MVG Research Group

The *Machine Vision Research Group* (MVG Group) focuses on interdisciplinary research problems from the field of machine vision and medicine. The problems are solved using methods of digital image processing and analysis, machine learning and deep learning.

Research area

Deep neural networks in early detection of melanomas

Extending the knowledge of melanoma classification by exploring areas such as:

- Artifact removal
- Thickness prediction
- General anatomic sites localisation
- Global pattern recognition
- Differt approach to acral lesions
- Confocal microscopy

People involved:

- Joanna Jaworek-Korjakowska
- Anna Wójcicka
- Andrzej Brodzicki
- Filip Noworolnik
- Dariusz Kucharski

Computer-aided dermatopathology

Research goal:
To improve skin melanoma diagnosis by providing additional means of automatic detection of important diagnostic features in histopathological images.

The research topics include:

- tissue segmentation
- epidermis segmentation
- nests of melanocytes segmentation
- epidermal morphometry measurement

Team members involved:

- J. Jaworek-Korjakowska
- P. Kłeczek
- D. Kucharski

Research activity

Publications:

- **Dariusz Kucharski**, **Pawel Kleczek**, **Joanna Jaworek-Korjakowska**, Grzegorz Dyduch, Marek Gorgon. *Semi-Supervised Nests of Melanocytes Segmentation Method Using Convolutional Autoencoders*. Sensors, 2020, vol. 20, issue 6, 1546, doi: 10.3390/s20061546 (HTML)
  [IF5 (2018) = 2.737, Top10]
- **Pawel Kleczek**, **Joanna Jaworek-Korjakowska**, Marek Gorgon. *A novel method for tissue segmentation in high-resolution H&E-stained histopathological whole-slide images*. Computerized Medical Imaging and Graphics, 2020, vol. 79, 2022, Art. ID 101686, doi: 10.1016/j.compmedimag.2019.101686 (HTML)
  [IF5 (2018) = 2.737, Top10]
- **Pawel Kleczek**, Grzegorz Dyduch, Agnieszka Graczyk-Jarzynka, **Joanna Jaworek-Korjakowska**. *A New Approach to Border Irregularity Assessment with Application in Skin Pathology*. Applied Sciences (Basel), 2019, 9(10), 2022, doi: 10.3390/app9102022 (Abstract, HTML, PDF)
  [IF5 (2018) = 2.287]
- **Paweł Kłeczek**, Martyna Lech, Grzegorz Dyduch, **Joanna Jaworek-Korjakowska**, Ryszard Tadeusiewicz. *Segmentation of black ink and melanin in skin histopathological images*. Proc. SPIE 10581, Medical Imaging 2018: Digital Pathology, 105811A (2018); doi: 10.1117/12.2292859. (Abstract)
- **Paweł Kłeczek**, Grzegorz Dyduch, **Joanna Jaworek-Korjakowska**, Ryszard Tadeusiewicz. *Automated epidermis segmentation in histopathological images of human skin stained with hematoxylin and eosin*. Proc. SPIE 10140, Medical Imaging 2017: Digital Pathology, 101400M (2017). doi: 10.1117/12.2249018. (Abstract, Poster PDF)
- **Paweł Kłeczek**, Sylwia Mól, **Joanna Jaworek-Korjakowska**. *The Accuracy of H&E Stain Unmixing Techniques When Estimating Relative Stain Concentrations*. PCBBE 2017: Advances in Intelligent Systems and Computing, Springer (2017), doi: 10.1007/978-3-319-66905-2_7, pp. 87–97 (Abstract)

Conferences:

- SPIE Medical Imaging 2018 (Houston, TX, USA)
  Paweł Kłeczek: *Segmentation of black ink and melanin in skin histopathological images*[1] (poster)
- 20-th Polish Conference on Biocybernetics and Biomedical Engineering (Kraków, Polska)
  Paweł Kłeczek: *The accuracy of H&E stain unmixing techniques when estimating relative stain concentrations*[2] (poster)
- SPIE Medical Imaging 2017 (Orlando, FL, USA)
  Paweł Kłeczek: *Automated epidermis segmentation in histopathological images of human skin stained with hematoxylin and eosin*[3] (poster)

Anomaly detection with the use of pre-trained CNN architectures

Research goal:
To detect anomalies in multivariate diagnostic signals of the synchrotron control system by pre-trained CNN architectures.

SOLARIS National Synchrotron Radiation Centre is a research facility that provides high quality synchrotron light. To control such a complex system it is necessary to monitor signals from various devices and subsystems. Anomaly detection prevents from financial loss, unplanned downtimes and

in extreme cases cause damage. As artificial intelligence techniques including machine learning and deep neural networks have become state-of-the-art solutions for anomaly detection tasks which are one of the most challenging in data analysis, our team conducts research on the use of them for anomaly detection in multivariate diagnostic signals.

The research topics include:

- data mining and preparation
- data preprocessing
- CNN architectures building

Team members involved:

- M. Piekarski
- J. Jaworek-Korjakowska

Detection and analysis of patterns

Cell detection

To improve speed and quality of testing new drugs against Clostridium difficile infection, we developed an algorithm for automatic bacteria cytotoxicity classification. It was based on two kinds of fluorescence images - DAPI and GFP. We experimented with many different methods from classical image processing and machine learning algorithms to convolutional neural networks. This research was was conducted in cooperation with Stanford University.

The research topics include:

- fluorescence images
- image processing
- sharing information from different images
- convolutional neural networks

Team members involved:

- J. Jaworek-Korjakowska
- A. Brodzicki

Bacteria response clustering

Newly opened project, in cooperation with Stanford University. The main idea is to analyse bacteria reaction in response to different serums.

The research topics include:

- data clustering
- bacteria response analysis

Team members involved:

- J. Jaworek-Korjakowska
- A. Brodzicki

Reconstructing images' missing areas with generative models

The research topics include:

- reconstruction
- generative learning
- GANs
- autoencoders

Team members involved:

- J. Jaworek-Korjakowska
- D. Kucharski

Vehicle interior image segmentation

The research topics include:

- dataset preparation
- image classification
- image segmentation

Team members involved:

- J. Jaworek-Korjakowska
- A. Kostuch

Strony

A

- Awards & Prizes

C

- Conferences

G

- Grants

I

- intro

P

- Przydatne materiały
- Publications

R

- Research partners

T

- Team

1)

All authors: **P. Kłeczek**, M. Lech, G. Dyduch, **J. Jaworek-Korjakowska**, R. Tadeusiewicz.

2)

All authors: **P. Kłeczek**, S. Mól, **J. Jaworek-Korjakowska**

3)

All authors: **P. Kłeczek**, G. Dyduch, **J. Jaworek-Korjakowska**, R.Tadeusiewicz

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