75 lat POLITECHNIKI ŚLĄSKIEJ

Politechnika Śląska

UCZELNIA BADAWCZA

Priority Research Area

Process automation and Industry 4.0

Part III B

Gliwice 29.10.2020 r.

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Politechnika Śląska

UCZELNIA BADAWCZA

TECHNICAL DIAGNOSTICS AND MAINTENANCE SYSTEMS, MEASUREMENT SYSTEMS IN INDUSTRY AND ENVIRONMENTAL PROTECTION

Faculty of Mechanical Engineering

Development of signal processing and analysis methods

Goal:

- Improvement of diagnosing process.
- Simplification of the diagnostic inference process
- Extending the fault identification process considering complex object conditions

Assumptions:

- Focusing on systems of continuous monitoring and diagnostics of machines
- New sources of diagnostic signals
  - Ultrasounds
  - Acoustic emission
  - Electric parameters
  - Magnetic field parameters
- Focusing on industrial needs
- Developing limits of diagnostic parameters

Development of multi-channel diagnostic data fusion methods

Goal:

- Improvement and simplification of the diagnostic inference process based on multi-channel data
- Improving the efficiency of the machine condition classification
- Adaptation to the requirements of autonomous systems with distributed computing intelligence

Assumptions:

- Algorithms with minimal user involvement
- Automation of the data selection processing
- Simplify the user layer

Development of time series prediction methods and diagnostic inference

Goal:

- Linking condition monitoring with aspects of machine operation management
- Orientation of operational activities to prediction condition changes
- Standardization of predictive systems and adaptation to cooperation with enterprise management systems

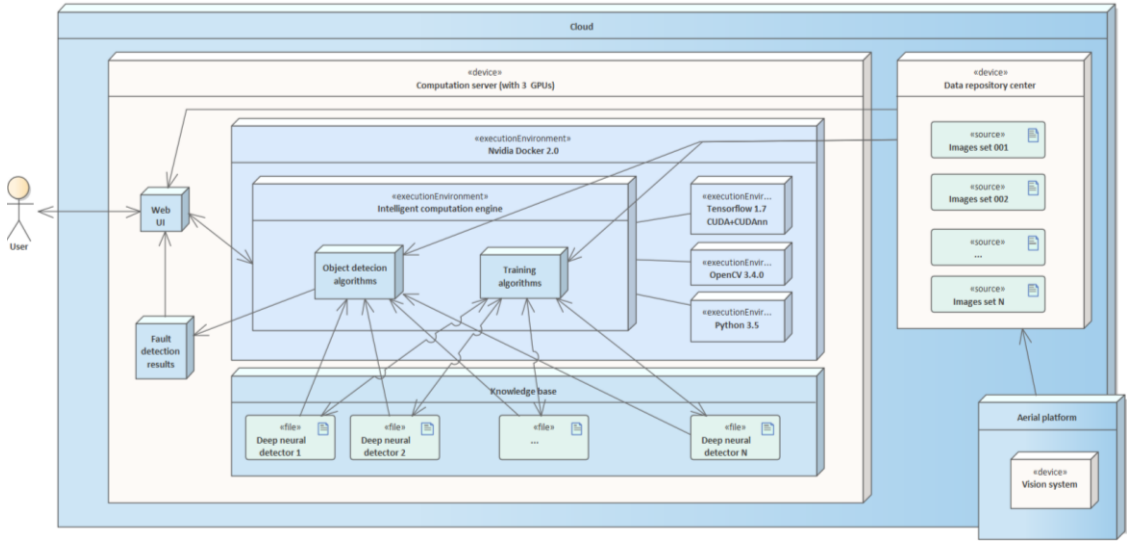
Assumptions :

- Visual tuning of prediction systems
- Automatic processing and analysis of historical data
- Searching for the relationship between the constructional and operational features and the predicted features of the condition
- Diversification of information sources for development of predictive models
- Standardization of data types and formats

Development of intelligent fault diagnosis methods and tools for power line systems (1)

