TOP 10 NEURAL NETWORK PAPERS: RECOMMENDED READING – ARTIFICIAL INTELLIGENCE RESEARCH

https://neuralnetworktoppapers.wordpress.com/

Predicting Learners Performance Using Artificial Neural Networks in Linear Programming Intelligent Tutoring System

Samy S. Abu Naser, Al-Azhar University-Gaza, Palestine.

ABSTRACT

In this paper we present a technique that employ Artificial Neural Networks and expert systems to obtain knowledge for the learner model in the Linear Programming Intelligent Tutoring System(LP-ITS) to be able to determine the academic performance level of the learners in order to offer him/her the proper difficulty level of linear programming problems to solve. LP-ITS uses Feed forward Back-propagation algorithm to be trained with a group of learners data to predict their academic performance. Furthermore, LP-ITS uses an Expert System to decide the proper difficulty level that is suitable with the predicted academic performance of the learner. Several tests have been carried out to examine adherence to real time data. The accuracy of predicting the performance of the learners is very high and thus states that the Artificial Neural Network is skilled enough to make suitable predictions.

KEYWORDS

Linear Programming, Intelligent Tutoring System, backprobagation, Artificial Neural Network.

For More Details : http://aircconline.com/ijaia/V3N2/3212ijaia06.pdf

Volume Link : http://airccse.org/journal/ijaia/current2012.html

REFERENCES

[1] Abu Naser, S., Ahmed, A., Al-Masri, N. and Abu Sultan,Y., (2011), Human Computer Interaction Design of the LP-ITS: Linear Programming Intelligent Tutoring Systems, International Journal of Artificial Intelligence & Applications, 2(3).

[2] Abu Naser, S., (2012).A Qualitative Study of LP-ITS: Linear Programming Intelligent Tutoring System, International Journal of Computer Science & Information Technology, 3(1).

[3] Roll, I., Aleven, V., McLaren, B. M., & Koedinger, K. R. (2011). Improving students' help-seeking skills using metacognitive feedback in an intelligent tutoring system. Learning and Instruction, 21(2).

[4] Abu Naser, S. and Abu Zaiter O., (2008). An Expert System For Diagnosing Eye Diseases Using Clips, Journal of Theoretical and Applied Information Technology, 5(4).

[5] Abu Naser, S. El- Hissi, H., Abu- Rass, M. and El- khozondar, N., (2010). An Expert System for Endocrine Diagnosis and Treatments using JESS, Journal of Artificial Intelligence, 3(4).

[6] Shakiba, M., Teshnehlab, M., Zokaie,S., and Zakermoshfegh M., (2008). Short-Term Prediction of Traffic Rate Interval Router Using Hybrid Training of Dynamic Synapse Neural Network Structure 8(8).

[7] Khatib, T. and AlSadi,S., (2011). Modeling of Wind Speed for Palestine Using Artificial Neural Network. Journal of Applied Sciences 11(4).

[8] Tanoh, A., Konan, K., Koffi, S., Yeo, Z., Kouacou, M., Koffi, B. and Nguessan S.,(2008). A Neural Network Application for Diagnosis of the Asynchronous Machine. Journal of Applied Sciences 8(19).

[9] Senol, D. and Ozturan,M., (2010). Stock price direction prediction using artificial neural network approach: The case of Turkey. J. Artif. Intell., 3: 261-268.

[10] Lotfi, A. and Benyettou, A., (2011). Using Probabilistic Neural Networks for Handwritten Digit Recognition. Journal of Artificial Intelligence 4(4).

[11] Khanale, P. and Chitnis, S.,(2011). Handwritten Devanagari Character Recognition using Artificial Neural Network. Journal of Artificial Intelligence 4(1).

[12] Eriki, P. and Udegbunam, R. (2010). Application of neural network in evaluating prices of housing units in Nigeria: A preliminary investigation. J. Artif. Intell., 3: 161-167

[13] Shahrabi, J., Mousavi, S. and Heydar, M., (2009). Supply Chain Demand Forecasting: A Comparison Of Machine Learning Techniques and Traditional Methods. Journal of Applied Sciences 9(3).

[14] Kanakana1, G. and Olanrewaju, A. (2011). Predicting student performance in Engineering Education using an artificial neural network at Tshwane university of technology, ISEM 2011 Proceedings, September 21-23, Stellenbosch, South Africa.

[15] Kyndt, E., Musso, M., Cascallar, E. and Dochy, F., (2011). Predicting academic performance in higher education: Role of cognitive, learning and motivation. Earli Conference 2011 edition:14th location:Exeter, UK date:30 August - 3 September 2011.

[16] Mukta P. and Usha A., (2009). A study of academic performance of business school graduates using neural network and statistical techniques, Expert Systems with Applications, volume: 36, Issue: 4, Elsevier Ltd, ; pp.: 7865-7872

[17] Croy, M., Barnes, T., and Stamper, J. (2008). Towards an Intelligent Tutoring System for Propositional Proof Construction, Computing and Philosophy, A. Briggle, K. Waelbers, and P. Brey (Eds.), IOS Press, Amsterdam, Netherlands pp. 145-15.

Comparison of Support Vector Machine and Back Propagation Neural Network in Evaluating the Enterprise Financial Distress

Ming-Chang Lee[1] and Chang To[2], [1]Fooyin University, Taiwan and

[2]Shu-Te University, Taiwan.

ABSTRACT

Recently, applying the novel data mining techniques for evaluating enterprise financial distress has received much research alternation. Support Vector Machine (SVM) and back propagation neural (BPN) network has been applied successfully in many areas with excellent generalization results, such as rule extraction, classification and evaluation. In this paper, a model based on SVM with Gaussian RBF kernel is proposed here for enterprise financial distress evaluation. BPN network is considered one of the simplest and are most general methods used for supervised training of multilayered neural network. The comparative results show that through the difference between the performance measures is marginal; SVM gives higher precision and lower error rates.

KEYWORDS

Enterprise Financial Distress, Support Vector Machines, Back-Propagation Neural Network, Gaussian RBF Kernel.

REFERENCES

[1] Bongini, P., Laeven, L., and Majnoni, G., (2002), "How good is the market at assessing bank fragility? A Horse Race between different indictors", Journal of banking & Finance, Vol. 26, pp. 1011-1028.

[2] Chakraborty, S., Sharma, S. K., (2007), "Prediction of corporate financial health by Artificial Neural Network", International Journal of Electronic Finance, Vol. 1, No. 4, pp. 442-459

[3] Chang, C. C., and Lin, C. J., (2009), LIBSVM: a library for support vector machines. Software available at http://www.csie.ntu.edu.tw/"cjin/libsvm. (2009-11-18)

[4] Chen, A. S. and Leung, M. T., (2004), "Regression Neural Network for error correction in foreign exchange forecasting and trading", Computers & Operations Research, Vol. 31, pp. 1049-1068.

