Signal Processing and Analysis of Electrical Circuit

Adam Glowacz 1,∗, and Jose Alfonso Antonino Daviu 2

1 Department of Automatic Control and Robotics, Faculty of Electrical Engineering, Automatics, Computer Science and Biomedical Engineering, AGH University of Science and Technology, al. A. Mickiewicza 30, 30-059 Kraków, Poland
2 Instituto Tecnológico de la Energía, Universitat Politècnica de València (UPV), Camino de Vera s/n, 46022 Valencia, Spain; joanda@die.upv.es
* Correspondence: adglow@agh.edu.pl

Received: 16 December 2019; Accepted: 20 December 2019; Published: 23 December 2019

1. Introduction

The analysis of electrical circuits is an essential task in the evaluation of electrical systems. Electrical circuits are made up of interconnections of various elements, such as resistors, inductors, transformers, capacitors, semiconductor diodes, transistors and operational amplifiers. Electrical signals, acoustic and vibrations carry useful information. They are known as diagnostic signals. Electrical circuits are used for equipment, circuit protection, circuit control, computers, electronics, electrical engineering, cars, planes and trains.

The analysis of signals is also essential. It is used for electrical engineering, sound recognition, speaker recognition, fault diagnosis, image processing, fast Fourier transform (FFT), wireless communication, control systems, process control, genomics, economy, seismology, feature extraction and digital filtering.

2. The Present Special Issue

This special issue with 34 published articles shows the significance of the topic “Signal Processing and Analysis of Electrical Circuit”. The topic gained noticeable attention in recent time. The accepted articles are categorized into four different areas:

- Signal processing and analysis methods of electrical circuits;
- Electrical measurement technology;
- Applications of signal processing of electrical equipment;
- Fault diagnosis of electrical circuits;

The paper [1] describes the fault diagnosis of a commutator motor using signal processing methods and acoustic signals. Five commutator motors were analyzed: a healthy commutator motor, a commutator motor with a broken rotor coil, a commutator motor with shorted stator coils, a commutator motor with a broken tooth on sprocket and a commutator motor with a damaged gear train. Feature extraction method MSAF-15-MULTIEXPANDED-8-GROUPS (Method of Selection of Amplitudes of Frequency Multiexpanded 8 Groups) was introduced [1]. Processing and feature extraction of an underwater acoustic signal was shown in the paper [2]. The authors proposed a feature extraction method for an underwater acoustic signal. It was based on VMD (variational mode decomposition), DCO (duffing chaotic oscillator) and KPE (kind of permutation entropy) [2]. The next paper [3] presented two models (HOCTVL1 model and SAHOCTVL1 model) for solving the problem of image deblurring under impulse noise. The proposed models are good for recovering the corrupted images [3].

A multispectral backscattered light recorder of insects’ wingbeats was presented in the paper [4]. The proposed device extracted a signal of the wingbeat event and color characterization of the insect.
The authors of the paper analyzed the following insects: the bee (Apis mellifera) and the wasp (Polistes gallicus) [4]. A 13-bit 3 MS/s asynchronous SAR ADC with a passive resistor was described [5]. Passive resistors were adopted by the described delay cell. A delay error was less than 5 percent [5]. A miniaturized frequency standard comparator based on FPGA was presented. The noise floor of the analyzed comparator was better than $7.50 \times 10^{-12}$ (1/s) [6]. A low-ripple switched-capacitor DC–DC Converter with parallel low-dropout regulator was proposed. The converter used a four-bit DCpM control and parallel low-dropout regulator [7]. A fuzzy logic system was proposed for the assessment of stator winding short-circuit faults in induction motors. The proposed approach achieved a positive classification rate of 98% [8]. A capacitance-to-time converter-based electronic interface was designed. The proposed interface is suitable for on-chip integration with sensors of force, humidity, position etc. [9]. The self-calibrating dynamic comparator was developed. The presented approach reduced the input offset by $10\times$ [10]. There are also other interesting articles in the presented special issue. The proposed approaches and devices can be improved and used for the electrical systems in the future.

