM

Objectives:

Hardware:

Photonic-IT (PIT) System development

Software:

PIT system control software development

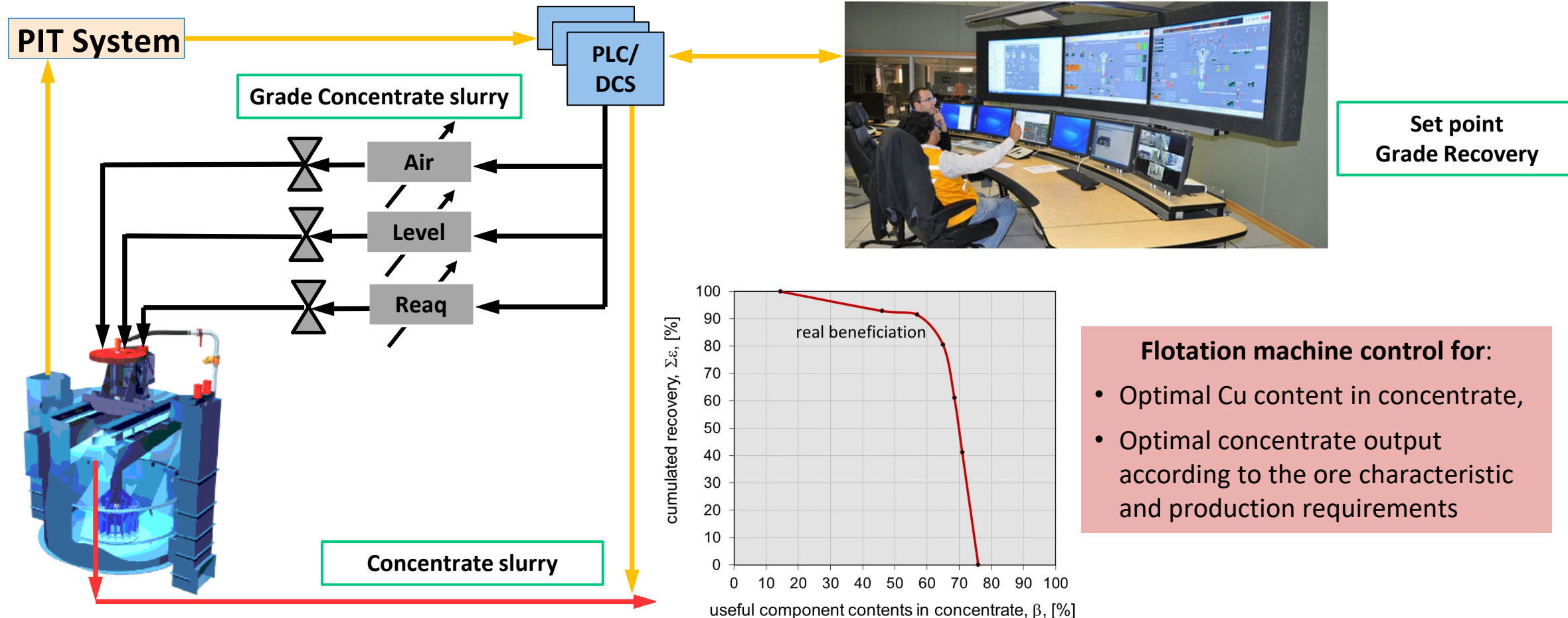
ML and AI algorithms and software development

Technology:

