AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Neural networks and fuzzy systems in engineering

Academic year: 2013/2014 Code: RMS-1-608-s ECTS credits: 3

Faculty of: Mechanical Engineering and Robotics

Field of study: Mechatronics with English as instruction languagege Specialty: —

Study level: First-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 6

Course homepage: —

Responsible teacher: dr inż. Czop Piotr (pczop@agh.edu.pl)

Academic teachers: dr inż. Czop Piotr (pczop@agh.edu.pl)

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	is able to evaluate important and less important aspects (priorities) in a solving process of engineering problems with the use of neural networks or fuzzy-logic systems		Engineering project, Execution of laboratory classes
M_K002	learns and develops teamwork skills		Involvement in teamwork
M_K003	improves ability to evaluate required human and hardware resources in application to solve engineering problems with neural networks and fuzzy-logic systems		Engineering project
Skills			
M_U001	is able to define a neural network structure required to solve a given engineering problem		Execution of laboratory classes
M_U002	is able to create a multi-layer neural network with a topology adequate to solve a simple engineering task, e.g. approximation of data generated with the use of a nonlinear mathematical function.		Execution of laboratory classes

M_U003	is able to develop a fuzzy-logic system allowing to conduct an inference process in order to solve a simple engineering task, e.g. taking design or maintenance decision, grouping or classifying data sets		Execution of laboratory classes
Knowledge			
M_W001	has a fundamental knowledge regarding neural network taxonomy, architectures and topologies. knows basic methods of learning of neural networks.		Test
M_W002	has fundamental knowledge in area of fuzzy algebra and fuzzy inference methods		Test
M_W003	has knowledge about adjustment and identification of parameters of neural and fuzzy logic systems and their combinations with the use of numerical optimization methods.		Test
M_W004	has ability to provide research and commercial application areas of neural networks and fuzzy-logic systems taking into account their strengths and weaknesses (advantages/disadvantages)		Test

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Others	Fieldwork classes	Workshops	E-learning
Social competence												
M_K001	is able to evaluate important and less important aspects (priorities) in a solving process of engineering problems with the use of neural networks or fuzzy-logic systems	+	-	+	-	-	-	-	-	-	-	-
M_K002	learns and develops teamwork skills	-	-	+	-	-	-	-	-	-	-	-
M_K003	improves ability to evaluate required human and hardware resources in application to solve engineering problems with neural networks and fuzzy-logic systems	-	-	+	-	-	-	-	-	-	-	-
Skills												
M_U001	is able to define a neural network structure required to solve a given engineering problem	-	-	+	-	-	-	-	-	-	-	-

M_U002	is able to create a multi-layer neural network with a topology adequate to solve a simple engineering task, e.g. approximation of data generated with the use of a nonlinear mathematical function.	-	-	+	-	-	-	-	-	-	-	-
M_U003	is able to develop a fuzzy-logic system allowing to conduct an inference process in order to solve a simple engineering task, e.g. taking design or maintenance decision, grouping or classifying data sets	-	-	+	-	-	-	-	-	-	-	-
Knowledge												
M_W001	has a fundamental knowledge regarding neural network taxonomy, architectures and topologies. knows basic methods of learning of neural networks.	+	-	-	-	-	-	-	-	-	-	-
M_W002	has fundamental knowledge in area of fuzzy algebra and fuzzy inference methods	+	-	-	-	-	-	-	-	-	-	-
M_W003	has knowledge about adjustment and identification of parameters of neural and fuzzy logic systems and their combinations with the use of numerical optimization methods.	+	-	-	-	-	-	-	-	-	-	-
M_W004	has ability to provide research and commercial application areas of neural networks and fuzzy-logic systems taking into account their strengths and weaknesses (advantages/disadvantages)	+	-	-	-	-	-	-	-	-	-	-

Module content

Lectures

1. Introduction
2. Model of an artifical neuron
3. Topologies and classification of neural networks
4. Fuzz-sets theory and fuzzy inference methods
5. Classification of fuzzy-systems.
6. Neural networks and fuzzy system learning process
7. Application scope

Laboratory classes

1. Network topologies
2. Training methods

3. Fuzzy system inference mechanism
4. Applications: time series forecasting
5. Applications: approximation and modeling of dynamic systems
6. Applications: pattern recognition

Method of calculating the final grade
Average from an exam and laboratory exercises (project-orientated work)

Prerequisites and additional requirements
Ability to work with Matlab/Simulink packages
Ability to use an algorithmic approach to solve engineering problems
Knowledge about numerical methods including algorithms for minimizing the criterial function regarding the zero-order methods (searching), first-, and second order methods (first/second derivative)
Knowledge about fuzzy algebra and fuzzy-logic inference methods
Knowledge about theory of neural networks

Recommended literature and teaching resources
1. Tadeusiewicz R.: Sieci neuronowe, Warszawa 1993
2. Tadeusiewicz R.: Odkrywanie właściwości sieci neuronowych przy użyciu programów w języku C1. , Kraków 2007
3. Żurada J., Barski M., Jędruch M.: Sztuczne sieci neuronowe, Warszawa 1996
4. Fausett L., Fundamental of Neural Networks architectures, algorithms, and applications, Prentice Hall, USA 1994.
5. Osowski S., Sieci neuronowe do przetwarzania informacji, Warszawa 2006.

Scientific publications of module course instructors related to the topic of the module
Additional scientific publications not specified

Additional information
None

Student workload (ECTS credits balance)

Student activity form	Student workload
Realization of independently performed tasks	50 h
Preparation for classes	30 h
Summary student workload	80 h
Module ECTS credits	3 ECTS