The proposed topics are essential for industry. Signal processing and analysis of diagnostic signals are used for fault diagnosis and monitoring systems [11–26]. Signal processing and image processing methods are used for many applications, for example medical applications [27–36]. Switched-Capacitor DC–DC converters are also an interesting topic of research [37–41].

3. Concluding Remarks

Acceleration of the development of electrical systems, signal processing methods and circuits is a fact. Electronics applications related to electrical circuits and signal processing methods have gained noticeable attention in recent time. The methods of signal processing and electrical circuits are widely used by engineers and scientists all over the world.

The presented papers have made a contribution to electronics. The presented applications can be used in the industry. The presented approaches require further improvements for industry and other applications.

Author Contributions: A.G. wrote original draft preparation. He was responsible for editing. J.A.A.D. was also responsible for editing. He also supervised the paper. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: The Guest Editors would like to thank all authors, reviewers and editorial board of MDPI Electronics journal for their valuable contributions to this special issue.

Conflicts of Interest: The authors declare no conflict of interest.

References
1. Glowacz, A. Acoustic-based fault diagnosis of commutator motor. Electronics 2018, 7, 299. [CrossRef]
2. Li, Y.; Chen, X.; Yu, J.; Yang, X. A Fusion Frequency Feature Extraction Method for Underwater Acoustic Signal Based on Variational Mode Decomposition. Duffing Chaotic Oscillator and a Kind of Permutation Entropy. Electronics 2019, 8, 61. [CrossRef]
3. Xiang, J.; Ye, P.; Wang, L.; He, M. A Novel Image-Restoration Method Based on High-Order Total Variation Regularization Term. Electronics 2019, 8, 867. [CrossRef]
4. Rigakis, I.; Potamitis, I.; Tatlas, N.A.; Livadaras, I.; Ntalampiras, S. A Multispectral Backscattered Light Recorder of Insects’ Wingbeats. Electronics 2019, 8, 277. [CrossRef]
5. Ju, H.; Lee, M. A 13-bit 3-MS/s Asynchronous SAR ADC with a Passive Resistor Based Loop Delay Circuit. Electronics 2019, 8, 262. [CrossRef]
6. Tang, S.; Ke, J.; Wang, T.; Deng, Z. Development of a Miniaturized Frequency Standard Comparator Based on FPGA. Electronics 2019, 8, 123. [CrossRef]
7. Lee, J.Y.; Kim, G.S.; Oh, K.I.; Baek, D. Fully Integrated Low-Ripple Switched-Capacitor DC–DC Converter with Parallel Low-Dropout Regulator. Electronics 2019, 8, 98. [CrossRef]
8. Mejia-Barron, A.; de Santiago-Perez, J.J.; Granados-Lieberman, D.; Amezquita-Sanchez, J.P.; Valtierra-Rodriguez, M. Shannon Entropy Index and a Fuzzy Logic System for the Assessment of Stator Winding Short-Circuit Faults in Induction Motors. *Electronics* 2019, 8, 90. [CrossRef]

9. De Marcellis, A.; Reig, C.; Cubells-Beltran, M.D. A Capacitance-to-Time Converter-Based Electronic Interface for Differential Capacitive Sensors. *Electronics* 2019, 8, 80. [CrossRef]

10. Ramkaj, A.; Strackx, M.; Steyaert, M.; Tavernier, F. An 11 GHz Dual-Sided Self-Calibrating Dynamic Comparator in 28 nm CMOS. *Electronics* 2019, 8, 13. [CrossRef]

11. Yan, X.P.; Xu, X.J.; Sheng, C.X.; Yuan, C.Q.; Li, Z.X. Intelligent wear mode identification system for marine diesel engines based on multi-level belief rule base methodology. *Meas. Sci. Technol.* 2018, 29. [CrossRef]

12. Stief, A.; Ottewill, J.R.; Orkisz, M.; Baranowski, J. Two Stage Data Fusion of Acoustic. Electric and Vibration Signals for Diagnosing Faults in Induction Motors. *Elektron. Elektrotechnika* 2017, 23, 19–24. [CrossRef]