Flotation technology adjustment for the ML process

Fast froth content measurements technology for the ML process

PIT System in KGHM Mineral Proc. Plant



Designing of Pilot process in KGHM

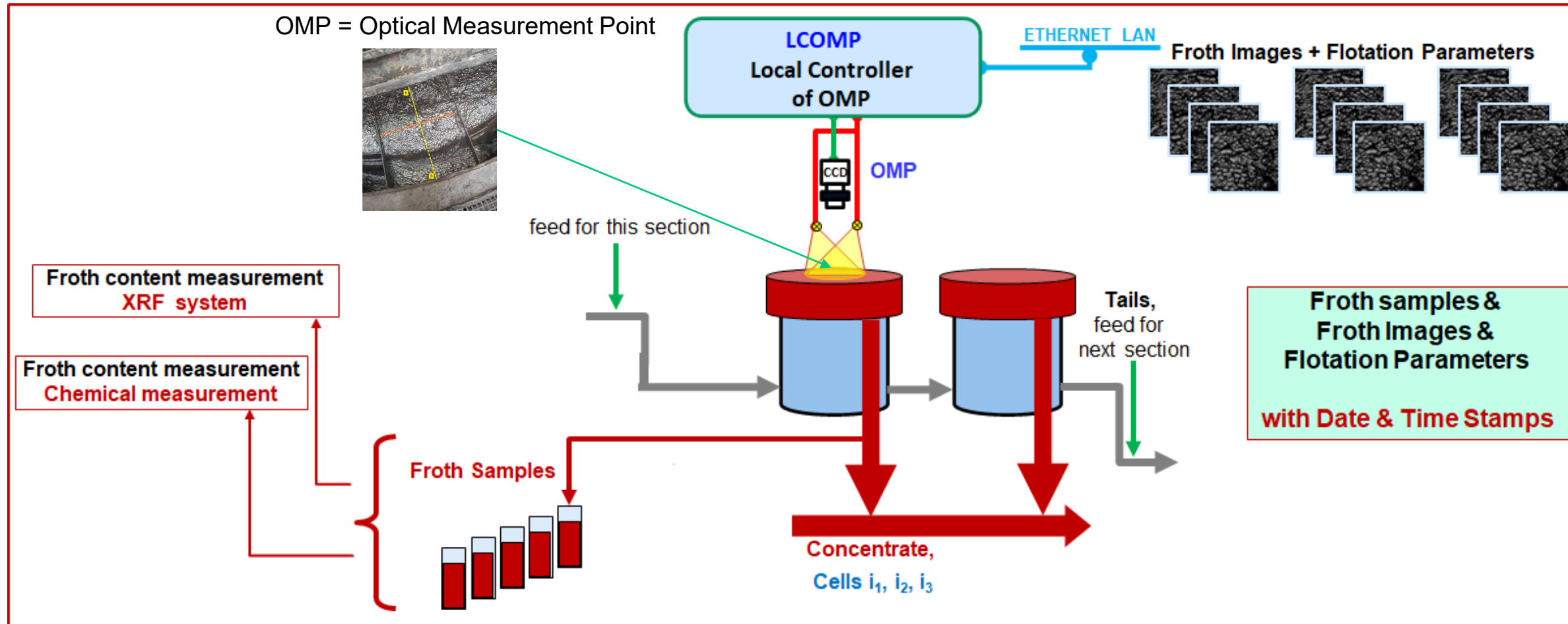