[5] Chen, A. S., Leung , M. T. and Daouke, H.,(2003), "Application of neural networks to an emerging financial market: Foresting and training the Taiwan stock index", Computers and Operations Research, Vol. 31, pp. 901-923.

[6] Coats, P. K. and Fant, L. F., "Recognizing financial distress pattern using a neural network tool, Financial", Management, Autumn, (1993) pp. 142-155

[7] Cristianini, N.,and Shawe-Taylor, J., (2000), "An Introduction to Support Vector Machines", Cambridge University Press.

[8] Fan, A., and Palaniswami, M., (2000), "Selecting bankruptcy predictors using a support vector machine approach", Proceedings of the International Joint Conference on Neural Network, pp. 340-352.

[9] Fausett, L., (1994), "Fundamentals of Neural Networks: Architecture", Algorithms and Applications, New Jersely: Prentice-Hall.

[10] Gestel, T. V., Baestens, B., Suykens, J., and Poel, D. V., (2006), "Bayesian kernel based on classification for financial distress detection", European Journal of operational Research, Vol. 172, pp. 979-1003.

[11] Keerthi, S. S. and Lin, C. C., (2003), "Asymptotic behaviors of Support vector machines with Gaussian Kernel", Neural Computation, Vol. 15, No. 7, pp. 1667-1689.

[12] O'Neill, T. J. and Penm, J., (2007)," A new approach to testing credit rating of financial debt issuers", International Journal of Services and Standards, Vol.3, No.4, 390-401

[13] Odom, M., and Sharda, R., (1990), "A neural network model for bankruptcy prediction", IEEE INNS International Joint Conference on Neural Networks, Vol. 12, pp. 163-168.

[14] Pompe, P. M. and Bilderbeek, J., (2005), "The Prediction of Bankruptcy of Small and Medium Size Industrial Firms", Journal of Business Venturing, Vol. 20, pp. 847-868.

[15] Randall, S. S. and Dorsey, R. E (2000), " Dorsey, Reliable Classification Using Neural Networks: A Genetic Algorithm and Back Propagation Comparison", Decision Support Systems, 30, pp. 11-22.

[16] Schölkopf, S. C. Burges, J. C., and Smola, A. J., (1999), "Advances in Kernel Methods: Support Vector Learning", MIT Press, Cambridge, MA.

[17] Su, C. T., Yang, T. , and Ke, C. M. , (2002), "A neural network approach for semiconductor wafer post-sawing inspection", IEE Transaction on Semiconductor Manufacturing,, Vol. 15, No. 2, pp. 260-266.

[18] Tam, K. Y. and Kiang, M., (1992), " Managerial applications of neural network: the case of bank failure predictions", Management Sciences, Vol. 38, pp. 927-947

[19] Vapnik, V. N., (1999), "Statistical learning theory", New York: J. Wiley-Interscience.

[20] enugopal, V. V. and Baets, W., (1994), "Neural Networks and Statistical Techniques in Marketing Research: A Concept Comparison", Marketing Intelligence and Planning , Vol.1, No. 7, pp. 23-30

[21] Yuan, S. F. and Chu, F. L., (2006), "Support vector machines based on fault diagnosis for turbo-pump rotor", Machine Systems and Signal Processing, Vol. 20, pp. 939-952

[22] Yuan, X., (2007), "Grey Relational Evaluation of Financial Situation of Listed Company", Journal of Modem Accounting and Auditing, Vol. 3, No. 3, pp. 41-44

[23] Zhang, Z., Hu, M., and Platt, H., (1999), "Artificial neural networks in bankruptcy prediction: General framework and cross-validation analysis", European Journal of Operation Research, Vol. 116 pp. 16-32.

[24] Singh, A. P., Rai, C. S., and Chandra, P., (2010), "Empirical Study of FFANN Tolerance to Weight Stuck at Max/Min Fault, International Journal of Artificial Intelligence & Application, Vol. 1, No. 2, pp. 13-21.

An Efficient Automatic Mass Classification Method In Digitized Mammograms Using Artificial Neural Network

Mohammed J. Islam[1], Majid Ahmadi[2] and Maher A. Sid-Ahmed[3]

Department of Electrical and Computer Engineering, University of Windsor, 401 Sunset Avenue, Windsor, ON N9B 3P4, Canada

ABSTRACT

In this paper we present an efficient computer aided mass classification method in digitized mammograms using Artificial Neural Network (ANN), which performs benign-malignant classification on region of interest (ROI) that contains mass. One of the major mammographic characteristics for mass classification is texture. ANN exploits this important factor to classify the mass into benign or malignant. The statistical textural features used in characterizing the masses are mean, standard deviation, entropy, skewness, kurtosis and uniformity. The main aim of the method is to increase the effectiveness and efficiency of the classification process in an objective manner to reduce the numbers of false-positive of malignancies. Three layers artificial neural network (ANN) with seven features was proposed for classifying the marked regions into benign and malignant and 90.91% sensitivity and 83.87% specificity is achieved that is very much promising compare to the radiologist's sensitivity 75%.

KEYWORDS

Artificial Neural Network, Digitized Mammograms, Texture Features.

REFERENCES

[1] A. Oliver, J. Freixenet, R. Marti, J. Pont, E. Perez, E.R.E. Denton, R. Zwiggelaar, (2008) "A novel breast tissue density classification methodology", IEEE Transactions on Information Technology in Biomedicine, Vol. 12, No.1, pp. 55-65.

[2] R.E. Bird (1990) "Professional quality assurance for mammography screening programs", Journal of Radiology, Vol. 175, pp. 587-605.

[3] H.D. Cheng, X.J. Shi, R. Min, L.M. Hu, X.P. Cai, H.N. Du (2006) "Approaches for automated detection and classification of masses in mammograms", Pattern Recognition, Vol. 39, pp. 646-668.

[4] S.C. Yang, C.M. Wany et.al. (2005) "A Computer-aided system for mass detection and classification in digitized mammograms", Journal of Biomedical Engineering-Applications, Basis and Communications, Vol. 17, pp. 215-228.

[5] R. O. Duda, P. E. Hart, D. G. Stork (2001), Pattern Classification, John Wiley and Sons, second edition.

[6] H.P. Chan, D. Wei, M.A. Helvie, B. Sahiner et.al. (1995) "Computer-aided classification of mammographic masses and normal tissue: linear discriminant analysis in texture feature space", Journal of Physics in Medicine and Biology, Vol. 40, pp. 857-876.

[7] B. Sahiner, N. Petrick, H.P. Chan (2001) "Computer-aided characterization of mammographic masses: accuracy of mass segmentation and its effects on characterization", IEEE Trans. Med. Imaging, Vol. 20, No. 12, pp. 1275–1284.

[8] J.L. Viton, M. Rasigni, G. Rasigni, A. Liebaria (1996) "Method for characterizing masses in digital mammograms", Opt. Eng., Vol. 35, No. 12, pp. 3453–3459.