13. Singh, G.; Naikan, V.N.A. Detection of half broken rotor bar fault in VFD driven induction motor drive using motor square current MUSIC analysis. *Mech. Syst. Signal Process.* 2018, 110, 333–348. [CrossRef]

14. Zhang, C.; Peng, Z.X.; Chen, S.; Li, Z.X.; Wang, J.G. A gearbox fault diagnosis method based on frequency-modulated empirical mode decomposition and support vector machine. *Proc. Inst. Mech. Eng. Part C* 2018, 232, 369–380. [CrossRef]

15. Michalak, M.; Sikora, B.; Sobczyk, J. Diagnostic Model for Longwall Conveyor Engines. In *Man-Machine Interactions 4*, ICMMI 2015, *Book Series: Advances in Intelligent Systems and Computing*, *Proceedings of the Man-Machine Interactions 4—4th International Conference on Man-Machine Interactions*, ICMMI 2015, Kociersz Pass, Poland, 6–9 October 2015; Springer: Berlin/Heidelberg, Germany, 2016; Volume 391, pp. 437–448. [CrossRef]

16. Glowacz, A.; Glowacz, W. Vibration-Based Fault Diagnosis of Commutator Motor. *Shock Vib.* 2018, 7460419. [CrossRef]

17. Glowacz, A.; Glowacz, Z. Recognition of rotor damages in a DC motor using acoustic signals. *Bull. Pol. Acad. Sci. Tech. Sci.* 2017, 65, 187–194. [CrossRef]

18. Glowacz, A. Recognition of acoustic signals of induction motor using FFT. *SMOFS-10 and LSVM. Eksploat. Niezawodn.* 2015, 23, 569–574. [CrossRef]

19. Legutko, S. Development Trends in Machines Operation Maintenance. *Eksploat. Niezawodn.* 2009, 2, 8–16.

20. Hreha, P.; Radvanska, A.; Knapcikova, L.; Krolczyk, G.M.; Legutko, S.; Krolczyk, J.B.; Hloch, S.; Monka, P. Roughness Parameters Calculation by Means of On-Line Vibration Monitoring Emerging from AWJ Interaction With Material. *Metrol. Meas. Syst.* 2015, 22, 315–326. [CrossRef]

21. Liu, M.K.; Weng, P.Y. Fault Diagnosis of Ball Bearing Elements: A Generic Procedure based on Time-Frequency Analysis. *Meas. Sci. Rev.* 2019, 19, 185–194. [CrossRef]

22. Sun, Y.; Zhang, Y.G. New Developments in Fault Analysis Based on Dynamical Perspective. *IETE J. Res.* 2016, 62, 500–506. [CrossRef]

23. Krolczyk, G.M.; Krolczyk, J.B.; Legutko, S.; Hunjet, A. Effect of the disc processing technology on the vibration level of the chipper during operations. *Teh. Vjesn.* 2014, 21, 447–450.

24. Irfan, M.; Saad, N.; Ibrahim, R.; Asirvadam, V.S. Condition monitoring of induction motors via instantaneous power analysis. *J. Intell. Manuf.* 2017, 28, 1259–1267. [CrossRef]

25. Pandiyan, V.; Caesarendra, W.; Tjahjowidodo, T.; Tan, H.H. In-process tool condition monitoring in compliant abrasive belt grinding process using support vector machine and genetic algorithm. *J. Manuf. Process.* 2018, 31, 199–213. [CrossRef]

26. Zmarzly, D.; Boczar, T.; Fracz, P.; Borucki, S. High Voltage Power Transformer Diagnostics using Vibroacoustic Method. In *Proceedings of the 2014 IEEE International Power Modulator and High Voltage Conference (IPMHVC)*, Santa Fe, NM, USA, 1–5 June 2014; pp. 561–564.

27. Kowalczyk, D.; Przewlocka, D.; Kryjak, T. Real-time implementation of contextual image processing operations for 4K video stream in Zynq UltraScale plus MPSoC. In *Proceedings of the 2018 Conference on Design and Architectures for Signal and Image Processing (DASIP)*, 9–12 October 2018; pp. 37–42.