Flotation Machine



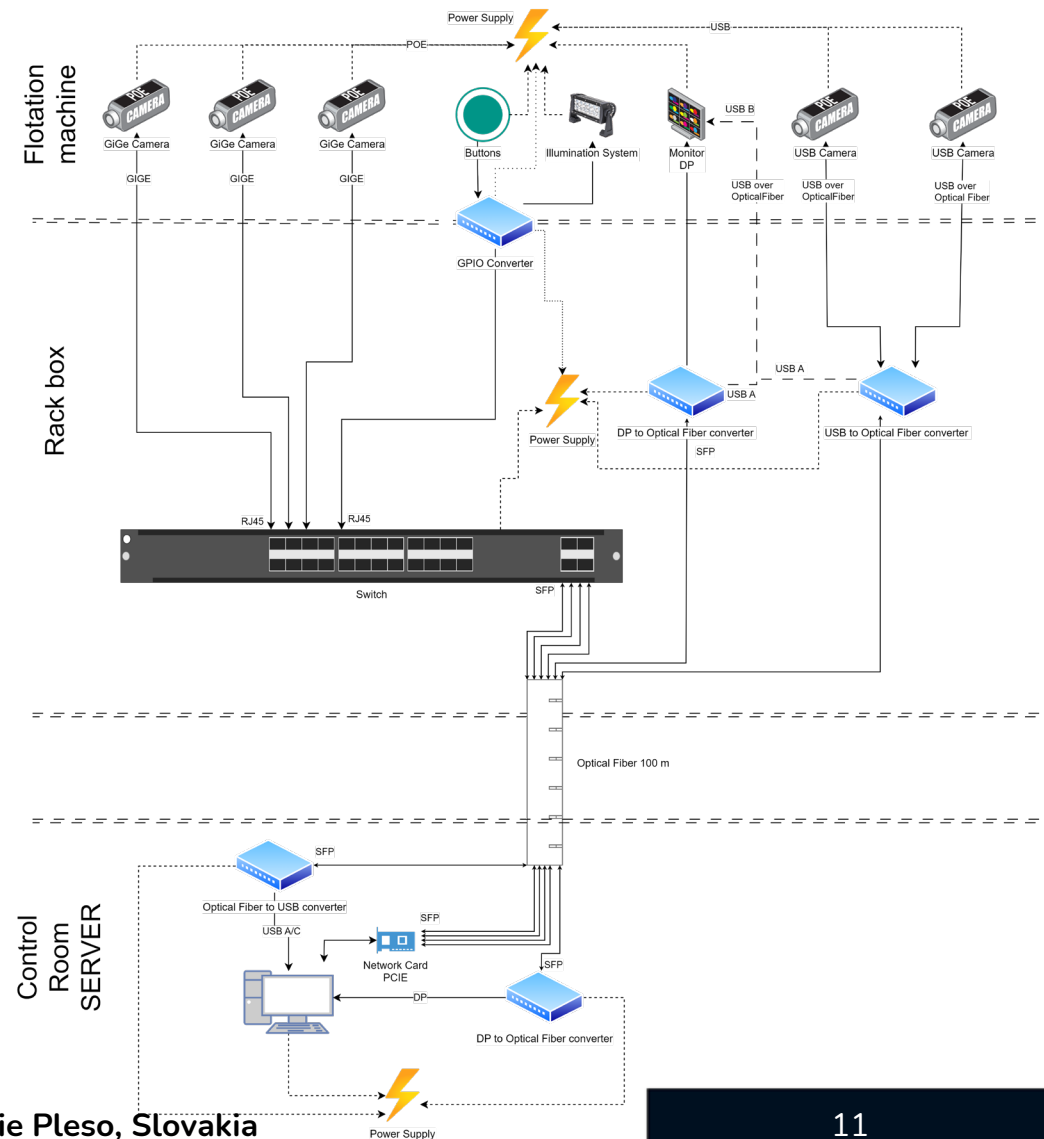
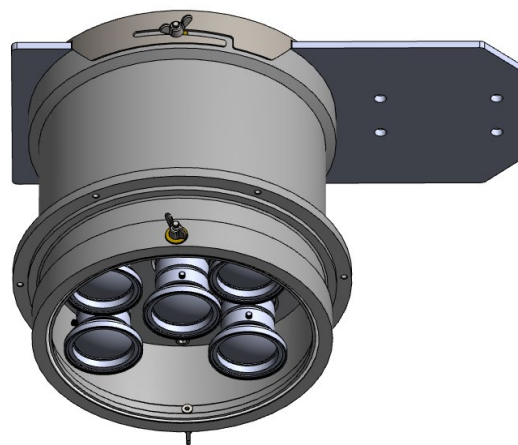
- Definition of technical, organizational and IT requirements for the Pilot process in KGHM
- Selection of a flotation machine for ML process