[9] P.J.G. Lisboa, (2000) "A review of evidence of health benefits from artificial neural networks in medical intervention", Neural Networks, Vol. 15, pp. 11-39.

[10]Y. Alginahi (2004) "Computer analysis of composite documents with non-uniform background", PhD Thesis, Electrical and Computer Engineering, University of Windsor, Windsor, ON, Canada.

[11]Y. Alginahi (2008) "Thresholding and character recognition in security documents with watermarked background", Proc. Int. Conf. on Digital Image Computing: Techniques and Applications, pp. 220- 225.

[12]B. Zheng, Y.H. Chang, X.H. Wang, W.F. Good (1999) "Comparison of artificial neural network and Bayesian belief network in a computer assisted diagnosis scheme for mammography", IEEE International Conference on Neural Networks, pp. 4181–4185.

[13]B. Sahiner, H.P. Chan, N. Petrick, M.A. Helvie, M.M. Goodsitt (1998) "Design of a high-sensitivity classifier based on a genetic algorithm: application to computer-aided diagnosis", Phys. Med. Biol. Vol. 43, No. 10, pp. 2853–2871.

[14]M.A. Sid-Ahmed (1995) "Image processing theory, algorithms and architectures", McGraw-Hill, New York, 1st edition.

[15]Y. Alginahi, M.A. Sid-Ahmed and M. Ahmadi (2004) “Local thresholding of composite documents using Multi-layer Perceptron Neural Network”, in 47th IEEE International Midwest Symposium on Circuits and Systems, pp. 209-212.

[16]J. Suckling et al. (1994) “The Mammographic Image Analysis Society Digital Mammogram Database Excerpta Medica”, International Congress Series, Vol. 1069, pp. 375-378. [17]DTREG, http://www.dtreg.com

FPGA Based Adaptive Neuro Fuzzy Inference Controller for Full Vehicle Nonlinear Active Suspension Systems

Ammar A. Aldair[1] and Weiji Wang[2ss]

School of Engineering and Design, University of Sussex, Falmer, East Sussex Brighton, BN1 9QT, UK

ABSTRACT

A Field Programmable Gate Array (FPGA) is proposed to build an Adaptive Neuro Fuzzy Inference System (ANFIS) for controlling a full vehicle nonlinear active suspension system. A Very High speed integrated circuit Hardware Description Language (VHDL) has been used to implement the proposed controller. An optimal Fraction Order PIλ D μ (FOPID) controller is designed for a full vehicle nonlinear active suspension system. Evolutionary Algorithm (EA) has been applied to modify the five parameters of the FOPID controller (i.e. proportional constant Kp, integral constant Ki , derivative constant Kd, integral order λ and derivative order μ). The data obtained from the FOPID controller are used as a reference to design the ANFIS model as a controller for the controlled system. A hybrid approach is introduced to train the ANFIS. A Matlab Program has been used to design and simulate the proposed controller. The ANFIS control parameters obtained from the Matlab program are used to write the VHDL codes. Hardware implementation of the FPGA is dependent on the configuration file obtained from the VHDL program. The experimental results have proved the efficiency and robustness of the hardware implementation for the proposed controller. It provides a novel technique to be used to design NF controller for full vehicle nonlinear active suspension systems with hydraulic actuators.

KEYWORDS

Full vehicle, Nonlinear Active Suspension System, Neuro-fuzzy Control, FPGA, Hardware Implementation.

REFERENCES

[1] Gilbert, B., A monolithic 16-channel Analog arry Normalizer. IEEE Journal of solid state circuits, 1984. 19(6): p. 956-963.

[2] Ishizuka, O., et al., Design of a Fuzzy Controller With Normalization Circuits. IEEE International Conference on Digital Objective Identifier, 1992: p. 1303-1308.

[3] Yamakawa, T., A Fuzzy Programmable Logic Array (Fuzzy PLA). IEEE International Conference on Digital Objective Identifier, 1992: p. 459-465.

[4] Manzoul, M.A. and D. Jayabharathi, FUZZY CONTROLLER ON FPGA CHIP. IEEE
International Conference on Digital Objective Identifier, 1992: p. 1309-1316.

[5] Obaid, Z.A., et al., Analysis and Performance Evaluation of PD-like Fuzzy Logic Controller Design Based on Matlab and FPGA International Journal of Computer Science, 2010. 37(2).

[6] Economakos, G. and C. Economakos, A Run-Time Recongurable Fuzzy PID Controller Based on Modern FPGA Devices. Mediterranean Conference on Control and Automation, 2007: p. 1-6.

[7] Tipsuwanpornm, V., et al., Fuzzy Logic PID controller based on FPGA for process control. IEEE International Syposium on Industrial Electronics, 2004. 2: p. 1495-1500.

[8] Hu, B.S. and J. Li, The Fuzzy PID Gain Conditioner: Algorithm, Architecture and FPGA
Implementation. IEEE International Conference on Industrial Technology, 1996: p. 621-624.

[9] Singh, B., et al., Design and VLSI implementation of Fuzzy Logic Controller International Journal of Computer and Network Security, 2009. 1(3).'

[10] S.Poorani, et al., FPGA BASED FUZZY LOGIC CONTROLLER FOR ELECTRIC VEHICLE.
Journal of The Institution of Engineers, 2005. 45(5): p. 1- 14.

[11] Cirstea, M., J. Khor, and M. McCormick, FPGA Fuzzy Logic Controller for Variable Speed Generator. IEEE International Conference on Control Application, 2001: p. 5-7.

[12 Barriga, A., et al., Modelling and implementation of fuzzy systems based on VHDL. International Journal of Approximate Reasoning, 2006. 41: p. 164-178.

[13] Blake, J.J., et al., The implementation of fuzzy systems, neural networks and fuzzy neural networks using FPGAs Information Science, 1998. 112: p. 151-168.

[14] Ando, Y. and M. Suzuki, Control of Active Suspension Systems Using the Singular Perturbation method. Control Engineering Practice, 1996. 4(33): p. 287-293.

[15] Merritt, H., Hydraulic Control Systems. 1969, USA: John wiley and Sons,Inc.

[16] xue, D., Y. Chen, and D. Atherton, Linear Feedback Controller Analysis and Design with MATLABE. 2007, USA: The Society for Industrial and Applied Mathematics.

[17] Back, T., Evolutionary Algorithms in Theory and Practice. 1996, London, UK: Oxford University Press.

[18] Nguyen, H.T., et al., A First Course in Fuzzy and Neural Control. 2003, USA: Chapman & Hall/ CRC.

[19] Jang, J.-S.R., ANFIS: Adaptive Network Based Fuzzy Inference System. IEEE Transaction on System, Man and Cybernetics 1993. 23(3): p. 665-686.

