GRANT AGREEMENT No.: 764902 **Project Acronym: TOMOCON** **Project title: Smart tomographic sensors for advanced industrial process control**	TOMOCON Smart Tomographic Sensors for Advanced Industrial Process Control	
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Innovative Training Network

TOMOCON

Deliverable Title

Textbook Publication of TOMOCON Results

Description

This deliverable describes the TOMOCON Special Issue in MDPI Sensors as the final publication of the TOMOCON project results.

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Approved by Supervisory Board:		24.02.2022

Dissemination Level: **Public**

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Revision Sheet

Revision Number	Purpose of Revision	Effective Date
0	Initial Issue	24.02.2022

Dissemination Level: **Public**

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Textbook Publication of TOMOCON Results

Special Issue "Tomographic Sensors for Industrial Process Control"

1. Background

Control systems in the process industry have the task of ensuring a stable processing of material streams within a well-defined sequence of operations. Such operations are, for instance, reaction, separation, crystallization, solidification, mixing, and drying. For that purpose, the contemporary process industry typically employs control systems with local sensors for, e.g., temperature, pressure, flow, and filling level. With the ongoing progress in sensor development, there is now a growing interest in using sensors with higher complexity in industrial control systems. One such category is process tomography sensors.

Process tomography is an established class of imaging techniques, used to obtain 2D or 3D information of the distribution and flow of materials in pipes and vessels. Compared to its counterparts in medical diagnostics and non-destructive testing, process tomography typically targets high scanning speed rather than high spatial resolution. In recent years, a number of different process tomography modalities have evolved. These are, for example, electrical tomography, magnetic tomography, ultrasound tomography, microwave tomography, and optical tomography. However, some of the classical tomography modalities, such as X-ray tomography, emission tomography, and magnetic resonance imaging, have also been made fast enough to study industrial processes.

With respect to industrial process control, tomographic imaging had so far been of lesser consideration as real time reconstruction and feature extraction was difficult to achieve. However, recent developments in powerful and smart massive parallel computing architectures have changed the game. Process tomography can now be turned into a powerful sensor element for tomography-based process control.

2. Overview of TOMOCON Special Issue

The Special Issue “Tomographic Sensors for Industrial Process Control" in MDPI Sensors is summarizing the main project results of the TOMOCON project thereby presenting the latest scientific and technical achievements in the field of process control using process tomography techniques. The Special Issue especially focuses on a holistic demonstration of this technology for typical industrial processes in the fields of chemical, environmental, and energy engineering. The presented technical solutions include tomography sensors, data processing, and control strategies with a proof-of-principle demonstration. The contributions also deal with new concepts for hardware and software, e.g., real-time tomographic sensing and data processing as well as novel theoretical control concepts for the use of tomography sensors in control loops.

The guest editor of the Special Issue is Prof. Uwe Hampel who is also the Coordinator of the TOMOCON project. All publications of the Special Issue have been peer-reviewed and published open access. The special issue has also been open for researchers who are not part of the TOMOCON project but have been interested in publishing their latest research results in the field of process control using process tomography techniques. The deadline for manuscript submissions is 30th April 2022.

For more information, please see:
https://www.mdpi.com/journal/sensors/special_issues/TSIPC

3. Published papers (until 28.02.2022)

The following 10 papers have been published by 28.02.2022:

Yuchong Zhang, Adel Omrani, Rahul Yadav, Morten Fjeld, Supporting Visualization Analysis in Industrial Process Tomography by Using Augmented Reality—A Case Study of an Industrial Microwave Drying System. *MDPI Sensors*, 21/19, 6515 (2021); https://doi.org/10.3390/s21196515

Rahul Yadav, Adel Omrani, Guido Link, Marko Vauhkonen, Timo Lähivaara, Microwave Tomography Using Neural Networks for Its Application in an Industrial Microwave Drying System. *MDPI Sensors*, 21/20, 6919 (2021); https://doi.org/10.3390/s21206919

Soheil Aghajanian, Guruprasad Rao, Vesa Ruuskanen, Radosław Wajman, Real-Time Fault Detection and Diagnosis of $CaCO_3$ Reactive Crystallization Process by Electrical Resistance Tomography Measurements. *MDPI Sensors*, 21/21, 6958 (2021); https://doi.org/10.3390/s21216958

Panagiotis Koulountzios, Soheil Aghajanian, Tomasz Rymarczyk, Tuomas Koiranen, Manuchehr Soleimani, An Ultrasound Tomography Method for Monitoring CO_2 Capture Process Involving Stirring and $CaCO_3$ Precipitation. *MDPI Sensors*, 21/21, 6995 (2021); https://doi.org/10.3390/s21216995

Marzieh Hosseini, Anna Kaasinen, Mahdi Aliyari Shoorehdeli, Guido Link, Timo Lähivaara, Marko Vauhkonen, System Identification of Conveyor Belt Microwave Drying Process of Polymer Foams Using Electrical Capacitance Tomography. *MDPI Sensors*, 21/21, 7170 (2021); https://doi.org/10.3390/s21217170

Adel Omrani, Rahul Yadav, Guido Link, Timo Lähivaara, Marko Vauhkonen, John Jelonnek, An Electromagnetic Time-Reversal Imaging Algorithm for Moisture Detection in Polymer Foam in an Industrial Microwave Drying System. *MDPI Sensors*, 21/21, 7409 (2021); https://doi.org/10.3390/s21217409

Thomas Suppan, Markus Neumayer, Thomas Bretterklieber, Stefan Puttinger, Hannes Wegleiter, A Model-Based Analysis of Capacitive Flow Metering for Pneumatic Conveying Systems: A Comparison between Calibration-Based and Tomographic Approaches. *MDPI Sensors*, 22/3, 856 (2022); https://doi.org/10.3390/s22030856

Prima Asmara Sejati, Noritaka Saito, Yosephus Ardean Kurnianto Prayitno, Koji Tanaka, Panji Nursetia Darma, Miku Arisato, Kunihiko Nakashima, Masahiro Takei, On-Line Multi-Frequency Electrical Resistance Tomography (mfERT) Device for Crystalline Phase Imaging in High-Temperature Molten Oxide. *MDPI Sensors*, 22/3, 1025 (2022); https://doi.org/10.3390/s22031025

Rasmus Eilkær Hansen, Thorsten Bæk, Simon Lehnskov Lange, Niels Møller Israelsen, Markku Mäntylä, Ole Bang, Christian Rosenberg Petersen, Non-Contact Paper Thickness

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and Quality Monitoring Based on Mid-Infrared Optical Coherence Tomography and THz Time Domain Spectroscopy. *MDPI Sensors*, 22/4, 1549 (2022); https://doi.org/10.3390/s22041549

Muhammad Awais Sattar, Matheus Martinez Garcia, Luis M. Portela, Laurent Babout, A Fast Electrical Resistivity-Based Algorithm to Measure and Visualize Two-Phase Swirling Flows. *MDPI Sensors*, 22/5, 1834 (2022); https://doi.org/10.3390/s22051834

TOMOCON intends to publish 4 more journal articles by the end of the submission deadline on 30th April 2022.

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