- The research focuses on the intelligent fault diagnosis system for automatic analysis of a huge number of images with 4K resolution collected during flight inspection of the overhead power lines with the use of aerial platforms. The developed system can be used to detect and locate anomalies of power line structures e.g. anomalies of towers, conductors, dampers, insulators, etc. The proposed system is based on the predefined deep neural network called Faster R-CNN which is dedicated for solving real-time object detection problems. The faster R-CNN-based neural model created on COCO dataset was additionally retrained by the authors applying images gathered as a result of flight inspections in order to obtain the high performance of the whole system. The comprehensive verification tests were carried out to prove the merits of the proposed solution.
- Research team: E. Piechoczek (RT), P. Przystałka, prof. PŚ (RMT), G. Kopacz (TAURON Dystrybucja)
- Cooperation with industrial partners: AIRPAS EP, TAURON Dystrybucja

Development of intelligent fault diagnosis methods and tools for power line systems (2)

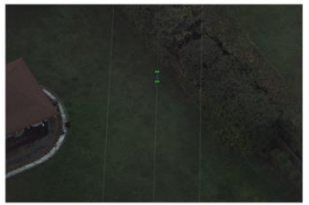


(a)

(b)

(c)

(d)

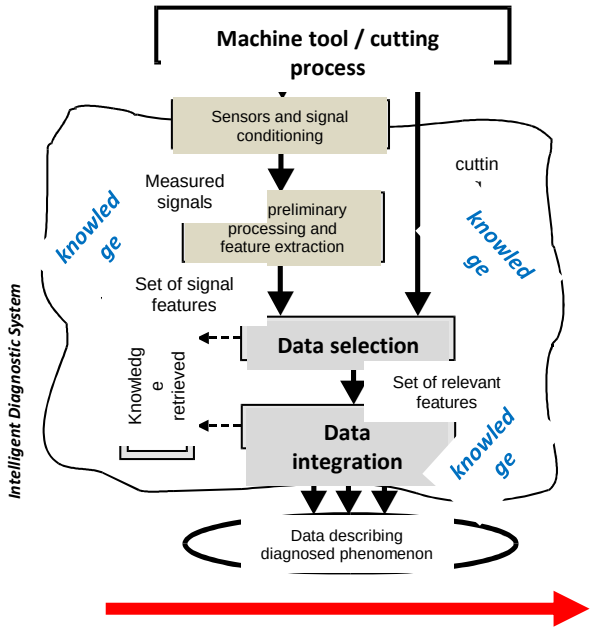


(a)

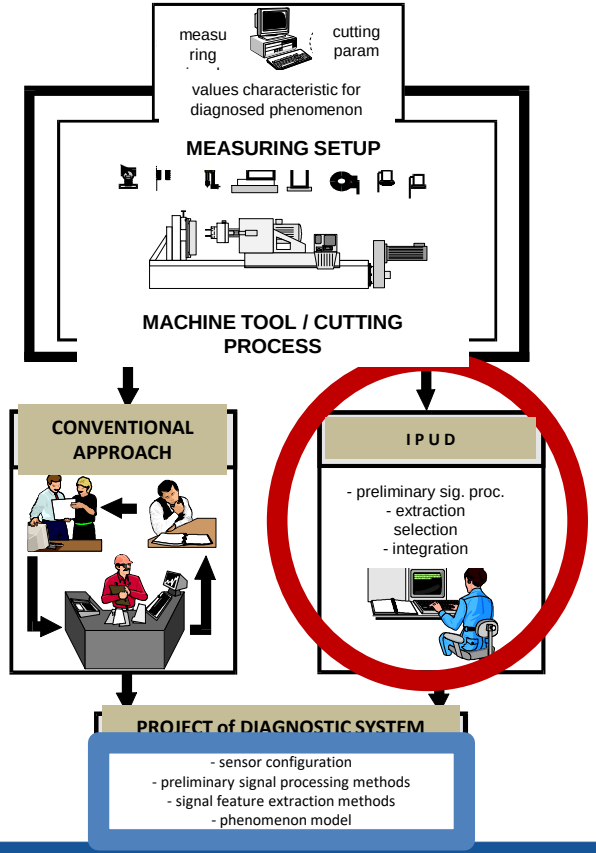
(b)