Artificial Neural Network Controller for Performance Optimization of Single Phase Inverter

Shubhangi S. Ambekar[1] and Madhuri A. Chaudhari[2], [1]K.D.K. College of Engg., India and [2]Visvesvaraya National Institute of Technology, India

ABSTRACT

Thyristorised Power control provides high efficiency. However, generated harmonics cause a nuisance in power system operation. The work presented here, deals with reduction of harmonics (3rd-11th) by using Multiple Pulse Modulation technique. Traditional numerical methods do not yield accurate pulse-positions as non-linearity is involved in computation. In this paper, a continuous Hopfiled Neural Network is designed for Harmonic minimization in a 1Φ inverter output voltage. Results show considerable improvement in voltage spectrum if trigger pulses are generated at the ANN positions as harmonic contents are reduced with significant improvement in fundamental voltage resulting in reduction in device ratings. The ANN controlled voltage is used to drive a 1Φ Induction motor in MATLAB simulation and is compared with SPWM controlled VSI driving the same motor load. The quantitative analysis is given in tabular form. This shows feasibility of design of a controller for optimized performance of a single phase VSI.

KEYWORDS

Neural Network controller, Harmonic minimization, Performance optimization, Inverter, Motor control.

For More Details: http://aircconline.com/ijaia/V3N1/3112ijaia05.pdf

Volume Link : http://airccse.org/journal/ijaia/current2012.html

REFERENCES

1. D. Jang, G. Choe, " Asymmetrical PWM method for ac chopper with improved input power factor", IEEE PESC Conf. Rec. , 1991, pp 838 - 845.

2. R. L. Kirlin, Sam Kwok, S. Legowski, A. M. Trzynadlowski, " Power Spectra of a PWM Inverter with Randomized Pulse Position", IEEE Trans. on Power Electronics, Vol. 9, No.5, Sept. 1994, pp 463 - 472.

3. H. R Karshenas, H. A. Kajori, S.B. Dewan, " Generalized Techniques of Selective Harmonic Elimination and Current Control in Current Source Inverters/ Converters", IEEE Trans. on Power Electronics, vol.10, No. 5, Sept. 1995, pp 567-573.

4. K. A. Krishnamoorthy, G. K. Dubey, G. N. Revankar, "Converter Control with Selective Reduction of Harmonics", Proc. IEE, vol. 125, No. 2, 1978, pp 141-145.

5. S. R. Bowes, P.R. Clark, " Regular Sampled Harmonic Elimination PWM Control of Inverter Drives", IEEE Trans. on Power Electronics, Vol. 10, No. 5, Sept. 1995, pp 521-531.

6. Maxfred Grotzbach, Reiner Redmann, "Analytical Predetermination of Complex Line-Current Harmonics in Controlled AC / DC Converters", IEEE Trans. on Industrial Applications, Vol. 33, No. 3, May-June 1997, pp 601-611.

7. S. S. Ambekar, A. G. Keskar, "A Neuro-Evolutionary Approach to Selective Harmonic Elimination for a Single Phase Converter / Inverter", International Conference on Evolutionary Computing, Computer, Communication, Control & Power, Chennai, Jan. 2000.

8. A Text Book on "Elements of Artificial Neural Networks", K. Mehrotra, C. K. Mohan, S. Ranka, Penram International Publishing, India.

9. Joy Mazumdar, R.G. Harley, F.C. Lambart, G.K. Venayagamoorthy, "Neural Network based Method for Predicting Non-linear Load Harmonics", IEEE Trans. On Power Electronics, vol.22, No. 3, May 2007, pp 1036-1045.

10. S. Joseph Jawhar, N.S. Marinuthu, "An Intelligent Controller for a non-linear Power Electronic Boost Converter", International Journal of Soft Computing 3 (1) : 69-73, 2008.

11. John W. Finch, Damian Giaouris, "Controlled AC Electric Drives", IEEE Trans. On Industrial Electronics, vol. 55, No. 2, Feb. 2008, pp 481-491.

The Energy Regeneration of Electromagnetic Energy Saving Active Suspension in Full Vehicle with Neuro fuzzy Controller

Ammar A. Aldair[1] and Weiji J. Wang[2]

School of Engineering and Design, University of Sussex, Falmer, East Sussex, UK

ABSTRACT

To improve the vehicle performance such as ride comfort and road handling, the active suspension system should be used. However, the current active suspension system has a high energy consumption therefore reducing the fuel economy. In this paper the vibration excited by road unevenness is treated as a source of mechanical energy. It is being converted into electrical energy to compensate for the energy consumption by the active suspension. To achieve this task, an electromagnetic active suspension system has been introduced. The power generated from this device has been used as input power of the pump of the hydraulic actuators. Adaptive neuro-fuzzy controllers have been designed to generate a signal to control the valves of the hydraulic actuators.

KEYWORDS

Energy regeneration, Electromagnetic suspension, Full vehicle model, Neuro-fuzzy control, Nonlinear hydraulic actuators.

REFERENCES

[1] Shian, C., H. Ren, and Senlin, L. New Reclaiming Energy Suspension and its Working Principle Chinese Journal of Mechanical Engineering, 2007. 13(11): pp. 177-182.

[2] Ren, H., C. Shian, and L. Senlin, A Permanent Magnetic Energy Regenerative Suspension. ZL 200520072480.9, 2005.

[3] Shian, C., H. Ren, and Senlin, L. Operation Theory and Structure Evaluation of Reclaiming Energy Suspension. Transactions of the Chinese Society for Agricultural Machinery, 2006. 37(5): pp. 5-9.

[4] Yong-chao, Z., et al., Isolation and Energy Regenerative Performance Experimental Verification of Automotive Electrical Suspension. Journal of Shanghai Jiaotong University, 2008. 42(6): pp. 874-877.

[5] Zhengquan, W. and C. Yu, Brief Introduction to Structure and Principle of Electromagnetic Shock Absorber. Motor Technology, 2007. 8: pp. 56-59.

[6] Karnopp, D., Power requirements for traversing uneven roadways. Vehicle System Dynamics, 1978. 7: pp. 135-152.

[7] Velinsky, S. and R. White, Vehicle Energy Dissipation due to Road Roughness. Vehicle System Dynamics, 1980. 9: p. 359-384.

[8] Karnopp, D., Permanent Magent Linear Motors used as Variable Mechanical Dampers for Vehicle Suspensions. Vehicle System Dynamics, 1989. 18: pp. 187-200.

[9] Suda, Y. and T. Shiiba, New Hybrid Suspension System with Active Control and Energy Regeneration. Vehicle System Dynamics, 1996. 25: pp. 641-654.

[10] Martins, I., et al., Permanent-Magnets Linear Actuators Applicability in Automobile Active Suspensions. IEEE Transaction on Vehicular Technology,, 2006. 55(1): pp. 86-94.

[11] Montazeri, M. and M. Soleymani, Investigation of the Energy Regeneration of Active Suspension Systemin Hybrid Electric Vehicles. IEEE Transaction on Industral Electronics, 2010. 57(3): pp. 918- 925.

