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Master Thesis

in

Automatic Control and Robotics

of

The Department of Robotics and Decision Systems

2023/2024

All the diploma projects given in the Polish version can be performed and edited in English. **Below you can find few samples of MSC Thesis in English**

Master diploma thesis title in English language

Ms Thesis Title (Polish)	Dedykowany system edukacyjny do modelowania i identyfikacji parametrycznej złożonych obiektów automatyki
Ms Thesis Title (English)	<i>A dedicated educational system for modelling and parameter identification of complex automation plants</i>
Project supervisor	J. Kozłowski, PhD
Project consultant	J. Kozłowski, PhD
Project goal	Student has to be familiar with professional knowledge on system modelling (e.g. partial differential equations, non-linear state-space models) and non-trivial estimation schemes. Hardware part with analog devices (e.g. DC engines) has to be assembled. Yet, on-line presentation (PC screen) of estimation results has to be available in the ultimately manufactured set.
Tasks	<ol style="list-style-type: none"> 1. Perform extended studies on the professional literature on modelling of non-trivial continuous-time automation systems. 2. Implement and verify numerically the selected schemes of parameter estimation of different industrial plants. 3. Design and implement hardware part of the educational set.
Bibliography	<ol style="list-style-type: none"> 1. Ljung L.: System identification. Theory for the user. Prentice-Hall Inc., Englewood Cliffs, New Jersey, USA, 1987 2. Unbehauen H., Rao G.P.: Continuous-time approaches to system identification - a survey. Automatica, vol. 26, 1990
Number of authors	1 person
Comments	JKe1

Master Thesis Subject (English)	Implementation and research of selected self-organizing artificial neural networks
Temat w języku pol.	<i>Implementacja i badania wybranych samoorganizujących się sztucznych sieci neuronowych</i>
Supervisor	dr hab. inż. Tomasz Talaśka
Consultant	
Aims	The aim of the master's thesis is the implementation and research of selected self-organizing, competitive neural networks of the type WTA (Winner Takes All), WTM (Winner Takes Most) and NG (Neural Gas)
Tasks	<ol style="list-style-type: none"> 1. Literature review and theoretical considerations on the discussed neural networks and their use in various applications 2. Implementation of selected networks, configuration of settings, tests and possible modifications 3. Preparation of training and testing data 4. Tests of selected networks and their direct comparison 5. Conclusions and observations
Literature	<ol style="list-style-type: none"> 1. Thevo Kohonen, Self-organizing maps, Springer, 2000 2. Jacek M. Żurada, introduction to Artificial Neural System, Treshold, 1993
Number of contractors	1
Comments	TTe1:

Master Thesis Subject (English)	Project and implementation of a laboratory stand for testing an intelligent building control system using a PLC controller
Temat w języku pol.	<i>Projekt i realizacja stanowiska laboratoryjnego do badania systemu sterowania inteligentnym budynkiem z wykorzystaniem sterownika PLC</i>
Supervisor	dr hab. inż. Tomasz Talaśka
Consultant	
Aims	The aim of the master's thesis is the project, implementation and research of a laboratory stand for testing a smart home control system using a PLC controller
Tasks	<ol style="list-style-type: none"> 1. Literature review and theoretical considerations on the smart city, smart home and buildings, etc. 2. Description of the construction and communication of PLC controllers. Examples of PLC use in smart city and building control systems 3. Project, implementation and tests of a laboratory stand: a) preparation of a model of an intelligent building b) assembly of appropriate sensors and elements imitating the operation of home appliances (e.g. radiators), c) implementation of a program for a PLC controller, d) development of instructions for exercises, e) model testing, methods of its control, etc 4. Developing a concept for extending the stand with new modules (e.g. garden watering system, etc.), conclusions.
Literature	P.Vivekanandan, D.L.Prakash, J.Anitha, Building Management System using PLC, Indian Journal of Emerging Electronics in Computer Communications, Vol.2, Iss. 1, 2015.
Number of contractors	1
Comments	TTe2

