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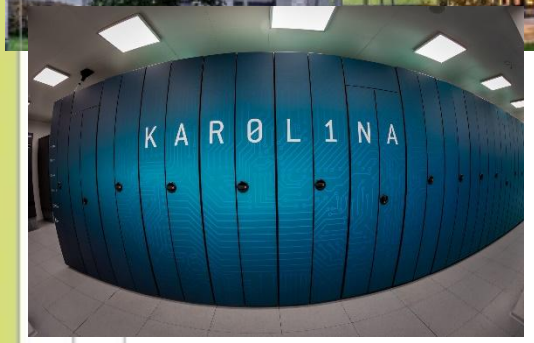

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IT4I is a leading research, development, and innovation centre active in the field of high-performance computing (HPC), high-performance data analysis (HPDA), and artificial intelligence (AI) operating the most powerful supercomputing systems in the Czech Republic. The Karolina GPU supercomputer is 15th on the Green500 ranking (June 2022) of the most energy-efficient supercomputers in the world (**seventh in Europe**). IT4I is a university research institute of VSB – Technical University of Ostrava (VSB TUO). VSB TUO was founded in 1849.

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https://scholar.google.com/citations?user=X8XJqgsAAAAJ&hl=en&oi=ao

ARTIFICIAL INTELLIGENCE

EuroHPC Joint Undertaking

EUROPEAN UNION
European Structural and Investment Funds
Operational Programme Research, Development and Education

Centralized WAN connectivity 100G
Centralized STORAGE, 5+PB

https://www.it4i.cz/en/infrastructure/our-supercomputers

IT4Innovations is **a strategic research infrastructure** in the Czech Republic and together with another two infrastructures CESNET and CERIT-SC constitutes e-Infrastructure of the Czech Republic called e-INFRA CZ**.**

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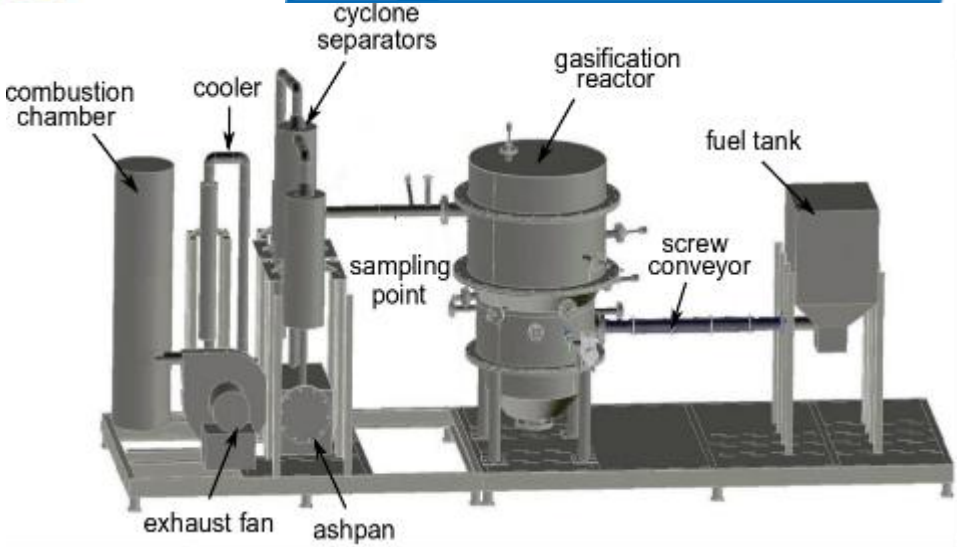
IT4INNOVATIONS AND CENET: RESEARCH COOPERATION

Centrum ENET | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER | ABB | APT | SMOLO | IPP INSTITUTE OF PLASMA PHYSICS OF THE CZECH ACADEMY OF SCIENCES

- Efficient and low-emission technologies for industrial use of combustion and gasification systems from low-value biogenic residues and wastes ; TOPIC ID: HORIZON-CL5-2022-D3-03-06. Deadline: Jan 10, 2023
- The call is related to the active Czech project CEET supported by https://www.tacr.cz/en/ .
- The main goal of the CEET project (2020-4), which includes a cooperation of **IT4Innovations (IT4I@VSB)** with **Center of Energy and Environmental Technologies (CEET)** VSB TUO is the development of a modular, mobile, robust and scalable technology solution for the efficient conversion of alternative fuels, waste and by-products as alternative raw materials into usable chemicals and useful forms of energy, their storage and efficient use, following the principles of the circular economy. **IT4I@VSB is responsible for creation of digital twins of selected CEET processes.**
- More details: Praks P., **Praksová R.**, et al. *Using artificial intelligence methods for simulation of gasification of biomass and communal waste*. IEEE ICCC 2021, https://doi.org/10.1109/iccc51557.2021.9454641
- Praks P.; Lampart M.; **Praksová R.**; Brkić D.; Kozubek T.; Najser J. *Selection of Appropriate Symbolic Regression Models Using Statistical and Dynamic System Criteria: Example of Waste Gasification. Axioms* **2022** (Accepted on Sept. 2)