[12] Xu, L., X. Guo, and J. Liu, Evaluation of Energy-regenerative Suspension Structure Based on Fuzzy Comprehensive Judgment. Advanced Materiral Research, 2010. 139-141: pp. 2636-2642.

[13] Zuo, L., et al., Design and Characterization of an Electromagnetic Energy Harvester for Vehicle Suspensions. Smart Mater. Structure, 2010. 19: pp. 1-10.

[14] Xue-chun, Z., U. Fan, and Z. Yong-chao, A Novel Energy Regenerative Active Suspension for Vehicles. J. Shanghai Tiaotong University, 2008. 13(2): pp. 184-188.

[15] Zulfatman and Rahmat M., Application of Self-tuning Fuzzy PID Controller on Industral Hydraulic Actoutor Using System Identification Approach. International Journal on Smart Sensing and Intelligent System, 2009. 2(2): pp. 246-261.

[16] H, M., Hydrulic Control Systems 1967, New York: John Wiley and Sons, Inc. International Journal of Artificial Intelligence & Applications (IJAIA), Vol.2, No.2, April 2011 43

[17] Ando, Y. and M. Suzuki, Control of Active Suspension System Using the Singular Perturbation Method Control. Engineering Practice, 1996. 4(3): pp. 287-293.

[18] Aldair, A. and W. Wang, FPGA Based Adaptive Neuro-Fuzzy Inference Controller for Full Vehicle Nonlinear Avtive Suspension System. International Journal of Artificial Intelligence and Applications (IJAIA), 2010. 1(4): pp. 1-13.

[19] Aldair, A. and W. Wang, Design of Fractional order Controller Based on Evolutionary Algorithm for a Full Vehical Nonlinear Active Suspension System. International Journal of Control and Automation (IJCA), 2010. 3(4): pp. 33-46.

[20] Chang, Y., N-Dimension Golden Section Search: Its Variants and Limitations. 2nd International Conference on Biomedical Engineering and Informatics, BMEI'09, 2009: pp. 1-6. A

Interpretation Trained Neural Networks Based on Genetic Algorithms

Safa S. Ibrahim and Mohamed A.Bamatraf, Assiut University, Egypt

ABSTRACT

In this paper, constructive learning is used to train the neural networks. The results of neural networks are obtained but its result is not in comprehensible form or in a black box form. Our goal is to use an important and desirable model to identify sets of input variable which results in a desired output value. The nature of this model can help to find an optimal set of difficult input variables. Accuracy. Genetic algorithms are used as an interpretation of achieving neural network inversion. On the other hand the inversion of neural network enables to find one or more input patterns which satisfy a specific output. The input patterns obtained from the genetic algorithm can be used for building neural network system explanation facilities.

KEYWORDS

Neural Networks, Genetic Algorithms , Constructive Learning, Accuracy.

REFERENCES

[1] C.J. Giles, D. Chen, G. Sun, H. Chen, Y. Lee, M.W. Goudreau, Constructive learning of recurrent neural networks: Limitations of recurrent cascade correlation and a simple solution, IEEE Trans. Neural Networks 6(1)(1995)829-836.

[2] R. Parekh, J. Yang, V. Honavar, Constructive neural networks learning algorithms for multi-category pattern classification, Technical Report TR95-15, AI Research Group, Dept. of Computer Science, Iowa State University, Tech. Rep. ISU-CS-TR97-06 (3)(1997)1924-1929.

[3] E. Littmann, H. Ritter, Learning and generalization in cascade network architectures, Neural Computation (8)7(1996)1521-1539.

[4] L. Prechelt, Investigation of the casCor family of learning algorithms, Neural Netwrks (10)5(1997)885-896.

[5] F. J. Smieja, Neural network constructive algorithms: Trading generalization for learning efficiency, Circuits, Systems and Signal Processing (12)2(1993)331-374.

[6] D. E. Goldberg, Genetic Algorithm in Search, Optimization, and Ma- chine Learning, AddisonWelsy, 2002.

[7] M. Mitchell, An Introduction to Genetic Algorithms, MIT press, 2005.

[8] R. Setiono, Extracting M-of-N rules from trained neural networks, IEEE Trans. on Neural Networks (11)2(2000)512-519.

[9] F. Wotawa, G. Wotawa, Deriving qualitative rules from neural networks-a case study for Ozone forecasting,AI Commun. (14)1(2001)23-33.

[10] A. Narayanan, E. Keedwell, D. Savic, Data Mining Neural Networks with Genetic Algorithms, 2008.

[11] M. Goebel, L. Gruenwald, A survey of data mining and knowledge discovery software tools, SIGKDD Explorations (1)1(1999)20-33.

[12] J. Han and M. Kamber, Data Mining: Concepts and Techniques, Second Edition, Morgan Kaufmann, 2006.

[13] W. Craven, Extracting Comprehensible Models from Trained Neural Networks, PhD thesis, Department of Computer Sciences, University of Wisconsin-Madison, 1996.

[14] G. Towell and J. Shavlik, The extraction of refined rules from knowledge-based neural networks, Machine Learning (13)1(1993)71-101.

[15] R. Andrews, J. Diederich, A. Tickle, Survey and critique of techniques for extracting rules from trained artificial neural networks, Knowledge Based System (8)6(1995)373-389.

[16] J. Neumann, Classification and Evaluation of Algorithms for Rule Ex- traction from Artificial Neural Networks, PhD. summer project, Uni- versity of Edingburgh, 1998.

[17] A. Darbari, Rule Extraction from Trained ANN: A Survey, Technical Report, Department of Computer Science, Dresden University of Tech- nology, Dresden, Germany, 2001.

[18] R. Krishnan, G. Sivakumar, P.Bhattacharya, A search technique for rule extraction from trained neural networks, Pattern Recognition Let- ters (20)3(1999)273-280.

[19] H. Tsukimoto, Extracting rules from trained neural networks, IEEE Trans. Neural Networks (11)2(2000)377-389.

[20] R. Setiono, Extracting rules from neural networks by pruning and hidden-unit splitting, Neural Computation (9)1(1997)205-225.

[21] W. Craven, Extracting Comprehensible Models from Trained Neural Networks, Ph.D. Dissertation, Univ. Wisconsin, 1996.

[22] Z. H. Zhou,Y. Jiang , S. F. Chen, Extracting symbolic rules from trained neural network ensembles, AI Commun. (16)1(2003)3-15.

[23] U. Markowska-Kaczmar and M. Chumieja, Discovering the mysteries of neural networks, International Journal of Hybrid Intelligent Systems (1)3,4(2004)153-163.

[24] U. Markowska-Kaczmar, The influence of prameters in evolutionary based rule extraction method from neural network, in: Proceedings of the Fifth International Conference on Intelligent Systems Design and Applications (ISDA 2005), 8-10 September, Wroclaw, Poland. IEEE Computer Society, 2005, pp.106-111.