Designing of Pilot process in KGHM

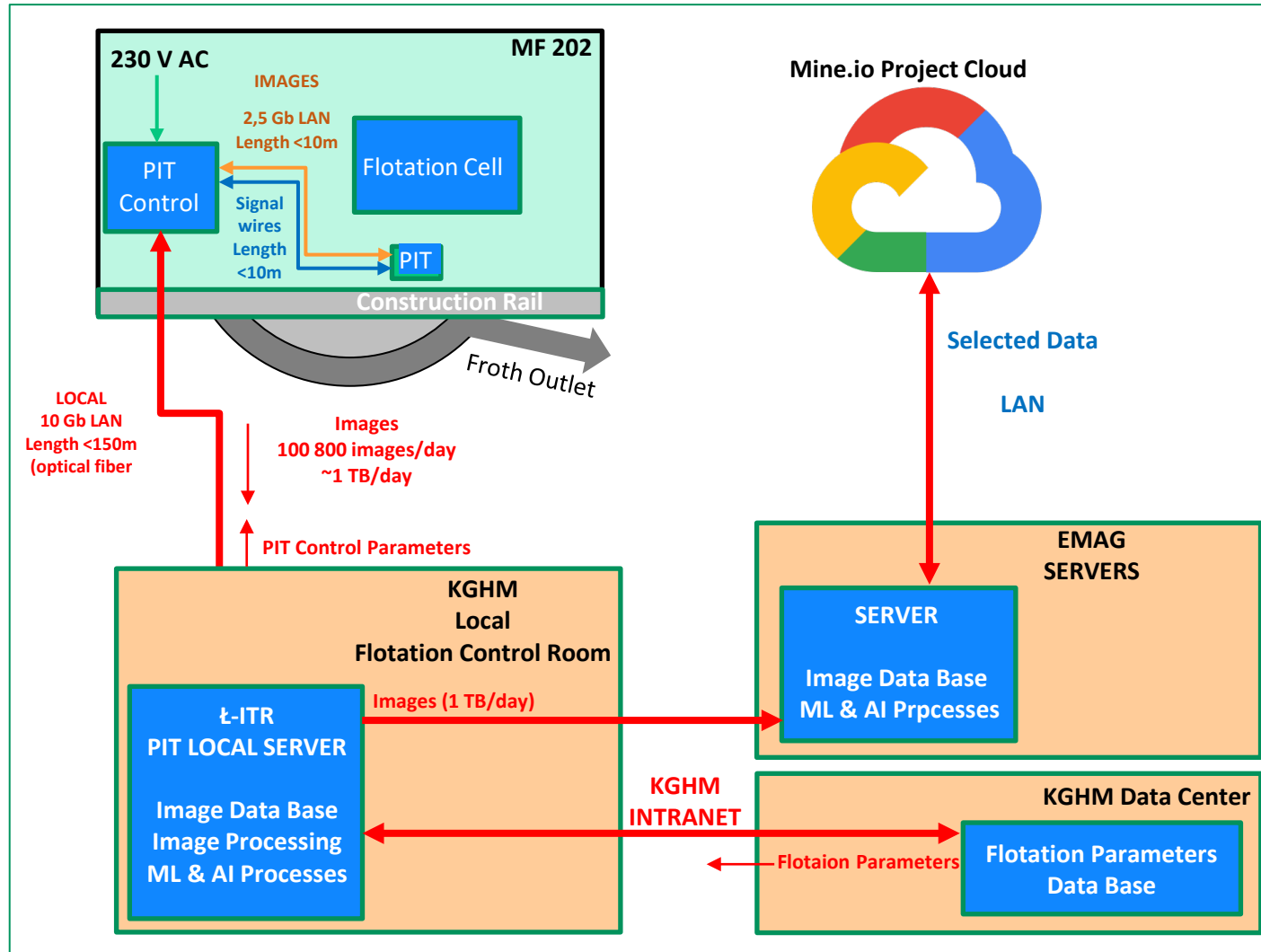
Designing of Machine Learning process



Photonic-IT (PIT) System

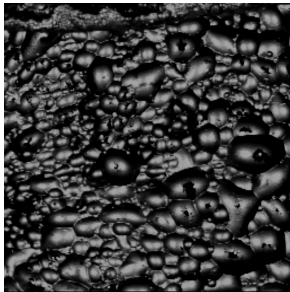


PIT System Architecture

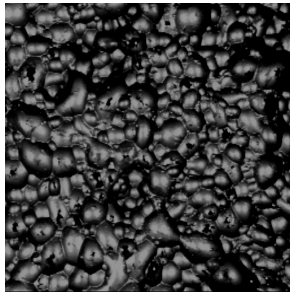


Linear Discriminant Analysis in Machine Learning process

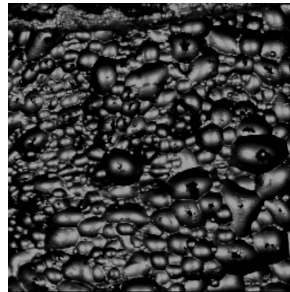
- **Dataset of images registered in Pb Mineral Processing Plant**
- **Data characteristics**
 - 1435 images
 - 7 Classification Groups – 205 images per group, 70 Chemical Groups
 - Each image described by 96 parameters
- **Examples of images in different Classification Groups**