Master Thesis Subject (English)	Implementation and comparison of selected artificial intelligence algorithms to exchange rate forecast
Temat w języku pol.	<i>Implementacja i porównanie wybranych algorytmów sztucznej inteligencji w prognozowaniu zmienności kursu walut</i>
Supervisor	dr hab. inż. Tomasz Talaśka
Consultant	
Aims	The aim of the master's thesis is the implementation and research of selected artificial intelligence algorithms to exchange rate forecast with particular emphasis on critical situations in the country (e.g. stock market crash, war, etc.)
Tasks	<ol style="list-style-type: none"> 1. Literature review and theoretical considerations on systems for predicting exchange rate volatility 2. Preparation of training, validation and testing data, determination of forecasting conditions, including critical periods 3. Implementation and tests of selected algorithms and their direct comparison 4. Conclusions
Literature	Katsuki Ito, Hitoshi Iima, Yoshihiro Kitamura, LSTM forecasting foreign exchange rates using limit order book, Finance Research Letters, 2022
Number of contractors	1
Comments	TTe3

Master Thesis Subject (English)	Analysis and research of selected swarm algorithms using various, multidimensional test functions
Temat w języku pol.	<i>Analiza i badania wybranych algorytmów rojowych z wykorzystaniem różnych, wielowymiarowych funkcji testowych</i>
Supervisor	dr hab. inż. Tomasz Talaśka
Consultant	
Aims	The aim of the master's thesis is the implementation (at least 3) of selected swarm algorithms and their comparative analysis using various test functions.
Tasks	<ol style="list-style-type: none"> 1. Literature review on swarm algorithms and their use in various applications. Detailed analysis of algorithms selected for implementation. 2. Implementation of selected algorithms, test functions, preparation and selection of an appropriate programming environment 3. Configuration and tests of algorithms, modifications, tests of algorithms for various functions (different types, dimensions). 4. Preparing a comparative analysis, conclusions, observations
Literature	Selected publications from the journal: https://www.sciencedirect.com/journal/swarm-and-evolutionary-computation
Number of contractors	1
Comments	TTe4

Master Thesis Subject (English)	Application of genetic programming to solve maze problems
Master Thesis Subject (Polish)	<i>Zastosowanie programowania genetycznego do rozwiązywania problemów labiryntowych</i>
Supervisor	dr inż. Tomasz Białaszewski
Consultant	dr inż. Tomasz Białaszewski
Aims	The aim of the work is to develop genetic programming algorithms to solve maze problems. Implementation of the considered approach should be done in the Racket environment.
Tasks	<ol style="list-style-type: none"> 1. Carrying out bibliographic searches. 2. Development and implementation of genetic programming algorithms 3. Carrying out appropriate simulation experiments 4. Presentation of numerical results 5. Conclusions (advantages, limitations, e.t.c.)
Literature	<ol style="list-style-type: none"> 1. https://racket-lang.org 2. Koza, J.R. (1992). Genetic Programming: On the Programming of Computers by Means of Natural Selection, MIT Press
Number of contractors	1 person
Comments	TBe1

Master Thesis Subject (English)	Genetic programming in symbolic regression problems
Master Thesis Subject (Polish)	<i>Programowanie genetyczne w problemach regresji symbolicznej</i>
Supervisor	dr inż. Tomasz Białaszewski
Consultant	dr inż. Tomasz Białaszewski
Aims	The aim of the work is to develop genetic programming algorithms to wide class symbolic regression problems. Implementation of the considered approach should be done in the Racket environment.
Tasks	1. Carrying out bibliographic searches. 2. Development and implementation of genetic programming algorithms 3. Carrying out appropriate simulation experiments 4. Presentation of numerical results 5. Conclusions (advantages, limitations, e.t.c.)
Literature	1. https://racket-lang.org/ 2. <i>Koza, J.R. (1992). Genetic Programming: On the Programming of Computers by Means of Natural Selection, MIT Press</i>
Number of contractors	1 person
Comments	TBe2