[25] R. T. Santos, j. C. Nievola, A. A. Freitas, Extracting comprehensible rules from neural network via genetic algorithms, in: Proc. 2000 IEEE Symp. On Combinations of Evolutionary Computation and Neural Net- works, San Antonio, TX, USA. 1, 2000, pp. 130-139.

[26] A. Duygu Arbatli and H. Levent Aki, Rule extraction from trained neu- ral networks using genetic algorithms, Elsevier (30)3(1997)1639-1648.

[27] T. -Y. Kwok, D. -Y. Yeung, Constructive algorithms for structure learn- ing in feedforward neural networks for regression problems, IEEE Trans. on Neural Networks (8)3(1997)630-645.

[28] S. E. Fahlman, C. Lebiere, The Cascade-Correlation Learning Archi- tecture, Morgan Kaufmann (2)(1990)524-532.

[29] L. Ma, K. Khorasani, A new strategy for adaptively constructing multi- layer feedforward neural networks, Neurocomputing (51)(2003)361-385.

[30] L. Ma, K. Khorasani, New training strategies for constructive neu- ral networks with application to regression problems, Neural Networks (17)4(2004)589-609.

[31] M. A. Potter, A genetic cascade-correlation learning algorithm, in: In- ternational Workshop on Combinations of Genetic Algorithms and Neu- ral Networks,IEEE Computer Society Press, 1992, pp.123-133.

[32] S. Salcedo-sanz, C. Bousoo-calzn, A hybrid neural-genetic algorithm for the frequency assignment problem in satellite communications, Applied Intellegent (22)3(2005)207-217.

[33] J. Branke, Evolutionary algorithms for neural network design and train- ing in: Proceedings of the First Nordic Workshop on Genetic Algorithms and its Applications, 1995, pp.145-163.

[34] J.C. Hsieh, P.C. Chang, S.H. Chen, Integration of genetic algorithm and neural network for financial early warning system: An Example of Taiwanese Banking Industry, in: Proceedings of First International Conference on Innovative Computing Information and Control (I), 2006, pp.562565.

[35] X. Yao, A review of evolutionary artificial neural networks, Int. J. Intell. Syst. 8(4)(1996)539567.

[36] P.P. Palmes, T. Hayasaka, S. Usui, Mutation-based genetic neural net- work, IEEE Trans. on Neural Networks (16)3(2005)587-600.

[37] C. R. Reeves, J. E. Rowe, Genetic algorithms - principles and perspec- tives, A guide to GA theory, Kluwer Academic Publishers, 2003.

[38] A. Tickle, R. Andrews, M. Golea, J. Diederich, The truth is in there: di- rections and challenges in extracting rules from trained artificial neural networks, IEEE Trans. on Neural Networks (9)(1998)1057-1068.

[39] R. Setiono, A penalty-function approach for pruning feedforward neural networks, Neural Computation (9)1(1997)185-204.

[40] I. Taha, J. Ghosh, Three techniques for extracting rules from feed- forward networks, Intelligent Engineering Systems Through Artificial Neural Networks (6)(1996)5-10.

[41] H. Liu, R. Setiono, Incremental feature selection, Journal of Applied Intelligence (9)3(1998)217- 230.

[42] R. Santos, J. C. Nievola, A. A. Freitas, Extracting comprehensible rules from neural networks via genetic algorithms, in: Proceedings of the 2000 IEEE Symposium on Combinations of Evolutionary Computation and Neural Networks (ECNN-2000), San Antonio, TX, USA, 2000.

[43] E. Keedwell, A. Narayanan, D. Savic, Creating rules from trained neural networks using genetic algorithms, International Journal of Computers, Systems and Signals (IJCSS)(1)1(2000)30-42.

[44] G. Bologna, A model for single and multiple knowledge based networks, ELSEVIER Artificial Intelligence in Medicine (28)2(2003)141-163.

[45] J. Huysmans, B. Baesens, J. Vanthienen, Using rule extraction to im- prove thed comprehensibility of predictive models, Technical Report KBI 0612, Katholieke

Universiteit Leuven, Department of Decision Sci- ences and Information Management, Leuven, Belgium(43)(2006)1-55.

[46] K. J. Cios, G. William, Uniqueness of medical data mining, Artificial Intelligence in Medicine (26)1(2002)1-24.

[47] S. B. Thrun, et al., The Monk's problems - A performance compari- son of diff erent learning algorithms, Department of Computer Science, Carnegie Mellon University, CMU-CS-91-197, 1991.

[48] H. W. William, O. L. Mangasarian, Multisurface method of pattern separation for medical diagnosis applied to breast cytology, Proc. of the National Academy of Sciences, U.S.A. (87)(1990)9193-9196.

An Exploratory Analysis on Half-Hourly Electricity Load Patterns Leading to Higher Performances in Neural Network Prediction

K.A.D. Deshani[1], M.D.T. Attygalle[1], A. Karunaratne[1] and L.L. Hansen[2], [1]University of Colombo, Sri Lanka and [2]University of Western Sydney , Australia

ABSTRACT

Accurate prediction of electricity demand can bring extensive benefits to any country as the forecasted values help the relevant authorities to take decisions regarding electricity generation, transmission and distribution appropriately. The literature reveals that, when compared to conventional time series techniques, the improved artificial intelligent approaches provide better prediction accuracies. However, the accuracy of predictions using intelligent approaches like neural networks are strongly influenced by the correct selection of inputs and the number of neuro-forecasters used for prediction. Deshani, Hansen, Attygalle, & Karunarathne (2014) suggested that a cluster analysis could be performed to group similar day types, which contribute towards selecting a better set of neuro-forecasters in neural networks. The cluster analysis was based on the daily total electricity demands as their target was to predict the daily total demands using neural networks. However, predicting half-hourly demand seems more appropriate due to the considerable changes of electricity demand observed during a particular day. As such clusters are identified considering half-hourly data within the daily load distribution curves. Thus, this paper is an improvement to Deshani et. al. (2014), which illustrates how the half hourly demand distribution within a day, is incorporated when selecting the inputs for the neuro-forecasters.

KEYWORDS

Clustering, Silhouette plots, Improve performance, Load curve prediction.

REFERENCES

[1] Barzamini, R., Hajati, F., Gheisari, S., & Motamadinejad, M. B. (2012). Short Term Load Forecasting using Multi-layer Perception and Fuzzy Inference Syatems for Islamic Countries. Journal of Applied Sciences , pp40-47.

[2] Deshani, K.A.D, Hansen, L. L., Attygalle, M.D.T, & Karunarathne, A. (2014). Improved Neural Network Prediction Performances of Electicity Demand: Modifying Inputs through Clustering. Second International Conference on Computational Science and Engineering (pp. 137-147). India: AIRCC.