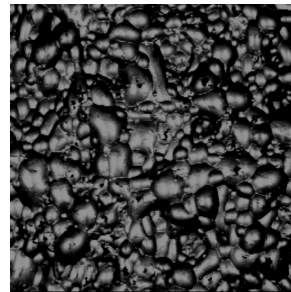
Group 1



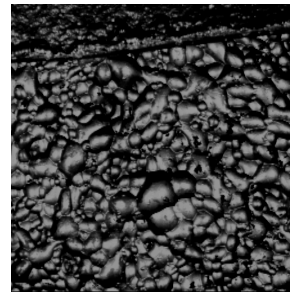
Group 2



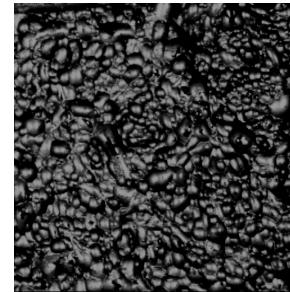
Group 3



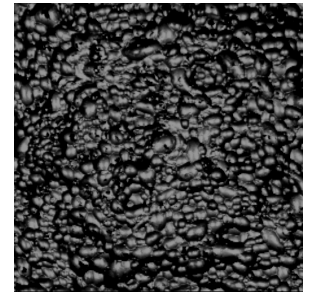
Group 4



Group 5