28. Kryjak, T.; Komorkiewicz, M.; Gorgon, M. Real-time Implementation of Foreground Object Detection From a Moving Camera Using the ViBE Algorithm. *Comput. Sci. Inf. Syst.* 2014, 11, 1617–1637. [CrossRef]

29. Kurtasz, P.; Boczar, T.; Witkowski, P.; Lorenc, M. The application of the multicomparative algorithm for classifying acoustic signals coming from partial discharges. *Prz. Elektrotech.* 2010, 86, 125–127.

30. Boczar, T.; Lorenc, M. The application of the descriptive statistics for recognizing electrical discharge forms registered by the acoustic emission method. *Prz. Elektrotech.* 2008, 84, 6–9.
31. Jablonski, M.; Tylek, P.; Walczyk, J.; Tadeusiewicz, R.; Pilat, A. Colour-Based Binary Discrimination of Scarified Quercus Robur Acorns under Varying Illumination. Sensors 2016, 16, 1319. [CrossRef]
32. Jaworek-Korjakowska, J.; Kleczek, P.; Tadeusiewicz, R. Detection and Classification of Pigment Network in Dermoscopic Color Images as One of the 7-Point Checklist Criteria. In Recent Developments and Achievements in Biocybern. Biomed. Eng. 2018, Book Series: Advances in Intelligent Systems and Computing, Proceedings of the 20th Polish Conference on Biocybernetics and Biomedical Engineering, Kraków, Poland, 20–22 September 2017; Springer: Berlin/Heidelberg, Germany, 2018; Volume 647, pp. 174–181. [CrossRef]
33. Glowacz, A.; Glowacz, Z. Recognition of images of finger skin with application of histogram, image filtration and K-NN classifier. Biocybern. Biomed. Eng. 2016, 36, 95–101. [CrossRef]
34. Kantoch, E. Recognition of Sedentary Behavior by Machine Learning Analysis of Wearable Sensors during Activities of Daily Living for Telemedical Assessment of Cardiovascular Risk. Sensors 2018, 18, 3219. [CrossRef]
35. Proniewska, K. Data mining with Random Forests as a methodology for biomedical signal classification. Bio-Algorithms Med-Syst. 2016, 12, 89–92. [CrossRef]
36. Proniewska, K.; Malinowski, K.; Pociask, E.; Proniewski, B. Classification of Sleep Disordered Breathing in the Evaluation of Acoustic Sound in Correlation with the ECG Signal. In Proceedings of the 2014 Computing in Cardiology Conference 2014 (CinC), Cambridge, MA, USA, 7–10 September 2014; Volume 41, pp. 153–156.
37. Jiang, Y.; Law, M.K.; Chen, Z.Y.; Mak, P.I.; Martins, R.P. Algebraic Series-Parallel-Based Switched-Capacitor DC-DC Boost Converter With Wide Input Voltage Range and Enhanced Power Density. IEEE J. Solid-State Circuits 2019, 54, 3118–3134. [CrossRef]
38. Mohey, A.M.; Ibrahim, S.A.; Hafez, I.M.; Kim, H. Design Optimization for Low-Power Reconfigurable Switched-Capacitor DC-DC Voltage Converter. IEEE Trans. Circuits Syst. I-Regul. Pap. 2019, 66, 4079–4092. [CrossRef]
39. Xie, F.Y.; Wu, B.C.; Liu, T.T. A Ripple Reduction Method for Switched-Capacitor DC-DC Voltage Converter Using Fully Digital Resistance Modulation. IEEE Trans. Circuits Syst. I-Regul. Pap. 2019, 66, 3631–3641. [CrossRef]
40. Zeng, T.; Wu, Z.; He, L.Z. Bridge modular switched-capacitor DC-DC converter with soft switching operation and multilevel voltage-gain range. IEEE Trans. Electr. Electron. Eng. 2019, 14, 1399–1408. [CrossRef]
41. Kumar, M.; Ramesh, S. Design and Implementation of Three-Winding Coupled Inductor and Switched Capacitor-Based DC-DC Converter Fed PV-TDVR. J. Circuits Syst. Comput. 2019, 28. [CrossRef]