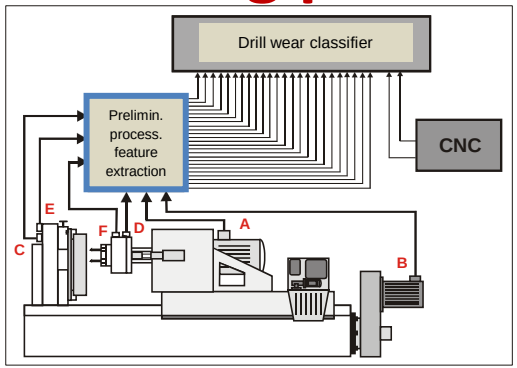
E. Piechoczek, P. Przystałka and G. Kopacz: Intelligent Fault Diagnosis Tool For Power Line Systems, GCMM2020 (przyjęty do druku)

Diagnostics of machine tools and cutting process

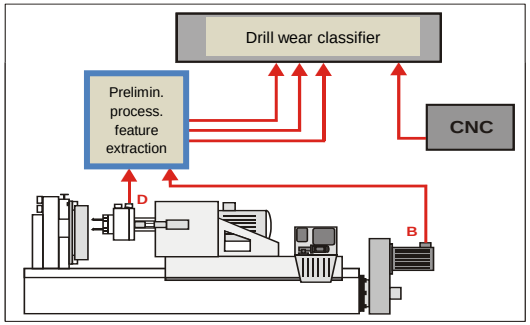


Application of inteligent diagnostic system concept
while designing diagnostic systems



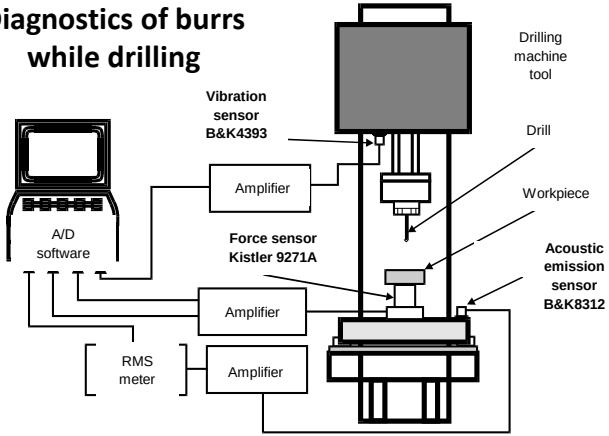


Example of preliminary and optimised diagnostic system



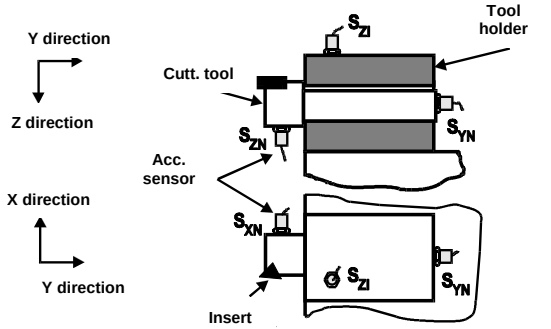
Diagnostics of machine tools and cutting process

Diagnostics of burrs while drilling

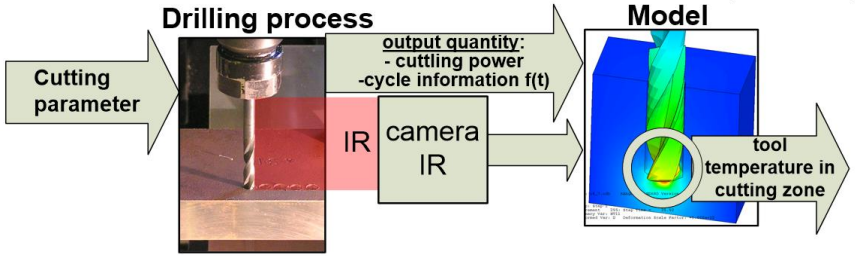


Diagnostics of machine tool kinematics

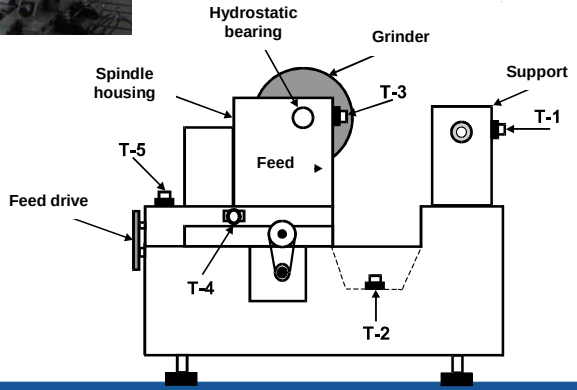
Diagnostics of cutting tool wear



Conception of temperature system monitoring while drilling



Diagnostics of thermal deformation



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Politechnika Śląska

UCZELNIA BADAWCZA

Areas of research and scientific interest for RG-1 staff in the POB5 framework

dr hab. inż. Jarosław Joostberens

Gliwice 29.10.2020 r.

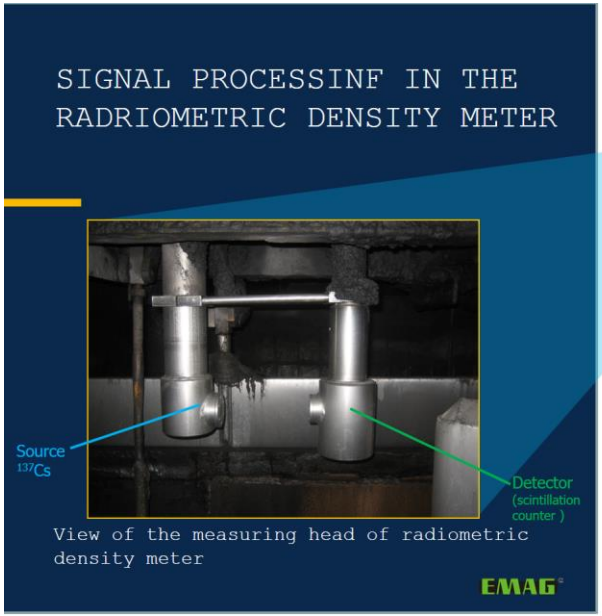
Industrial Measurements

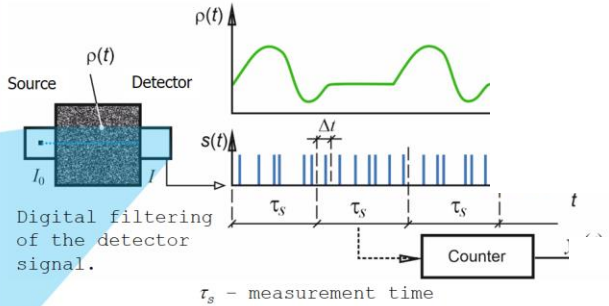
Radiometric meters

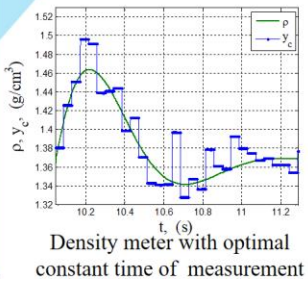
prof. dr hab. inż. Stanisław Cierpisz, dr hab. inż. Jarosław Joostberens

dr hab. inż. Jarosław Joostberens, mgr inż. Waldemar Sobierajski , ITI EMAG

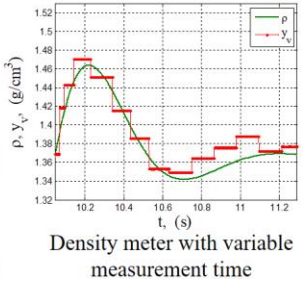
dr hab. inż. Jarosław Joostberens, mgr inż. Wojciech Pielucha