Master Thesis Subject (English)	A visual system for the navigation of a mobile robot
Master Thesis Subject (Polish)	<i>Wizualny system dla celów nawigacji robota mobilnego</i>
Supervisor	prof. dr hab. inż. Zdzisław Kowalczuk
Consultant	dr inż. M. Domżański
Aims	Development of a visual navigation system for a mobile robot operating in an indoor environment, which includes mapping / SLAM (enabling the recognition of obstacles) and generating the trajectory of the movement of a real mobile robot. It is worth considering the use of the Gaussian method of raycasting, then in the process of analyzing the paths possible to reach the destination point, one can estimate the density of the target function distribution.
Tasks	1. Literature review of solutions and algorithms, 2. Development of a mapping method, 3. Development of a path planning method related to point 2.4. Conducting tests, 5. Elaboration of the results.
Literature	1. Takayuki Osa. Multimodal trajectory optimization for motion planning. The International Journal of Robotics Research, 39(8):983–1001, 2020. 2. Wontek Lim et al. Hybrid trajectory planning for autonomous driving in on-road dynamic scenarios. IEEE Transactions on Intelligent Transportation Systems, 22(1):341–355, 2019.
Number of contractors	1
Comments	ZKe1: Working with elements of mathematical statistics.

Master Thesis Subject (English)	Analysis of the structure of datasets from the point of view of the effectiveness of teaching deep neural networks
Master Thesis Subject (Polish)	<i>Analiza struktury zbiorów danych z punktu widzenia skuteczności uczenia głębokich sieci neuronowych</i>
Supervisor	prof. dr hab. inż. Zdzisław Kowalczyk
Consultant	mgr inż. Jan Glinko
Aims	The databases used play a key role in data-driven approaches such as neural network training. Dataset characteristics such as diversity and balance are important here, as well as teaching positive and negative cases. Research studies of various cases should be carried out and practical conclusions on how to generate such databases should be presented..
Tasks	<ol style="list-style-type: none"> 1. Review of the subject literature, 2. Implementation of selected methods and datasets, 3. Carrying out training processes (ANN/DNN), 4. Presentation of the results..
Literature	<ol style="list-style-type: none"> 1. T. Mensink et al.: Factors of influence for transfer learning across diverse appearance domains and task types. arXiv preprint arXiv:2103.13318 (2021). 2. V. Cheplygina: Cats or CAT scans: Transfer learning from natural or medical image source data sets? Current Opinion in Biomedical Engineering 9, 21-27, 2019. 3. H. Bao, D. Li, and W. Furu: Beit: Bert pre-training of image transformers. arXiv preprint arXiv:2106.08254 (2021) 4. Z. Kowalczyk, J. Glinko: Training of deep learning models using synthetic datasets, 15th IC on Diagnostics of Processes and Systems, DPS'2022, ref. no. 111, 2022.
Number of contractors	1
Comments	ZKe2:

Master Thesis Subject	Head pose estimation in 3D space – review of solutions and critical analysis
Temat w języku pol.	Estymacja pozycji głowy w przestrzeni 3D – przegląd rozwiązań i analiza krytyczna
Supervisor	prof. dr hab. inż. Zdzisław Kowalczyk
Consultant	mgr inż. Jan Glinko
Aims	Review the available solutions and implementations for head position estimation in 3D space based on the image from the RGB camera. Building an appropriate dataset and evaluating the available algorithms.
Tasks	<ol style="list-style-type: none"> 1. Read the literature 2. Create a test environment 3. Carry out tests and describe the conclusions
Literature	1. Abate A., Bisogni C., Castiglione A., Nappi M.: <i>Head pose estimation: An extensive survey on recent techniques and applications</i> , Pattern Recognition, wolumin 127, 06.2022
Number of contractors	1
Comments	ZKe3: