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Power quality techniques research worldwide: A review

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ABSTRACT

In this study, a detailed analysis of research on the subject of power quality published during the period from 1970 to 2013 is presented; Elsevier's Scopus database was used as a reference, and bibliometric analysis techniques were employed. All materials reported in Scopus have been included. Different aspects of these publications have been studied, such as the publication type, subject, language, subcategories and journal type and the frequency with which the keywords were found. An analysis of the use of techniques such as heuristic optimisation, artificial intelligence and signal processing was also conducted within the framework of power quality. The keywords *harmonics*, *active filter*, *voltage sag*, *distributed generation* and *wavelet transform* were verified as the most commonly used terms other than the term *power quality*. The contributions were categorised geographically and by institution; China, USA and India were the main contributing countries, and the IEEE, the Indian Institute of Technology, and the North China Electric Power University were the main contributing research institutions. The most active categories in the fields of optimisation, artificial intelligence and signal processing were Genetic Algorithms and Particle Swarm Optimisation, Neural Network and Fuzzy Logic and Wavelet Transform and Fourier Analysis, respectively. This scientific publication analysis-based methodology presents new perspectives with respect to the research trends of the international scientific community.

Contents

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1. Introduction

Currently, the study of power quality (PQ) in all of its facets comprises a field of great interest to the scientific community [1–3]. However, such studies were not always considered particularly relevant within the field of electrical engineering because of a lack of normativity [4,5], among other reasons. Given the development of an information and knowledge-based society, the amount of electric equipment connected to the power grid, which incorporates power electronics, is continually increasing. This equipment includes, for example, large data banks, complex industrial processes, automatic systems and computers used not only for industrial and business applications but also governmental and even domestic applications. A strong dependence on such equipment forces the electric power grid to provide a quality power supply with voltage, current and frequency values within the ranges of device manufacturers' recommendations to prevent damage to the connected devices during normal use and to guarantee prolonged useful device life [6]. On the other hand, new energy sources such as renewable solar and wind power [7,8] are being introduced more frequently and can distort the quality of the power supplied to the grid [9]. Low-quality power supply voltage has been clearly demonstrated to induce damage and malfunctions in electric appliances [10]. Given these arguments, a statistical and bibliometric analysis of research in the field of power quality would be highly relevant [11] because it would provide a detailed vision of the advances in research and the trends in future work associated with this topic [12]. The methodologies applied to power quality include the use of heuristic optimisation techniques such as Particle Swarm Optimisation (PSO) [13], Genetic Algorithms (GA) [14] and Multi-Objectives Algorithms (Pareto) [15]; signal processing techniques such as the Fast Fourier Transform [16], the Wavelet Transform (WT) [17,18] and the S-Transform (ST) [19,20] and finally, Artificial Intelligence (AI) techniques for the automated classification of events, including Artificial Neural Networks (ANN) [21], Fuzzy Logic (FL) [22] and Supported Vector Machines (SVM) [23].

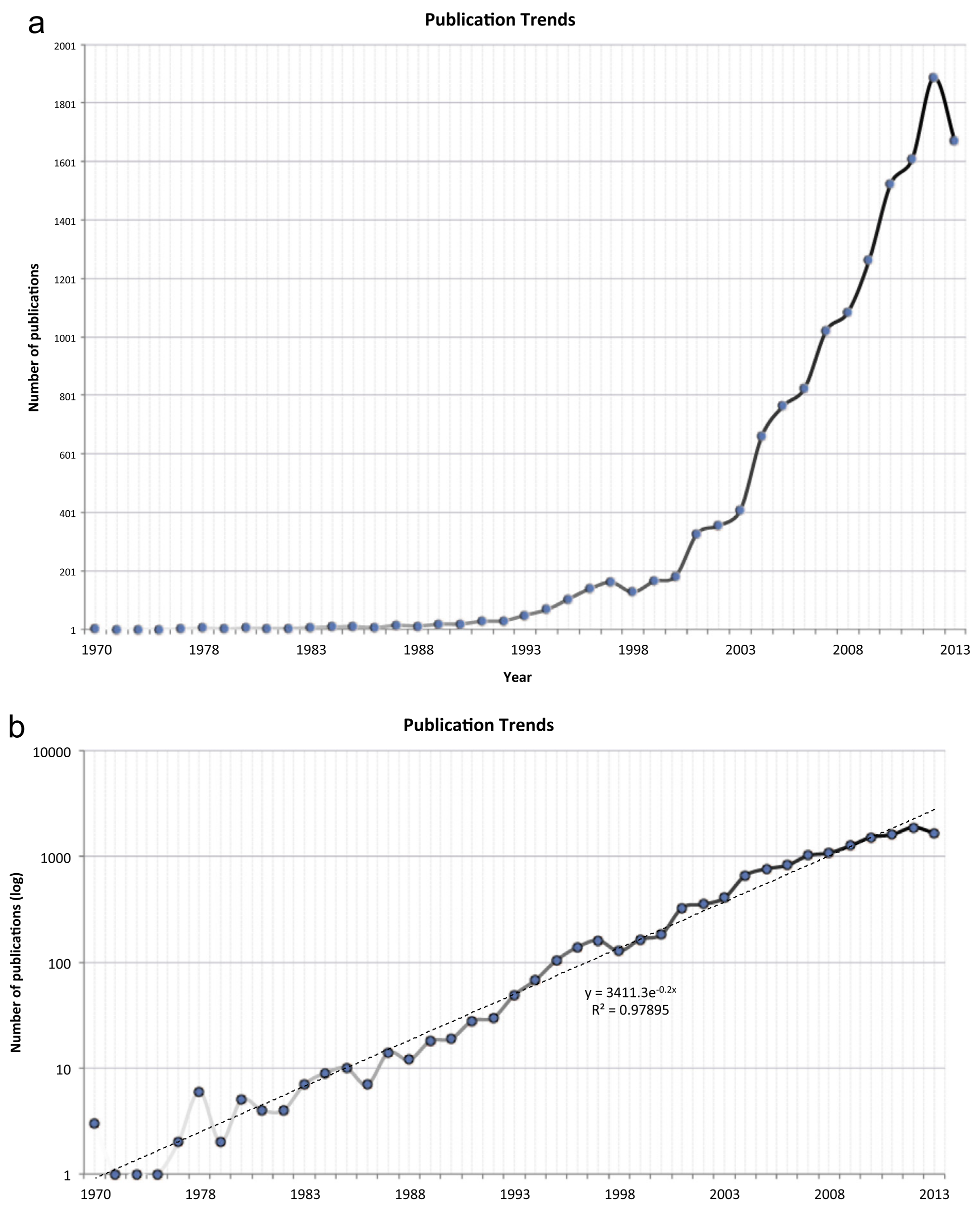

Fig. 1. Trend in power quality publications during the period of 1970–2013. The top panel (a) shows the data without scaling and the bottom panel (b) shows the data with a logarithmic scale along the *y*-axis.