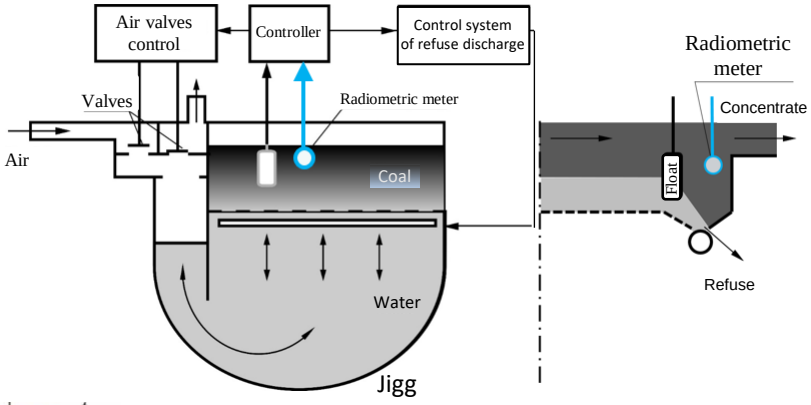


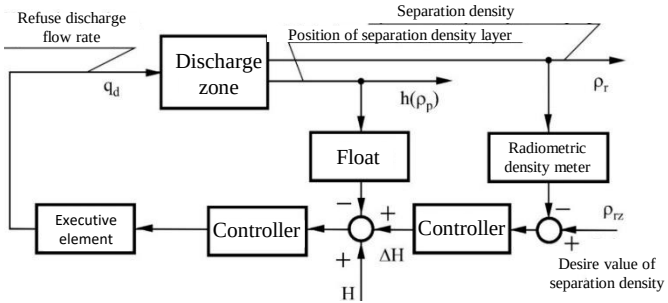


Density meter with optimal constant time of measurement



Density meter with variable measurement time



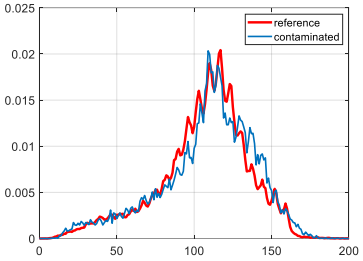


Industrial Measurements

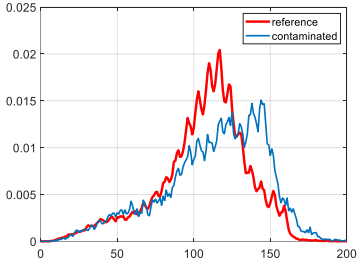
Machine vision based methods

Grayscale image of a coal sample contaminated with shale

Grayscale image of a pyrite-contaminated coal sample



Luminance histogram of a coal sample contaminated with shale



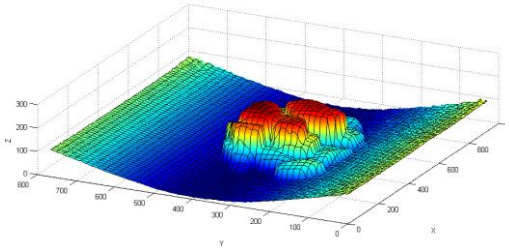
Luminance histogram of a pyrite-contaminated coal sample

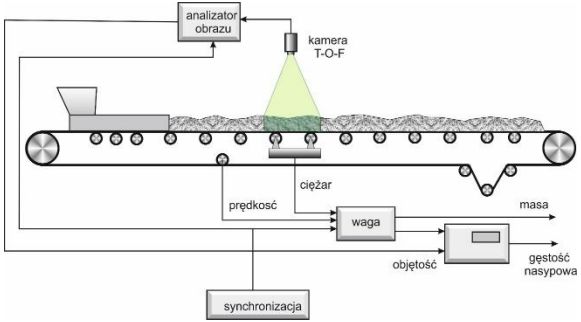
Approximation of irregular particles shape

Elliptical approximation

Polygonal approximation and Feret diameter

3D imaging of the coal stream





dr hab. inż. Adam Heyduk, prof. PŚ

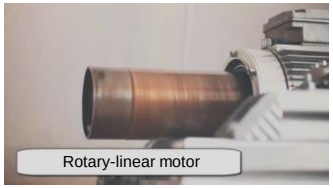
dr hab. inż. Joachim Pielot, prof. PŚ
dr hab. inż. Jarosław Joostberens
dr inż. Andrzej Nowrot
lek. med. Karol Fabiańczyk
Polcargo

