name of the unit:		symbol:
PROCESS TOMOGRAPHY – TOM DYAKOWSKI PROCESS TOMOGRAPHY LAB Institute of Applied Computer Science, Lodz University of Technology		I-24 http://www.iis.p.lodz.pl
head of the unit:	potential promoters:	contact person:
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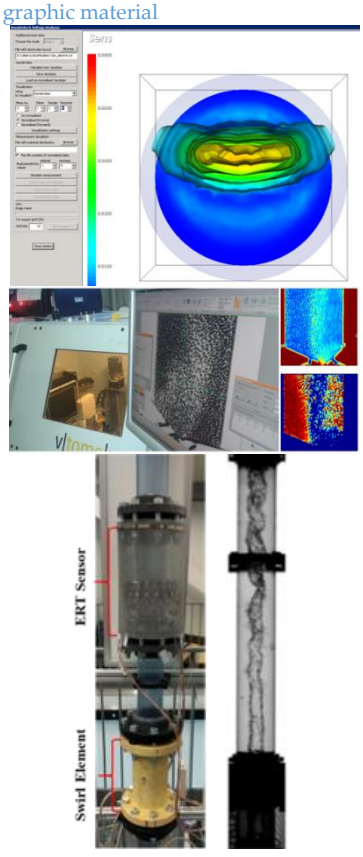
scope of activities:

The Institute of Applied Computer Science has a long track record of research activities in the field of process tomography, where the technology is used to support the diagnosis and monitoring of industrial processes linked to chemical engineering, food processing, raw materials handling to cite a few. We use our access to different modalities (electrical tomography, ultrasound tomography, X-ray tomography) and process installations to propose advanced algorithms to collect data via sensor development and to process and analyse it for different purposes (process visualisation, understanding, monitoring & control). We want to combine solid scientific foundation from applied mathematics and computer science (inverse problems, image reconstruction, image processing) with IT trends (AI/ML, VR/AR, parallel and distributed computing) to make the processed information more robust and easier to interpret or model. Our investigations tackle with development of modern, intelligent diagnostic platforms with an open architecture, meeting the expectations of Industry 4.0, with the possibility of free configuration and cooperation with external systems. We mainly conduct our activities at the Tom Dyakowski Process Tomography Lab (TDPTL) but also in world-class equipment via cooperation with national and international strategic partners (netrix.pl, HZDR (Germany), INSA-Lyon (France), TU Delft (The Netherlands)).

graphic material



present activities:

We currently address a variety of scientific challenges linked to process tomography and related field:

- Process control of gas-water separation efficiency using electrical resistance tomography – focus on alternative methods to image reconstruction for real-time control (MSCA project TOMOCON)
- Real-time overlay of tomography data on corresponding process using handheld-based augmented reality (activity annex to TOMOCON)
- Enhancement of image reconstruction of 3D ECT using deep learning
- Fast tomography data processing using massive parallel and distributed computations
- Development of image processing methods to analyse raw material properties (organic materials, meteorites) extracted from X-ray tomography images

Future activities:

Carry on the present activities listed above, with the emphasis on integrating IT trends for optimized real-time/online monitoring and diagnosis.

The portfolio of research groups was created as part of the Programme "STER" – Internationalisation of doctoral schools" as part of the realization of the project "Curriculum for advanced doctoral education & taining – CADET Academy of Lodz University of Technology".

publications/patents/awards/grants:

- Graph convolutional networks for enhanced resolution 3D Electrical Capacitance Tomography image reconstruction, Applied Soft Computing (2021), 110: 107608, https://doi.org/10.1016/j.asoc.2021.107608
- Multichannel Capacitive Imaging of Gas Vortex in Swirling Two-Phase Flows Using Parametric Reconstruction. IEEE Access (2020), 8: 69557-69565, https://doi.org/10.1109/ACCESS.2020.2986724
- On the Use of a Rotatable ECT Sensor to Investigate Dense Phase Flow: A Feasibility Study. Sensors (2020), 20: 4854, https://doi.org/10.3390/s20174854
- Quantitative analysis of flow dynamics of organic granular materials inside a versatile silo model during time-lapse X-ray tomography experiments. Computers and Electronics in Agriculture (2020), 172: 105346, https://doi.org/10.1016/j.compag.2020.105346
- Analysis of silo flow dynamic effects using ECT and short time Fourier transform. Flow Measurement and Instrumentation (2018), 62: 167-175, https://doi.org/ 10.1016/j.flowmeasinst.2018.02.003
- https://www.tomocon.eu

Keywords:

Process visualization; image processing; data handling; 3D printing; sensor design; tomography modalities for applied science

List of internship proposal in this research team:

Development of tomography sensors, 3D modelling and printing, data collection schemes, data handling methods, the use of machine learning and artificial intelligence, parallel and distributed computing