

Streszczenie w języku angielskim

This dissertation is a monothematic series of scientific publications on the application of artificial intelligence methods with a particular focus on the reinforcement learning algorithm. The work is interdisciplinary in nature and considers two main main branches: image processing tasks and control tasks. In the first, the topic of gesture detection through temporal segmentation of the video stream is addressed. The second branch focuses on controlling the spindle dynamics of a Computer Numeric Control (CNC) machine. Much of the research has been presented at international scientific conferences. Taking the above into account, the paper formulates the following research hypothesis.

It is possible to apply various artificial intelligence methods, especially the reinforcement learning algorithm, to both image processing and control tasks, with the goal of obtaining results no worse than with other methods known from the literature.

The hypothesis was made probable by performing the following tasks:

- 1) Literature studies on the use of the reinforcement learning algorithm to:
 - a) solving image processing tasks,
 - b) solving control tasks.
- 2) Collecting the necessary data and creating a set that allows training and verifying the correctness of the tested methods:
 - a) for the task of gesture detection,
 - b) for the task of controlling the dynamics of movement of the CNC machine spindle.
- 3) To propose a method that allows:
 - a) temporal segmentation of a continuous stream of gestures,
 - b) optimization of the control of the dynamics of the CNC machine spindle movement based on fuzzy logic,
 - c) optimize the control of the spindle motion dynamics of the CNC machine based on the reinforcement learning paradigm

Task 1. Literature studies on the use of the reinforcement learning algorithm

- a) The task was accomplished by preparing a literature review, which was presented at a national conference and collected in the form of a publication. The accumulated knowledge provided inspiration during further work.

- b) The task was accomplished by preparing a literature review, which was presented at an international conference and collected in the form of a publication. The accumulated knowledge provided inspiration during further work.

Task 2. Collect the necessary data and create a collection that allows to train and verify the correctness of the methods studied

- a) The task was carried out by creating a specialized database used during the research on the proposal of an algorithm whose task was to detect gestures in a continuous video stream through its temporal segmentation.
- b) The task was performed by creating a specialized database used during the research on the proposal of an algorithm whose task was to optimize the operation of a CNC machine through appropriate control of the dynamics of spindle movement.

Task 3. Propose the author's method

- a) The task was accomplished by publishing a paper describing a proposed method for temporal segmentation of a gesture stream. The paper also proposed an author's method of preprocessing video clips to minimize the adverse effects of a number of factors. The paper uses both deep neural networks and a reinforcement learning paradigm.
- b) The task was accomplished through the publication of two scientific articles that present proposed solutions based on fuzzy logic expert systems. In the course of the research, a particle swarm optimization algorithm and a genetic algorithm were also used to learn a set of rules. The results of the research were presented at the conference.
- c) The task was accomplished through the publication of a scientific article, in which the proposed solution based on neural network and reinforcement learning paradigm is presented. The results of the research were presented in the framework of the conference.

Keywords: artificial intelligence, reinforcement learning, image processing, control tasks, CNC machines, optimization