The Fraunhofer-Gesellschaft and the VSB – Technical University of Ostrava start German-Czech research collaboration for sustainable production: https://www.fraunhofer.de/en/press/research-news/2021/june-2021/fraunhofer-and-technical-university-ostrava-start-research-collaboration-for-sustainable-production.html

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AI-BASED GASIFICATION MODELLING

- IT4I uses explainable AI (distributed symbolic regression) as an interface for data-driven modelling
- **Example of input of the digital twin:** type of alternative fuel/waste (for example, a class of communal waste, or biomass)
- **Example of output of the digital twin:**
  - modelling of gasification temperature vs syngas composition
  - the optimal gasification temperature for the specified stochastic fuel (i.e., specified class of waste) for the user-defined target (e.g., maximization of calorific value of the syngas, or maximization of hydrogen volume in the syngas).
- Different models are developed and tested
  - Accuracy vs complexity
- Developed algebraic models are successfully verified by new measurements

Example: AI-based syngas composition modelling tool for CEET project developed by IT4Innovations

Gases:

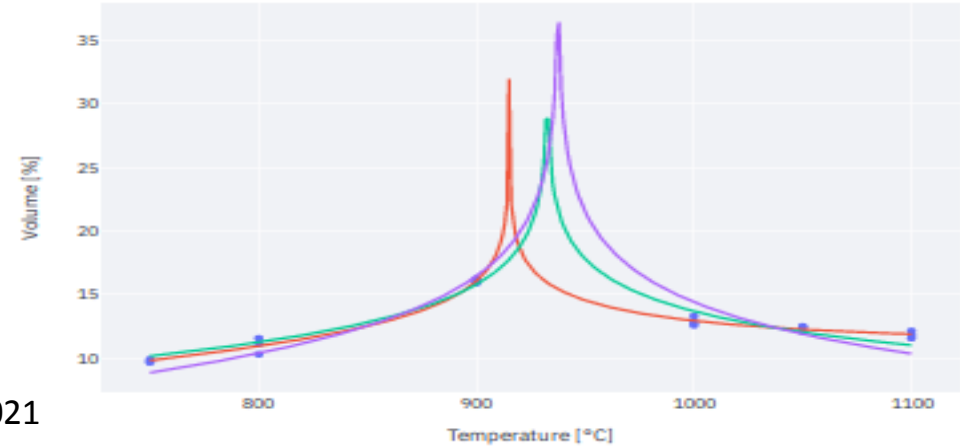
H2

Select models:

Model 18: (logm2... × Model 16: (6.536... × Model 15: logm2(... ×

	Selected model	MSE	Pearson Corr. Coef.
0	Model 18: (logm2(7.744805 * pow(-9.837645 + logm2(x0), -1.5165994)) + (0.0054770974 * x0))	0.0868	0.9905
1	Model 16: (6.5368786 + logm2(pow(abs(-9.864973 + logm2(x0)), -2.1570945)))	0.2861	0.9731
2	Model 15: logm2(13.480907 * pow(-9.872763 + logm2(x0), -3.1076837))	0.8642	0.9564

The maximum hydrogen concentration is estimated by models for the gasification temperature 900 - 1,000 ° C



More info: Praks, P., Brkic, D., Najser, J., Najser, T., Praksova, R., & Stajic, Z. Methods of Artificial Intelligence for Simulation of Gasification of Biomass and Communal Waste. 2021 22nd International Carpathian Control Conference (ICCC, IEEE). https://doi.org/10.1109/iccc51557.2021.9454641

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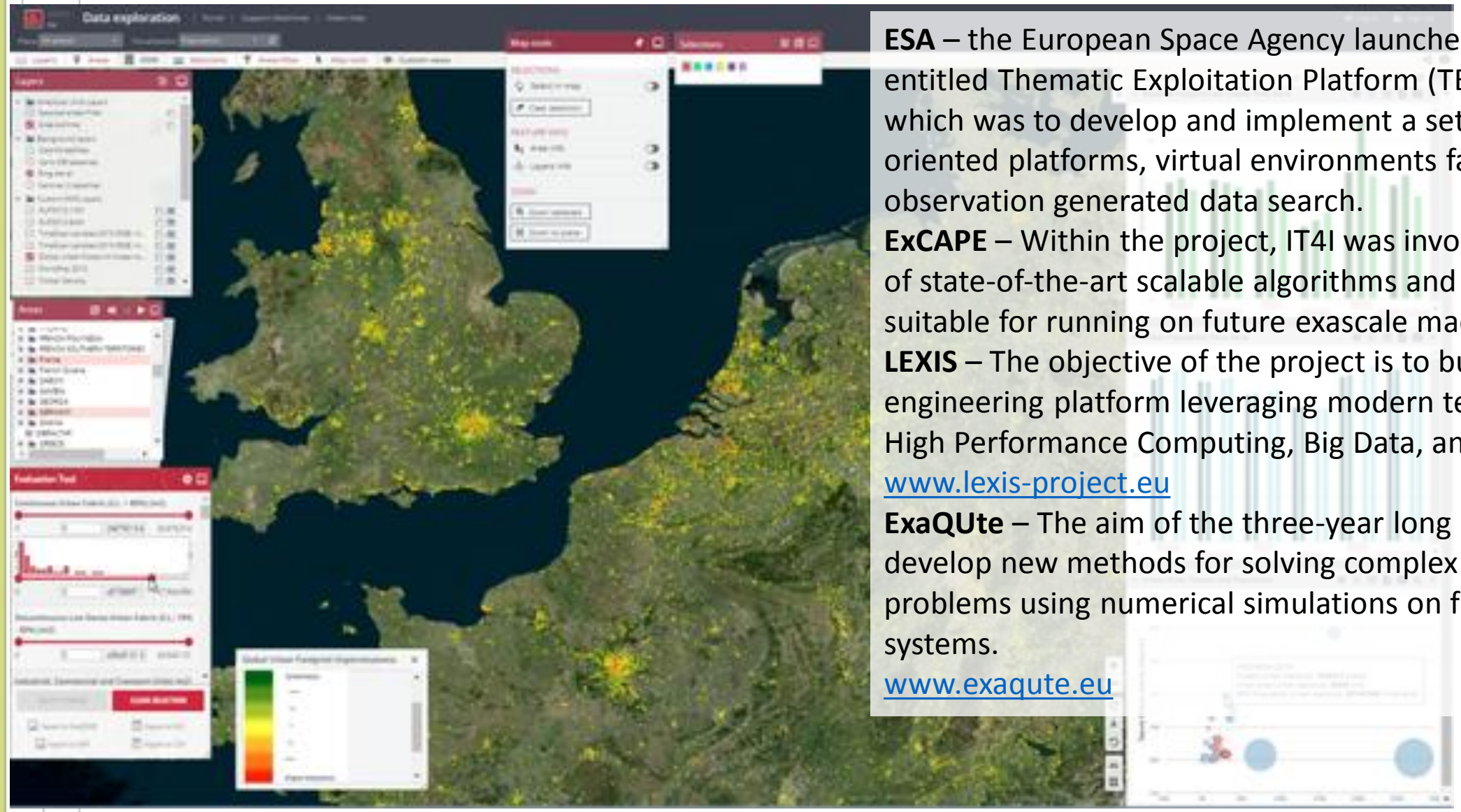
SELECTED INTERNATIONAL PROJECTS of IT4I@VSB



ESA – the European Space Agency launched an initiative entitled Thematic Exploitation Platform (TEP), the objective of which was to develop and implement a set of thematically oriented platforms, virtual environments facilitating Earth observation generated data search.

ExCAPE – Within the project, IT4I was involved in development of state-of-the-art scalable algorithms and implementations suitable for running on future exascale machines.

LEXIS – The objective of the project is to build an advanced engineering platform leveraging modern technologies from High Performance Computing, Big Data, and Cloud Computing.
www.lexis-project.eu

ExaQUte – The aim of the three-year long project ExaQUte is to develop new methods for solving complex engineering problems using numerical simulations on future exascale systems.
www.exaqute.eu

https://www.it4i.cz/en/research/research-flagships/hpc-platforms-for-scientific-workflow-execution

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I would like to cooperate with you in the preparation of your project. I have experience with statistical modelling of waste to energy processes using symbolic regression. My paper from Genetic programming and evolvable machines "Eureqa: Software review" has 104 citations. I finished my PhD study at the Faculty of Safety Engineering, VSB – Technical University of Ostrava (Ostrava, The Czech Republic) in 2014. The topic of my dissertation was "Uncertainty of radon volume activity measurement in residential rooms and work places". My PhD work included data analyses and statistical modelling of a Czech radon detector using symbolic regression and Monte-Carlo simulations. In my previous research work at **European Commission, JRC Ispra, Italy** (2015-2016), I gained experience with processing and data analysis using Python libraries (such as Pandas) and Git version control system. I was responsible for automated extracting of data, data visualisation and reporting from the JRC Vehicle Emission Laboratory.

I have been working for IT4Innovations since June 2019. Namely, I use AI methods such as genetic programming and symbolic regression techniques, for example, Python open-source packages AI Feynman and pySRURGS. Recently, I have also successfully used the Julia/Python ML package PySR on the IT4I Barbora cluster.
Moreover, IT4I of VSB TUO is a recognized partner with many international projects, see https://www.it4i.cz/en/research/our-research-activities

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