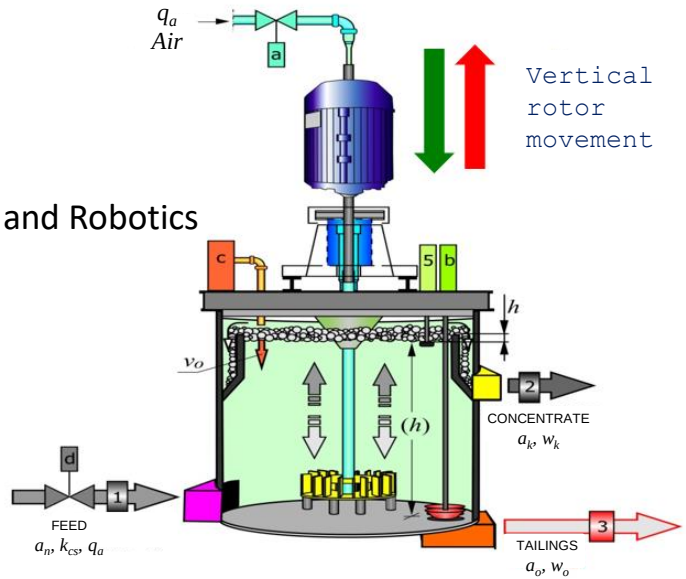
Automation in mineral processing

1) **Production of clean coal concentrates with control of the secondary enrichment of coal**
   dr hab. inż. Joachim Pielot, prof. PŚ
2) **Automatic Control of Coal Separation in a Jig**
   - prof. dr hab. inż. Stanisław Cierpisz,
   dr hab. inż. Jarosław Joostberens
3) **Automatic Control of Coal Flotation**

cooperation with the Department of Power Electronics, Electrical Drives and Robotics

dr hab. inż. Tomasz Trawiński, prof. PŚ
dr hab. inż. Joachim Pielot, prof. PŚ
dr hab. inż. Jarosław Joostberens
dr inż. Marcin Szczygieł
dr inż. Paweł Kowol





Research projects involving RG-1 staff

- POIR.04.01.04-00-0081/17: *Development of innovative scraper conveyors with increased startability and service life* . Patentus Spółka Akcyjna (leader), Politechnika Śląska w Gliwicach, Fabryka Elementów Napędowych "FENA" Sp. z.o.o. Team: dr hab. inż. K. Filipowicz, prof. PŚ, dr hab. inż. A. Wieczorek, prof. PŚ, dr hab. inż. J. Joostberens, dr hab. inż. A. Heyduk, prof. PŚ, dr inż. M. Kuczaj, mgr inż. W. Pielucha
- CuBR/III/3/NCBR/2017 *Innovative wireless communication system in pillar-chamber excavations in underground mining plants.* Team: prof. dr hab. inż. F. Plewa, prof. dr hab. inż. J. Palarski, dr hab. inż. A. Wojaczek, prof. PŚ, dr inż. K. Miśkiewicz
- PBS3/B2/15/2015: C*ontrol of roadheader cutting head movement for reduction of cutting energy consumption and dynamic loads*. Politechnika Śląska – Wydział Górnictwa i Geologii (leader), Famur S.A., Famur Institute Sp. z o.o. Team: dr hab. inż. Piotr Cheluszka, prof. PŚ, prof. dr hab. inż. M. Dolipski, dr inż. P. Sobota, dr hab. inż. A. Heyduk, prof. PŚ, dr hab. inż. J. Joostberens,
- *Intelligent Deep Mine Shaft Monitoring*, DMT GmbH & Co. KG, Germany, Boliden Mineral AB, Sweden, Deutsches Zentrum für Luft- und Raumfahrt e.V., Montanuniversität Leoben, Politechnika Śląska, Gliwice, Technische Hochschule Georg Simon Ohm, Nürnberg, Technische Universität Bergakademie Freiberg (TUBAF). Team: dr hab. inż. H. Kleta, dr hab. inż. A. Heyduk, dr inż. M. Jendryś
- N N524 360638: *A visualization method of supporting the assessment of the technical condition and safety of the shaft lining with the use of digital image analysis* . Team: dr hab. inż. H. Kleta, prof. dr hab. inż. M. Chudek, prof. dr hab. inż. S. Cierpisz, dr hab. inż. A. Heyduk, prof. PŚ, dr hab. inż. J. Joostberens, dr inż. M. Jendryś, mgr inż. A. Bączek.