[3] Farahat, M. A., & Talaat, M. (2012). Short-Term Load Forecasting Using Curve Fitting Prediction Optimized by Genetic Algorithms. International Journal of Energy Engineering , pp23-28.

[4] Hernandez, L., Baladron, C., Aguiar, J. M., Carro, B., & Esguevillas, A. S. (2012). Classification and Clustering of Electricity Demand Patterns in Industrial Parks. Energies , pp5215-5227.

[5] Nagi, J., Yap, K. S., Tiong, S. K., & Ahmed, S. K. (2008). Electrical Power Load Forecasting using Hybrid Self-Organizing Maps and Support Vector Machines. International Power Engineering and Optimization Conference, (pp. 51-56). Selangor.

[6] Seetha, H., & Saravanan, R. (2007). Short Term Electricity Load Prediction Using Fuzzy BP . Journal of Computing and Information Technology , pp267-282.

[7] Soares, L. J., & Medeiros, M. C. (2008). Modeling and Forecasting short-term electricity load: A comparison of methods with an application to Brazilian data. International Journal of Forecasting , pp630-644.

[8] The MathWorks, I. Statistics Toolbox.

Software Aging Analysis of Web Server Using Neural Networks

G.Sumathi and R. Raju, Sri Manakula Vinayagar Engineering College,India

ABSTRACT

Software aging is a phenomenon that refers to progressive performance degradation or transient failures or even crashes in long running software systems such as web servers. It mainly occurs due to the deterioration of operating system resource, fragmentation and numerical error accumulation. A primitive method to fight against software aging is software rejuvenation. Software rejuvenation is a proactive fault management technique aimed at cleaning up the system internal state to prevent the occurrence of more severe crash failures in the future. It involves occasionally stopping the running software, cleaning its internal state and restarting it. An optimized schedule for performing the software rejuvenation has to be derived in advance because a long running application could not be put down now and then as it may lead to waste of cost. This paper proposes a method to derive an accurate and optimized schedule for rejuvenation of a web server (Apache) by using Radial Basis Function (RBF) based Feed Forward Neural Network, a variant of Artificial Neural Networks (ANN). Aging indicators are obtained through experimental setup involving Apache web server and clients, which acts as input to the neural network model. This method is better than existing ones because usage of RBF leads to better accuracy and speed in convergence.

KEYWORDS

Software aging, software rejuvenation, rejuvenation schedule, ANN & RBF

REFERENCES

[1] Michael Grottke, Lei Li, Kalyanaraman Vaidyanathan, and Kishor S. Trivedi, "Analysis of Software Aging in a Web Server", IEEE Transactions on Reliability, vol. 55, no. 3, September 2006

[2] Yun-Fei Jia, Lei Zhao and Kai-Yuan Cai, "A Nonlinear Approach to Modeling of Software Aging in a Web Server", 15th Asia-Pacific Software Engineering Conference, 2008

[3] Yun-Fei Jia, Jing-Ya Su, and Kai-Yuan Cai, "A Feedback Control Approach for Software
Rejuvenation in a Web Server", 978-1-4244-3417-6/08, 2008 IEEE

[4] Xiu-E Chen, Quan Quan, Yun-Fei Jia and Kai-Yuan Cai, "A Threshold Autoregressive Model for Software Aging", Proceedings of the Second IEEE International Symposium on Service-Oriented System Engineering 0-7695-2726-4/06, 2006

[5] Lei Li, Kalyanaraman Vaidyanathan and Kishor S. Trivedi, "An Approach for Estimation of Software Aging in a Web Server", Proceedings of the 2002 International Symposium on Empirical Software Engineering 0-7695-1796-X/02, 2002

[6] A. T. Tai, L. Alkalaj, and S. N. Chau, "On-board preventive maintenance: a design-oriented analytic study for long-life applications", Performance Evaluation, 35, 215–232, 1998

[7] Y. Huang, C. Kintala, N. Kolettis, and N. Fulton, "Software Rejuvenation: Analysis, Module and Applications", in Proceedings of the 25th IEEE International Symposium on Fault-Tolerant Computing, pp. 381-390, Pasadena, USA, June 1995.

[8] S. Garg, A. Puliafito, M. Telek, and K. S. Trivedi, "Analysis of Software Rejuvenation Using Markov Regenerative Stochastic Petri Net", in Proceedings of the Sixth International Symposium on Software Reliability Engineering, pp. 24-27, 1995.

[9] T. Dohi, K. Goseva-Popstojanova, and K. S. Trivedi, "Analysis of software cost models with rejuvenation", in Proceedings of the International Symposium on High Assurance Systems Engineering, pp. 25–34, 2000

[10] T. Dohi, K. Goseva-Popstojanova, and K. S. Trivedi, "Estimating software rejuvenation schedules in high assurance systems", Computer Journal, 44(6):473–485, 2001

[11] Xin Yao, Senior Member, IEEE, "Evolving Artificial Neural Networks", Proceedings of the IEEE, vol. 87, no. 9, September 1999

[12] Hornik, K., Stinchcombe, M., White, H., "Multilayer feedforward networks are universal approximators", Neural Networks 3, 551-560, 1989

[13] Zhang, G. Peter and Qi, Min, "Neural network forecasting for seasonal and trend time series", European Journal of Operational Research 160, 501-514, 2005

[14] Hassoun,M. H., "Fundamentals of Artificial Neural Networks", MIT Press, 1995

[15] Xu, J., You, J. and Zhang,K., "A Neural-Wavelet based Methodology for software Aging

Forecasting", IEEE International Conference on Systems, Man and Cybernetics, Volume 1, Issue , 10-12 Oct. 2005 Page(s): 59 – 63 Vol. 1, 2005

[16] Hisham El-Shishiny, Sally Sobhy Deraz, Omar B. Badreddin, "Mining Software Aging: A Neural Network Approach", 978-1-4244-2703-1/08, 2008 IEEE

[17] D. Mosberger and T. Jin, "Httperf - A Tool for Measuring Web Server Performance", in the First Workshop on Internet Server Performance, Madison, USA, June 1998.

[18] Park. J, Sandberg. J.W, "Universal Approximation using Radial Basis Functions Network", Neural Computation, vol.3, pp. 246-257

[19] David Lorge Parnas, "Software Aging", 0270-5257/9 4000 1994 IEEE

[20] Michael Grottke, Rivalino Matias Jr., Kishor S. Trivedi, "The Fundamentals of Software Aging", 1st International Workshop on Software Aging and Rejuvenation, IEEE, 2008

[21] QingE WU, ZhenYu Han, TianSong Guo, "Application of an Uncertain Reasoning Approach to Software Aging Detection", Fifth International Joint Conference onINC, IMS and IDC, 2009

Home Appliance Identification for Nilm Systems Based on Deep Neural Networks

Deyvison de Paiva Penha and Adriana Rosa Garcez Castro, Federal University of Para, Brazil

ABSTRACT

This paper presents the proposal for the identification of residential equipment in non-intrusive load monitoring systems. The system is based on a Convolutional Neural Network to classify residential equipment. As inputs to the system, transient power signal data obtained at the time an equipment is connected in a residence is used. The methodology was developed using data from a public database (REED) that presents data collected at a low frequency (1 Hz). The results obtained in the test database indicate that the proposed system is able to carry out the identification task, and presented atisfactory results when compared with the results already presented in the literature for the problem in question.

