Virtual Technical Courses prior to Minería Digital 2026

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Monday, August 3

	PRE-CONGRESS ACTIVITIES	
	ONLINE	
	Virtual Technical Courses | Free Access for Registered to The Congress	
10:00 – 14:00	ENG **AI-Driven Critical Minerals Processing: From Mineralogy to Digital Simulation** **Dr. Selo Ndlovu**, Professor in the School of Mining Engineering and Mineral Resources at the University of Arizona, USA; **Dr. Thandie Moyo**, Assistant Professor of Energy and Mineral Engineering at The Pennsylvania State University, USA; **Dr. Nathalie Risso**, assistant professor in the School of Mining Engineering and Mineral Resources at the University of Arizona; and **César Araujo**, Doctor of Industrial Chemistry and Reaction Engineering	THE UNIVERSITY OF ARIZONA
14:00 – 17:00	SPA **Advanced tools for monitoring battery health and range to support decision-making in mining electromobility** **Dr. Kevin Espinoza**, Engineer, Advanced Mining Technology Center (AMTC), Universidad de Chile **Jorge García**, Researcher, Centro de Aceleración Sostenible de Electromovilidad (CASE), University of Chile **Francisco Jaramillo**, Researcher, Centro de Aceleración Sostenible de Electromovilidad (CASE), University of Chile **Diego Troncoso**, Engineer, Centro de Aceleración Sostenible de Electromovilidad (CASE), University of Chile	amtc

Tuesday, August 4

	PRE-CONGRESS ACTIVITIES
	ONLINE
	Virtual Technical Courses | Free Access for Registered to The Congress
10:00 – 13:00	SPA **AI and Machine Learning in Mining Geomechanics: Open-Pit and Underground Mining** **Gonzalo Bouldres,** Academic, University of Atacama **Julie Supanta,** Professor, University of Tarapacá
14:00 – 17:00	ENG **Machine Learning in Industrial Processes: Key aspects for Safety, Reliability and Efficiency** **Gustavo Pessin**, Full Researcher, Vale Institute of Technology

AI-Driven Critical Minerals Processing: From Mineralogy to Digital Simulation

School of Mining Engineering and Mineral Resources, The University of Arizona in collaboration with Metso, Finland

WHEN	LENGUAGE	LENGTH
Monday, August 3rd, 10 AM	English	4 hours

DESCRIPTION

This course provides an overview on the design of adaptive flowsheets for the recovery of critical minerals from unconventional resources, such as mine tailings. The course emphasizes the integration of hydrometallurgy, Artificial Intelligence (AI) and Machine Learning (ML) principles, and real-life simulation software HSC. Participants will gain an understanding of how mineralogical properties inform process selection, how to use data-driven methods to support flowsheet design, and how to evaluate process performance under circular economy principles

GENERAL OBJETIVES

Understand how mineralogical characteristics influence the selection and performance of critical minerals processing flowsheets.

Apply digitalization, AI/ML concepts, and HSC simulation tools to support adaptive process design and decision-making.

CONTENT AND PROGRAM

10:00 - 11:00	**Understanding Unconventional Feedstocks: challenges and opportunities** 1. Mineralogy-Driven Constraints on Flowsheet Selection 2. Process Behavior and Flowsheet Design	Dr. Selo Ndlovu & Dr. Thandie Moyo
11:00 - 11:10	Questions and discussion Module 1	
11:10 - 11:20	Break 1	
11:20 - 12:00	**Fundamentals of Artificial Intelligence and Machine Learning in Mineral Processing**	Dr. Nathalie Risso

12:00 - 12:10	Questions and discussion Module 2	
12:10 - 12:20	Break 2	
12:20 - 13:10	**Process Design and Optimization in HSC: Demo**	Cesar Araujo
13:10 – 13:50	**A Hydrometallurgy Case Study in HSC**	Cesar Araujo
13:50 – 14:00	**Questions and discussions Module 4**	Cesar Araujo

LECTURERS BIOS

Dr. Sehliselo (Selo) Ndlovu is a Professor in the School of Mining Engineering and Mineral Resources at the University of Arizona. She holds a BSc in metallurgical engineering from the University of Zimbabwe and a PhD in minerals engineering from Imperial College London, UK. She has over 20 years of experience in extractive metallurgy and hydrometallurgy, focusing on sustainable recovery of critical and precious metals from diverse sources. Ndlovu is internationally recognized for research in mineral characterization, leaching and bioleaching, solvent extraction, processing of low-grade and refractory ores, and valorization of mine tailings, metallurgical waste, and acid mine drainage. Her work integrates mineral–solution and mineral–microbe interactions with process and flowsheet development to enable scalable metal recovery technologies for rare earth elements, copper, cobalt, platinum group elements, and gold.

Dr. Nathalie Risso is a tenure-track assistant professor in the School of Mining Engineering and Mineral Resources at the University of Arizona and directs the Mine Automation and Autonomous Systems Laboratory. Her work focuses on integrating automation and cyber-physical systems to enable autonomous behavior in safety-critical mining environments. Her research emphasizes solutions for harsh, low-connectivity conditions where safety, robustness, and human–autonomous systems collaboration are essential. Risso received the 2023 SME Freeport-McMoRan Inc. Career Development Grant for research on AI-driven cyber-physical systems for mining applications.

Cesar Araujo, PhD, is a Doctor of Industrial Chemistry and Reaction Engineering with over 15 years of experience in process modeling and simulation across electrochemistry, oil refining, renewable fuels, and metallurgy. He has more than 10 years of R&D experience managing large-scale modeling projects and collaborating with diverse stakeholders. His current work focuses on process digitalization and the application of machine learning and artificial intelligence to process modeling and optimization, integrating chemical and metallurgical engineering with advanced modeling techniques. His main interests include Physics-Informed Neural Networks, Deep Reinforcement Learning, and Scientific Machine Learning.

Dr. Thandazile Moyo is an Assistant Professor of Energy and Mineral Engineering at The Pennsylvania State University and an expert in sustainable metal extraction from primary and secondary resources. She earned her Ph.D. in Chemical Engineering from University of Cape Town and combines fundamental research with industrial experience in gold plant operations. Her research focuses on responsible recovery of critical minerals using multiscale studies, electrochemical analysis, and advanced leaching techniques to optimize processing of complex ores and electronic waste. Her work integrates molecular-level methods such as Density Functional Theory (DFT) and X-ray Photoelectron Spectroscopy (XPS) with tank, heap, and pressure leaching studies. Through process mineralogy, she also advances the use of mining by-products, including coal-derived materials, for circular economy applications, linking surface science with industrial-scale processing to improve resource recovery and environmental stewardship.

Advanced tools for monitoring battery health and self-sufficiency to support decision-making in mining electromobility

Advanced Mining Technology Center (AMTC), University of Chile in collaboration with Centro de Aceleración Sostenible de Electromovilidad (CASE), University of Chile

WHEN	LENGUAGE	LENGTH
Monday, August 3rd, 14 PM	Spanish	3 hours

DESCRIPTION

The course is designed to introduce key concepts and advanced tools for monitoring the condition and range of batteries in mining electromobility. It covers indicators such as State of Charge (SoC), State of Health (SoH), and State of Maximum Power Available (SoMPA), along with online estimation methodologies, predictive inference, and operational data analysis, with the aim of anticipating critical events, evaluating energy self-sufficiency, and supporting decision-making in the management of electric mining fleets.

GENERAL OBJECTIVES

Introduce condition indicators related to monitoring the status and range of batteries in mining electromobility applications.

Review tools and methodologies for online estimation, predictive inference, and uncertainty characterization of these indicators.

Explore the use of these indicators and tools in assessing energy self-sufficiency and making decisions regarding the management of electric mining fleets.

CONTENT AND PROGRAM

14:00 - 14:50	**Module 1** **Real-time monitoring of battery vital signs, prediction of battery life and degradation**	Kevin Espinoza Francisco Jaramillo
14:50 - 15:00	Questions and discussions Module 1	
15:00 - 15:10	Break 1	
15:10 - 15:50	**Module 2** **Characterization of operating cycles, instantaneous electrical power, and energy consumption in mobile mining equipment**	Diego Troncoso
15:50 - 16:00	Questions and discussions Module 2	
16:00 - 16:10	Break 2	
16:10 - 16:40	**Module 3** **Case Study: Range of Self-Sufficiency Estimator for Electric Vehicles Using Physics-Based Models and Machine Learning Algorithms**	Jorge García
16:40 - 16:50	Questions and discussion Module 3	
16:50 - 17:00	**Conclusions and Closure of the Course**	

LECTURERS BIOS

Kevin Espinoza Oyanedel holds a degree in Civil Electrical Engineer and is a Master of Engineering Science, with a concentration in Electrical Engineering, from the University of Chile. Experience in research on tools for efficient estimation and forecasting of the state of charge in lithium-ion batteries, with applications in electromobility. He currently works as an engineer on electromobility projects in underground mining at the Advanced Mining Technology Center (AMTC), focusing on the technical analysis of charging technologies and the sizing of electrical infrastructure.

Jorge García Bustos holds a degree in Electronic Civil Engineering and is a Ph.D. candidate in Electrical Engineering at the University of Chile. His research focuses on developing advanced methodologies for diagnosing, predicting, and managing the health and range of lithium-ion batteries in electric vehicles, using

artificial intelligence and physical modeling techniques. He is a researcher at the Center for Sustainable Electromobility Acceleration (CASE), where he actively participates in fleet electrification projects in underground and urban mining. He has over four years of experience in electromobility, fleet optimization, data analysis, and decision support systems. He has led the development of tools for real-time monitoring of electric vehicles, integrating predictive models with industrial applications.

Francisco Jaramillo Montoya holds a bachelor's degree in Electrical and Civil Engineering from the University of La Frontera (Temuco, Chile) and a Ph.D. in Engineering from the University of Chile (Santiago, Chile). He currently works as a postdoctoral researcher at the Center for Sustainable Electromobility Acceleration (CASE). His research focuses on machine learning, control systems, and fault diagnosis and prediction using Bayesian algorithms. These methodologies have been developed and applied in various engineering contexts, including wastewater treatment using pilot-scale biological reactors, estimating the state of charge and predicting discharge time in lithium-ion batteries, and monitoring the structural health of wind turbine blades.

Diego Troncoso Kurtovic holds a degree in Electrical Civil Engineering and a Master of Science in Engineering with a concentration in Electrical Engineering from the University of Chile. He has experience in applied research on lithium-ion batteries, data processing for the analysis of health indicators, and electromobility projects in open-pit mining. He has also served as a coordinator for grant applications for electromobility and decarbonization projects in mining. He currently works as a project engineer at the Center for Sustainable Electromobility Acceleration (CASE), conducting research on second-life batteries, modeling of electric mining vehicles, and electromobility in open-pit and underground mining.

AI and Machine Learning in Mining Geomechanics: Open-Pit and Underground Mining

University of Tarapacá, Chile, in collaboration with University of Atacama, Chile

WHEN	LENGUAGE	LENGTH
Tuesday, August 4th, 10 AM	Spanish	3 hours

DESCRIPTION

Nowadays mining operations face more complex geotechnical conditions, both in open-pit mining (more challenging overall slopes, interaction with groundwater, and the effects of blasting) and in underground mining (deeper deposits, higher in-situ stresses, pillar/rib stability, and seismic hazards). In this scenario, operational continuity and safety depend on risk management that combines geomechanical understanding, monitoring, and informed decision-making. At the same time, digital transformation has increased the availability of data from geotechnical instruments and OT–IT systems (radar, prisms, InSAR, extensometers, microseismic data, and blasting records), thereby enabling the use of advanced analytics and artificial intelligence to support geomechanical risk management.

This technical course addresses the application of artificial intelligence in mining geomechanics as a tool for analyzing and modeling rock mass behavior, providing a technical and applied framework for integrating AI and machine learning into real-world operational contexts. The approach is practical, addressing diagnosis, forecasting, and decision support, including early warning systems, definition of risk thresholds, prioritization of inspections, and strengthening of response plans.

GENERAL OBJETIVES

Explain the main geomechanical conditions encountered in modern mining.

Understand the fundamentals of AI and machine learning techniques as applied to mining geomechanics.

Analyze real-world examples of AI and machine learning applications in mining geomechanics.

CONTENT AND PROGRAM

10:00 - 11:00	**Module 1** **Introduction to Mining Geomechanics**	Julie Supanta Quispe
11:00 - 11:10	Questions and discussions Module 1	
11:10 - 11:15	**Break 1**	
11:15 - 12:45	**Module 2** **Practical Applications of AI and Machine Learning in Mining Geomechanics**	Gonzalo Bouldres Vargas
12:45 - 12:55	Questions and discussions Module 2	
12:55 - 13:00	**Conclusions and Closure of the Course**	

LECTURERS BIOS

Julie Supanta Quispe holds a bachelor's degree in Mining Civil Engineering from the Univeristy of Atacama and a Master's degree in Geotechnical Engineering. She has professional experience in major mining operations, including Compañía Minera Doña Inés de Collahuasi and Radomiro Tomic. She currently serves as a professor in the Department of Mechanical Engineering at the University of Tarapacá, teaching courses in areas related to mining and materials analysis. In addition, she manages multiple service-provision projects, collaborating with public entities and private-sector companies on initiatives related to engineering, mining, and technological development.

Gonzalo Bouldres Vargas holds a bachelor's degree in Mining Engineering and a Master's degree in Industrial Engineering. He is currently pursuing a Master's degree in Data Science and Artificial Intelligence, as well as a degree in Mathematical and Computer Engineering. He serves as a faculty member in the Department of Mining Engineering at the University of Atacama, specializing in geomechanics, geotechnics, underground mining planning, and data science applied to mining. He has served as a geomechanical consultant on underground and open-pit mining projects, developing numerical modeling, stability analysis, and support design. He is the founder of the Mining Excellence Group in Digital Transformation, an initiative aimed at promoting digital technologies, advanced analytics, and artificial intelligence applied to mining.

Machine Learning in Industrial Processes: Key aspects for Safety, Reliability and Efficiency

Gustavo Pessin
Full Researcher, Vale Institute of Technology

WHEN	LENGUAGE	LENGTH
Tuesday, August 4th, 14 PM	English	2,5 hours

DESCRIPTION

Soft sensors are models that allow estimating the values of a variable based on other process information, without having to measure this variable directly. The main benefits of soft sensors are (1) they represent a low-cost alternative when compared to physical sensors, (2) they can work together with physical sensors, including to identify when they fail, (3) they allow implementation on existing devices, and (4) they provide real-time estimates, being an option for measurements where physical sensors depend on time-consuming analysis. In this tutorial, we are going to learn how to develop a data-driven soft sensor using Python considering data-driven techniques such as neural networks, decision trees, and other regression techniques. Besides the soft sensor development, we will discuss key aspects to developing safer, more reliable and more efficient models. The key aspects involve understanding the risk of not taking care of models' extrapolation, the effect of data quality and data quantity while building the models, and the importance of error distribution besides general metrics. After building the models, we will discuss good practices to improve efficiency, how to monitor performance and how to perform models' calibration. Real data from industrial processes will be used in the examples.

GENERAL OBJETIVES

Present the rationale for the development of data-driven soft sensors, tools and procedures to develop data-driven soft sensors, such as neural networks, tree-based models and linear regression models.

Describe key aspects for models' safety, such as (1) Model degradation, (2) Data quality, and (3) Data limits.

Describe key aspects for models' reliability, such as (1) Model's error distribution beyond its overall performance, (2) Training-testing-validation and statistical evaluation, and (3) Taking care of uncertainty.

Describe key aspects for models' efficiency, such as (1) Benchmarking metrics like execution time, computational complexity, memory usage, and energy consumption, (2) Evaluation of different hyperparameters, and (3) Feature engineering and feature selection.

Present how to transform a data-driven soft sensor created in a high-level language (such as Python) to structured text to run it on PLCs.

CONTENT AND PROGRAM

14:00 - 14:30	**Rationale, tools and procedures to develop data-driven soft sensors**	Gustavo Pessin
14:30 - 14:35	Questions and discussion	
14:35 - 14:55	**Key aspects for models' safety**	Gustavo Pessin
14:55 - 15:00	Questions and discussion	
15:00 - 15:20	**Key aspects for models' reliability**	Gustavo Pessin
15:20 - 15:25	Questions and discussion	
15:25 - 15:45	**Key aspects for models' efficiency**	Gustavo Pessin
15:45 - 15:50	Questions and discussion	
15:50 - 16:10	**Translating from high-level language (such as Python) to PLC structured text**	Gustavo Pessin
16:10 - 16:15	Questions and discussion	
16:15 - 16:30	**Conclusions and Closure of the Course**	Gustavo Pessin

LECTURER(S) BIO

Gustavo Pessin, D.Sc. (2013) has a strong background in building intelligent applications, integrating Machine Learning, IoT and Robotics to deploy Industrial and Environmental Applications. Pessin has dedicated efforts to create better and safer systems for industry and to help the understanding of ecological systems. Intelligent systems for industry have been developed for mineral activities, improving transportation safety and optimizing both extraction and production by means of instrumentation and development of machine learning tools to deal with image and sound recognition, anomaly detection and forecast models. Research on

ecological environments has been carried out by investigation on the use of RFIDs to keep track of wildlife. It was carried out in an international fashion with colleagues from UK, Australia, and USA. Furthermore, the deployment of a robot and its services to map geological facilities have been helping with the understanding of natural cavities. Pessin got his D.Sc. in Computer Science at the University of Sao Paulo, as a member of the Mobile Robotics Lab. During his D,Sc. Pessin carried out research with the Robotics Lab, at the Heriot-Watt University, Edinburgh, UK and the Communication and Distributed Systems Group, at the Universität Bern, Switzerland. In 2015, Pessin had a Visiting Scholar position within the Media Lab at the Massachusetts Institute of Technology. Currently, Pessin is a Full Researcher within the Robotics Lab, at the Vale Institute of Technology. Furthermore, Pessin is a member of three post-graduation programs, one in computer science, one in automation and one in emerging technologies for mining. Pessin has published more than 120 papers in peer- reviewed journals and conferences and has supervised more than 30 thesis and dissertations.