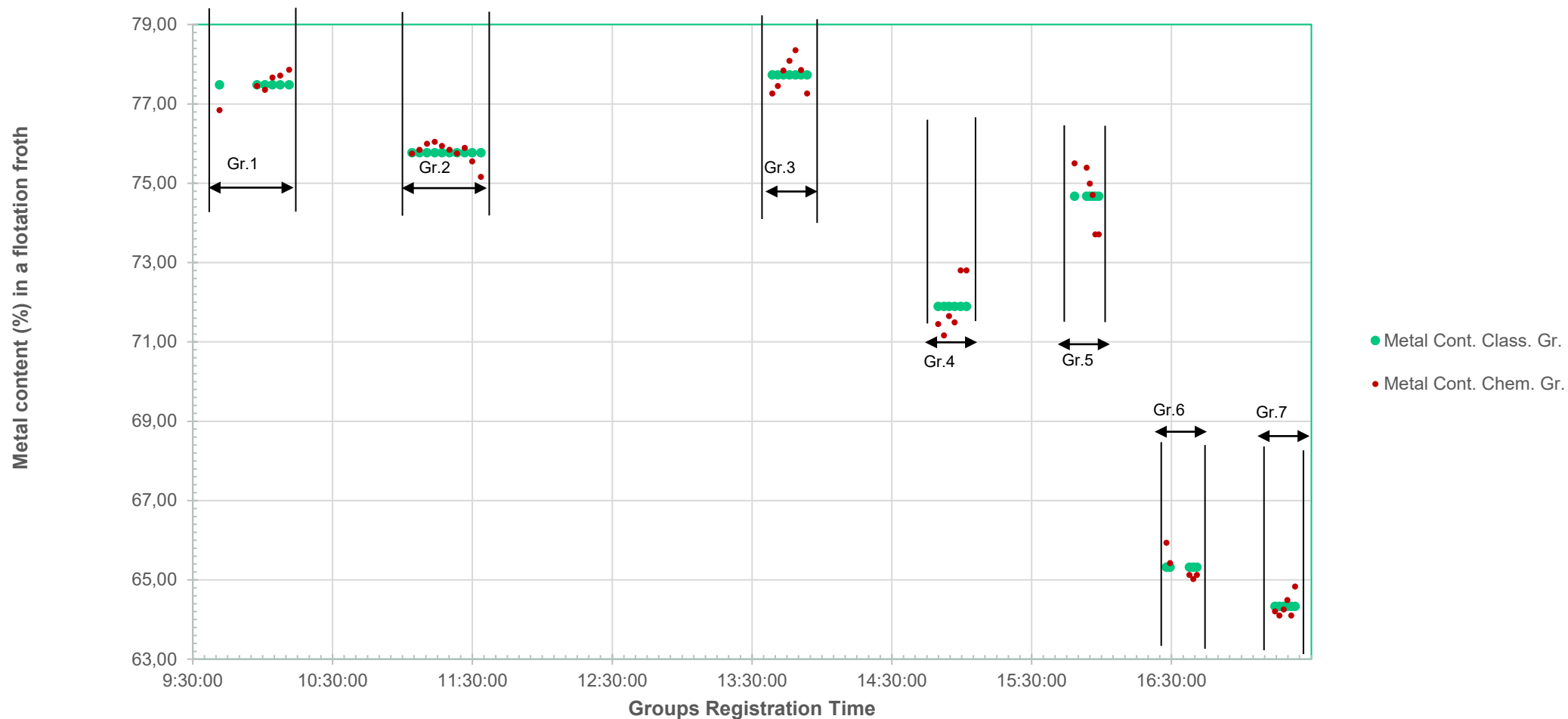


Group 6

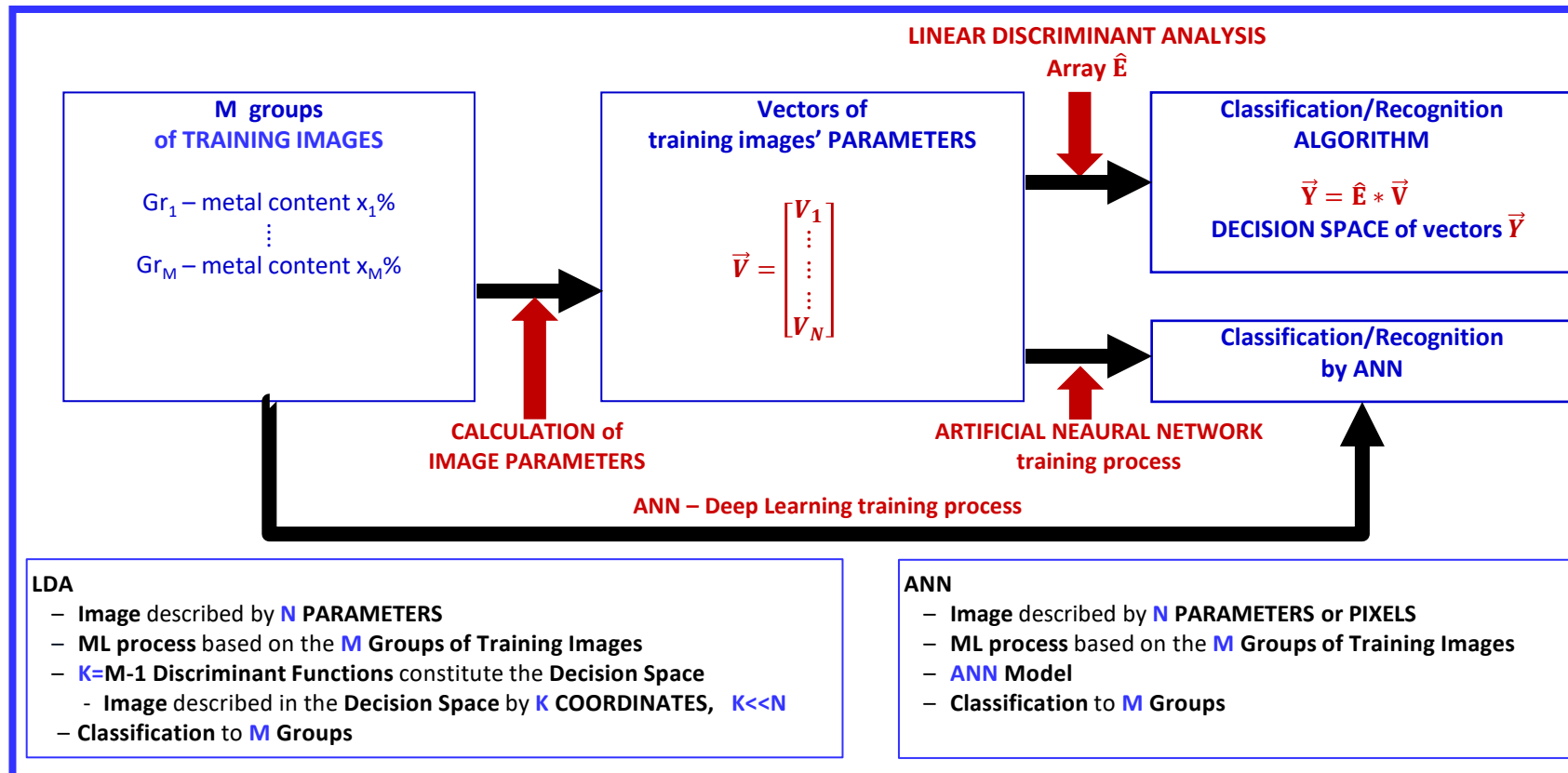


Group 7

Metal content in Classification and Chemical Groups



ML & AI Processes



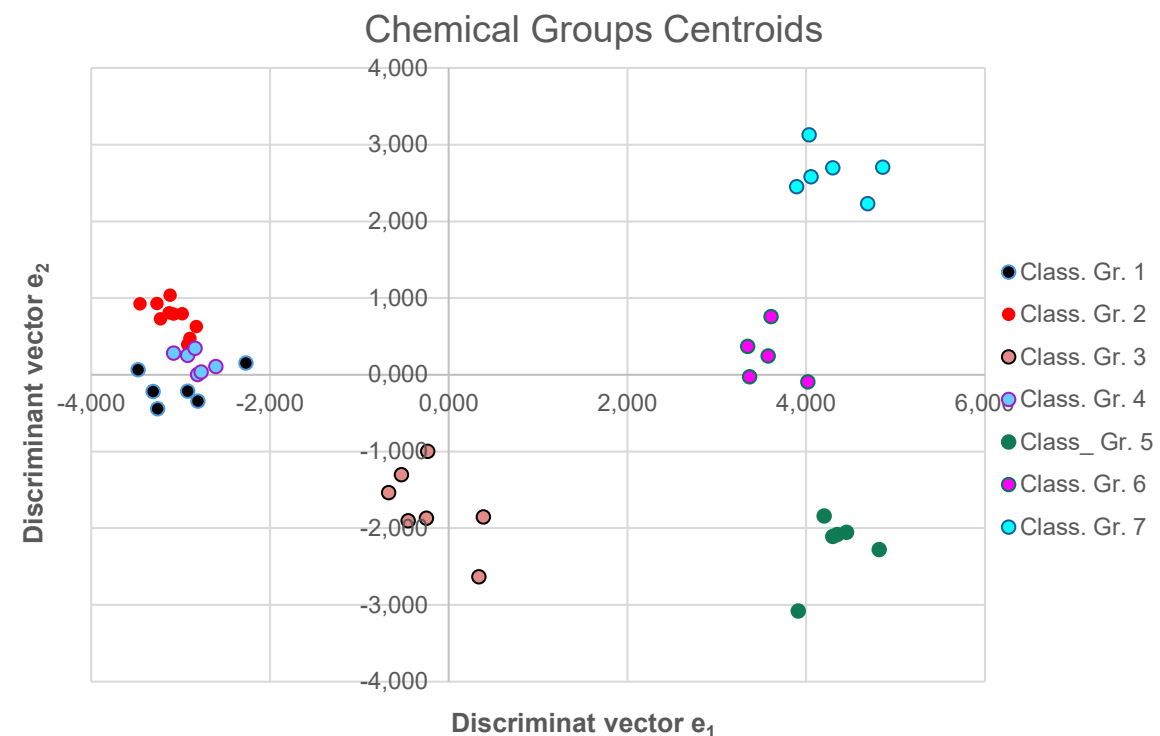
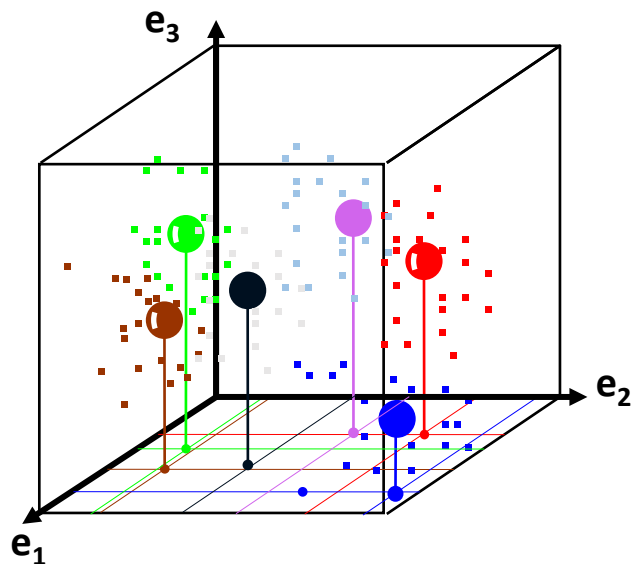