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INICJATYWA DOSKONAŁOŚCI

TECHNICAL DIAGNOSTICS, MEASURING SYSTEMS IN INDUSTRY AND ENVIRONMENTAL PROTECTION

Grzegorz Peruń

Faculty of Transport and Aviation Engineering

Topics areas of the realized works

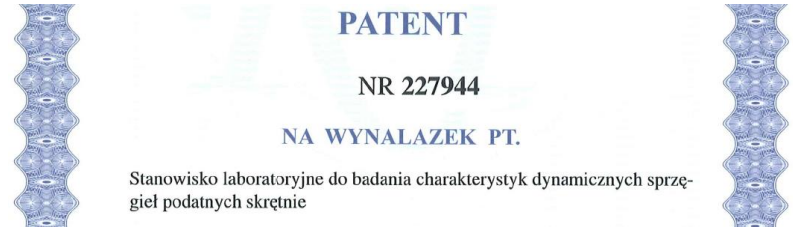
- Modeling and simulation of dynamic phenomena in toothed gears and transmission systems with gears.
- Computer-aided design of toothed gears and drive systems.
- Design optimization of gearboxes carried out to reduce their vibroacoustic activity.
- Diagnosis of different designs of toothed gears oriented to detection of local damages of wheel teeth and rolling bearings.
- Testing of technical objects using vibroacoustic diagnostic methods to assess technical condition, detecting damage in its early stages and evaluating wear.

Selected from current research work

Co-participation in research grants/projects:

- Grant MNiSW nr 4T07B00230 "Influence of design features and component wear on vibroactivity of gear drive systems".
- Research project N N509 554240 "Use of torsional vibration dampers to eliminate critical conditions in complex propulsion systems of transportation vehicles".
- Study for industry - "Testing of conveyor belt pulleys".

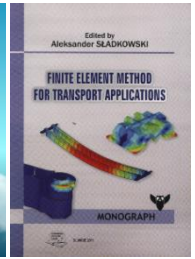
Patent for invention: Laboratory bench for testing dynamic parameters of torsionally flexible couplings. Authors: Opasiak T., Łazarz B., Peruń G.


PATENT

NR 227944

NA WYNALAZEK PT.

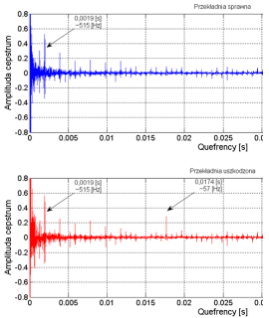
Stanowisko laboratoryjne do badania charakterystyk dynamicznych sprzęgieł podatnych skrętnie



Topics of the planned research work

- Identify opportunities for design optimization of various engineering objects, including:
  - automotive vehicle assemblies and equipment,
  - aircraft assemblies and equipment,
  - industrial transportation equipment,

  using modern design methods and tools.



- Diagnosing technical objects using various methods, including vibroacoustic diagnostics.
- Processing of recorded acoustic and vibration signals using various analysis methods.
- Identifying measures to determine technical condition.
- Developing diagnostic algorithms using advanced signal processing methods.

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INICJATYWA DOSKONAŁOŚCI

TECHNICAL DIAGNOSTICS AND MAINTENANCE SYSTEMS, MEASUREMENT SYSTEMS IN INDUSTRY AND ENVIRONMENTAL PROTECTION

Dariusz Buchczik, Sebastian Budzan

Faculty of Automatic Control, Electronics and Computer Science

FACULTY OF AUTOMATIC CONTROL, ELECTRONICS AND COMPUTER SCIENCE

DEPARTMENT OF MEASUREMENTS AND CONTROL SYSTEMS

Research team:

Sebastian Budzan, PhD, DSc

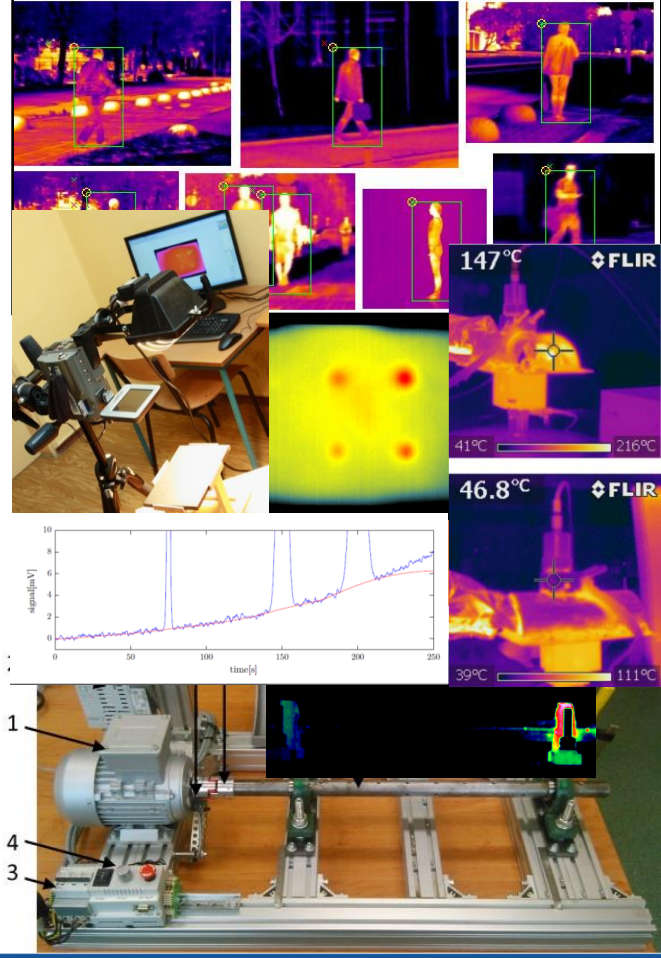
Dariusz Buchczik, PhD

Witold Ilewicz, PhD

Roman Wyżgolik, PhD

We are involved in the following research:

- Algorithms for measurement data analysis and estimation of measurement uncertainty, including:
  - analysis of complex chromatographic and spectrometric signals,
  - analysis of vibration signals of machines,
  - active and passive thermal imaging, image processing for technical diagnostics of machines,
  - calibration algorithms for measuring instruments and automation of calibration



FACULTY OF AUTOMATIC CONTROL, ELECTRONICS AND COMPUTER SCIENCE

DEPARTMENT OF MEASUREMENTS AND CONTROL SYSTEMS

Research team:

Sebastian Budzan, PhD, DSc

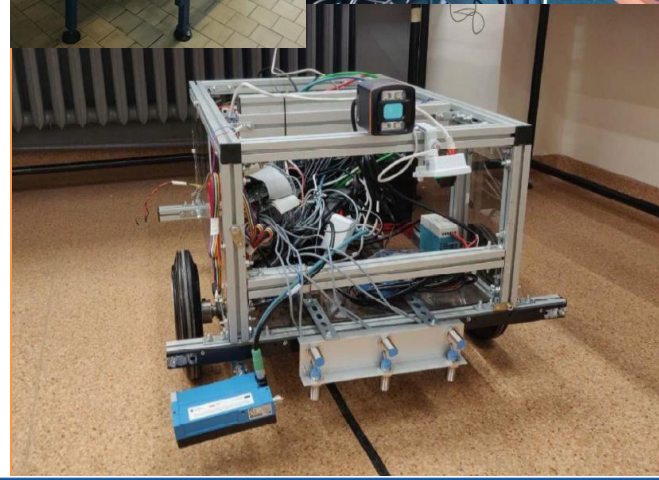
Dariusz Buchczik, PhD

Witold Ilewicz, PhD

Roman Wyżgolik, PhD

We are involved in the following research :

- processing of measurement results from different fields and statistical data analysis,
- AGV and AMR industrial platforms - design, software, testing,
- component tests at any stage of the production process, final product tests (In-Line and End of Line Testers),
- acquisition and processing of data using software environments : Visual C++, Matlab, Python, LabVIEW



Thank you for your attention