



POLISH NATIONAL AGENCY  
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<p>name of the unit:</p> <p><b>ANALYSIS OF IMAGES AND MULTIDIMENSIONAL DATA USING MACHINE LEARNING</b></p> <p>Institute of Information Technology, Lodz University of Technology</p>		<p>symbol:</p> <p><b>I-72</b></p> <p><a href="http://www.it.p.lodz.pl">http://www.it.p.lodz.pl</a></p>
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<p>scope of activities:</p> <p>The team deals with analysis of images and multidimensional data using machine learning, which includes the following tasks: classification, knowledge extraction, object localization and detection, segmentation, object tracking, etc. That type of analysis, in particular in problems with diverse data and structures, is often hard for simple, algorithmic approaches. In such situation applicable are machine learning techniques, which, basing on available knowledge (usually on a set of samples), try to automatically select a proper algorithmic model and its parameters. Currently, the most popular approaches in data analysis are: support vector machines (SVM), classic perceptron (MLP), etc., and in case of images – convolutional (CNN) and recurrent (RNN) neural networks. Team competencies cover also classic methods of image analysis like active contours (AC) and their original generalizations: active hyper-contours (AH) as well as active partitions (AP). Their advantage, which is particularly important, is ability to take into account domain knowledge while processing data. A crucial element of the conducted activity is also analysis of graph data, using extensions of convolutional networks, which has a wide area of application starting from chemical data analysis, through social networks analysis, finishing on classic image analysis.</p> <p>An import place occupies sound signal analysis. Although it is a completely different domain, it is possible to apply here artificial intelligence tools, usually used for other data, as well. The results of time-frequency analysis can be processed analogously to image data and machine learning allows to successfully identify and recognize patters, including high-level ones. Consequently, it is possible, to analyze the content of music recordings in a similar way to humans and automatically specify their semantically important features.</p> <p>It must be emphasized that during its activities the team pays a special attention on possibility of interpretation of automatically created models, which is of huge importance for their subsequent practical application.</p>		<p>graphic material</p>



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<p><b>present activities:</b> Current activities include:</p> <ul style="list-style-type: none"> <li>• image content analysis basing on structural representations other than regular grid of pixels,</li> <li>• graph data analysis</li> <li>• generalization of such techniques like active contours,</li> <li>• development and adaptation of currently leading deep learning solutions (convolutional and recurrent neural networks),</li> <li>• explanation of the processes occurring in trained models and interpretation of their results,</li> <li>• music recordings analysis, feature extraction and pattern analysis in sound signal using neural networks</li> <li>• searching for melody patterns in music recordings. Current research involves:</li> <li>• development of convolutional, including graph, neural networks together with method of their working interpretation,</li> <li>• structural prediction, semantic segmentation, active contours and their generalizations,</li> <li>• searching for methods of additional, expert knowledge usage, other then set of samples, during data analysis,</li> <li>• usage and interpretation of convolutional networks in sound signal analysis.</li> </ul>	
<p><b>Future activities:</b> Future activities covers:</p> <ul style="list-style-type: none"> <li>• further work on theoretical development of classic and graph convolutional neural networks</li> <li>• strengthening interpretation abilities of existing and new solutions</li> <li>• cooperation with external partners in order to apply classic and designed solutions for solving practical problems</li> </ul>	
<p><b>Keywords:</b> multidimensional data analysis, analysis of images and their sequences, graph analysis, pattern recognition, machine learning, artificial intelligence</p>	
<p><b>List of internship proposal in this research team:</b> Sample research topics:</p> <ol style="list-style-type: none"> <li>1. Image analysis using graph convolutional neural networks.</li> <li>2. Interpretation of convolutional, including graph, neural networks working.</li> </ol>	
<p><b>List of attachments:</b> None</p>	