ML Process

Definition of RELATIONS
between
Froth Content
and
Froth Image Parameters

AI Algorithms

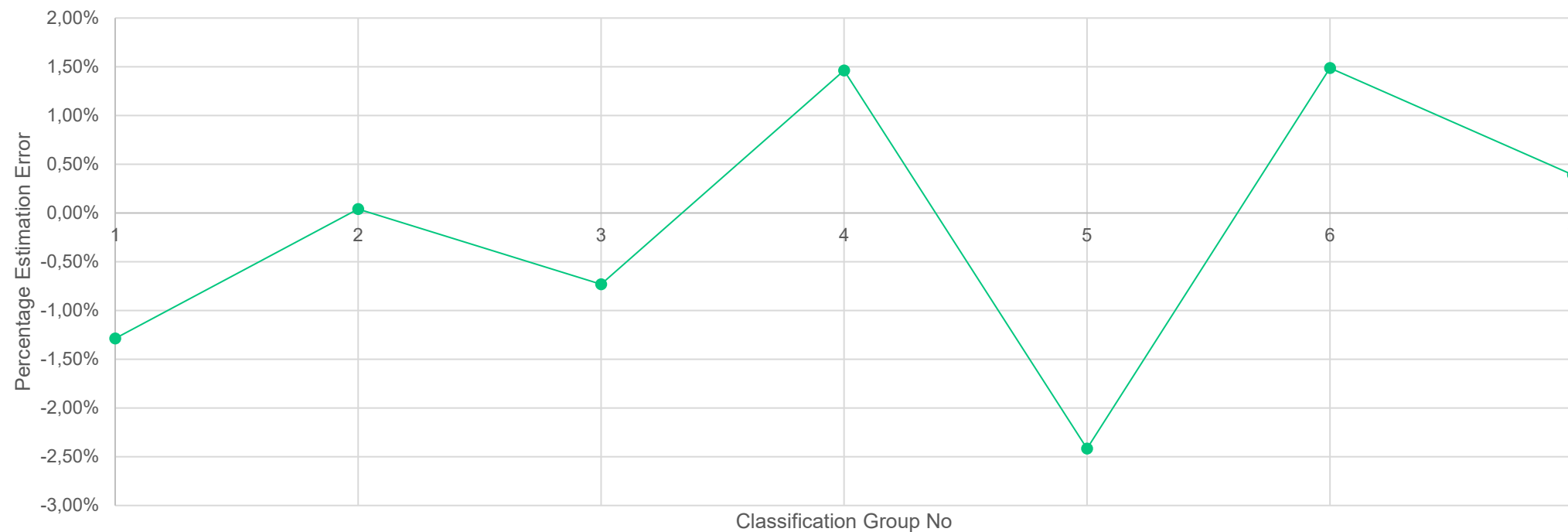
From classification
of froth images
to
Estimation
of the Cu content in froth images

Decision Space (6 dimensions)

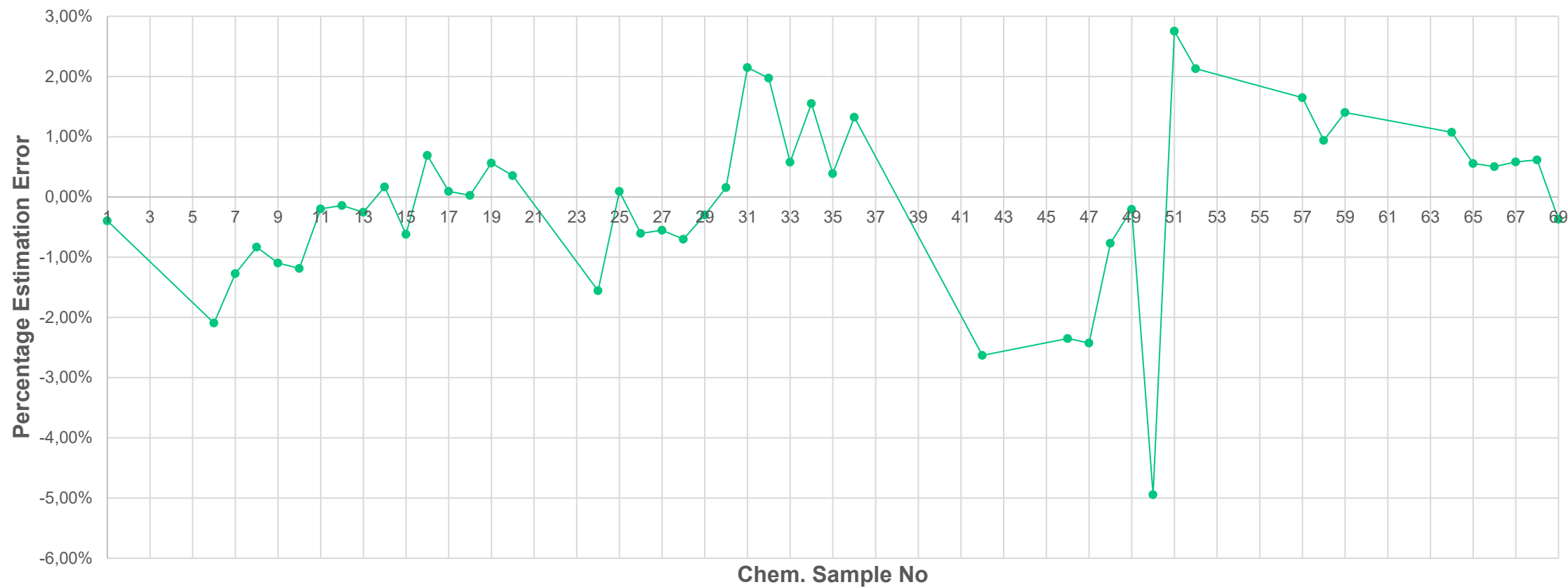


Schematic presentation of the Decision Space.

Percentage Error of Metal Content Estimation for Classification Groups



Percentage Error of Metal Content Estimation for Chemical Groups



Acknowledgments

The research is the result of the EU project „A Holistic Digital Mine 4.0 Ecosystem” and was financed by the project funds.

Call: **HORIZON-CL4-2022-RESILIENCE-01**
(A DIGITISED, RESOURCE-EFFICIENT AND RESILIENT INDUSTRY 2022)

Topic: **HORIZON-CL4-2022-RESILIENCE-01-06**

Type of Action: **HORIZON-IA**

Proposal number: **101091885**

Proposal acronym: **Mine.io**

Type of Model Grant Agreement: **HORIZON Action Grant Budget-Based**



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Thank you for your attention



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