KEYWORDS

Convolutional Neural Networks, identification of residential equipment, non-intrusive load monitoring, NILM.

For More Details: http://aircconline.com/ijaia/V9N2/9218ijaia06.pdf

Volume Link : http://airccse.org/journal/ijaia/current2018.html

REFERENCES

[1] HART, George William. Nonintrusive appliance load monitoring. Proceedings of the IEEE, v. 80, n. 12, p. 1870-1891, 1992.

[2] FIGUEIREDO, Marisa. Contributions to Electrical Energy Disaggregation in a Smart Home. 2014. Tese de Doutorado. APA. Disponível em: . Acessado em: novembro de 2017.

[3] WANG, Zhiguang; OATES, Tim. Encoding time series as images for visual inspection and classification using tiled convolutional neural networks. In: Workshops at the Twenty-Ninth AAAI Conference on Artificial Intelligence. 2015.

[4] ZHENG, Yi et al. Time series classification using multi-channels deep convolutional neural networks. In: International Conference on Web-Age Information Management. Springer, Cham, 2014. p. 298-310.

[5] LECUN, Yann et al. Convolutional networks for images, speech, and time series. The handbook of brain theory and neural networks, v. 3361, n. 10, p. 1995, 1995.

[6] LEE, Honglak et al. Unsupervised feature learning for audio classification using convolutional deep belief networks. In: Advances in neural information processing systems. 2009. p. 1096- 1104.

[7] LÄNGKVIST, Martin; KARLSSON, Lars; LOUTFI, Amy. A review of unsupervised feature learning and deep learning for time-series modeling. Pattern Recognition Letters, v. 42, p. 11-24, 2014.

[8] ZHENG, Yi et al. Exploiting multi-channels deep convolutional neural networks for multivariate time series classification. Frontiers of Computer Science, v. 10, n. 1, p. 96-112, 2016.

[9] KELLY, Jack; KNOTTENBELT, William. Neural nilm: Deep neural networks applied to energy disaggregation. In: Proceedings of the 2nd ACM International Conference on Embedded Systems for Energy-Efficient Built Environments. ACM, 2015. p. 55-64.

[10] DO NASCIMENTO, Pedro Paulo Marques. Applications of Deep Learning Techniques on NILM. 2016. Tese de Doutorado. Universidade Federal do Rio de Janeiro.

[11] Wan He and Ying Chai. An Empirical Study on Energy Disaggregation via Deep Learning, in Advances in Intelligent Systems Research, volume 133, 2nd International Conference on Artificial Intelligence and Industrial Engineering (AIIE2016), pp338-341, 2016

[12] DE BAETS, Leen et al. Appliance classification using VI trajectories and convolutional neural networks. Energy and Buildings, v. 158, p. 32-36, 2018.

[13] KOLTER, J. Zico; JOHNSON, Matthew J. REDD: A public data set for energy disaggregation research. In: Workshop on Data Mining Applications in Sustainability (SIGKDD), San Diego, CA. 2011. p. 59-62.

[14] KATO, Takekazu et al. Appliance Recognition from Electric Current Signals for InformationEnergy Integrated Network in Home Environments. ICOST, v. 9, p. 150-157, 2009.

[15] FIGUEIREDO, Marisa B.; DE ALMEIDA, Ana; RIBEIRO, Bernardete. An experimental study on electrical signature identification of non-intrusive load monitoring (nilm) systems. In: International Conference on Adaptive and Natural Computing Algorithms. Springer, Berlin, Heidelberg, 2011. p. 31-40.

[16] BATRA, Nipun et al. A comparison of non-intrusive load monitoring methods for commercial and residential buildings. arXiv preprint arXiv:1408.6595, 2014.

[17] CARVALHO, Jorge Miguel Vidal. Metodologias de monitorização de consumos. 2013.

[18] NAJMEDDINE, Hala et al. State of art on load monitoring methods. In: Power and Energy Conference, 2008. PECon 2008. IEEE 2nd International. IEEE, 2008. p. 1256-1258.

[19] PARSON, Oliver. Unsupervised training methods for non-intrusive appliance load monitoring from smart meter data. 2014. Tese de Doutorado. University of Southampton.

[20] WONG, Yung Fei et al. Recent approaches to non-intrusive load monitoring techniques in residential settings. In: Computational Intelligence Applications In Smart Grid (CIASG), 2013 IEEE Symposium on. IEEE, 2013. p. 73-79.

[21] PROVOST, Foster; KOHAVI, Ron. Guest editors' introduction: On applied research in machine learning. Machine learning, v. 30, n. 2, p. 127-132, 1998.

[22] ABDEL-HAMID, Ossama et al. Convolutional neural networks for speech recognition.
IEEE/ACM Transactions on audio, speech, and language processing, v. 22, n. 10, p. 1533-1545, 2014.

[23] Atabay, H.A.: Binary shape classification using convolutional neural networks. IIOAB J. 7(5), 332–336 (2016)

[24] VARGAS, A. C. G.; PAES, A.; VASCONCELOS, C. N. Um estudo sobre redes neurais
convolucionais e sua aplicação em detecção de pedestres. In: Proceedings of the XXIX Conference on Graphics, Patterns and Images. 2016. p. 1-4.

[25] WONG, Yung Fei; DRUMMOND, T.; ŞEKERCIOĞLU, Y. A. Real-time load disaggregation
algorithm using particle-based distribution truncation with state occupancy model. Electronics Letters, v. 50, n. 9, p. 697-699, 2014.

[26] ZHAO, Bochao; STANKOVIC, Lina; STANKOVIC, Vladimir. On a training-less solution for non-intrusive appliance load monitoring using graph signal processing. IEEE Access, v. 4, p. 1784-1799, 2016.

[27] KONG, Weicong et al. Improving Nonintrusive Load Monitoring Efficiency via a Hybrid Programing Method. IEEE Transactions on Industrial Informatics, v. 12, n. 6, p. 2148-2157, 2016.

[28] HIJAZI, Samer; KUMAR, Rishi; ROWEN, Chris. Using convolutional neural networks for image recognition. Tech. Rep., 2015. [Online]. Available: http://ip. cadence.com/uploads/901/cnn-wp-pdf.

[29] DE PAIVA PENHA, Deyvison; CASTRO, Adriana Rosa Garcez. Convolutional neural network applied to the identification of residential equipment in non-intrusive load monitoring systems. In: 3rd International Conference on Artificial Intelligence and Applications, pp. 11– 21, 2017. © CS & IT-CSCP 2017