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Solar energy research in Ibero-America, a citation mining approach

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Abstract

In this paper we present an analysis of all the research papers published on journals registered in the Web of Science, with the phrase “solar energy” in its title, abstract or keywords that have at least one author with address in Ibero-America. We present the results of citation mining applied to all such records published between 2002 and 2012. This analysis characterizes the behavior of the scientific production on solar energy in the most prolific countries in this region.

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1. Introduction

The research on solar energy in Ibero-America has increased both in quantity and quality of publications. However, to define an optimal development strategy it is important to make an accurate assessment. This is done by taking into account either the authors or the institutions involved in the publication.

In this work we analyze all the paper registered in the Web of Science (Thomson Reuters) that appear under the search of the phrase “solar energy”. The search was done taking into consideration titles, abstracts and key words of papers published worldwide between 2002 and 2012. Then, we selected Ibero-

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American countries with an individual production larger than or equal to 1% of the worldwide total. The search was done in June 2013.

It is noteworthy that WoS is the one of the most important data bases of scientific information in the world and that there is a bias towards papers written in English. Notwithstanding, we consider the sample to be significant for the study of the impact and pertinence of this research topic.

Recently, the analysis of citation mining [1], has been applied to study the characteristics of Mexican science in two of the most important journals Nature and Science [2] and to depict Ibero-American science (Russell et al. 2007).

The work is organized as follows: first, we present the method used for the analysis of the citation mining. In section 3 we applied a logistic method in order to foresee the evolution tendency of the area in the selected countries. In section 4 we show the bibliometric results, and in section 5 the results of the citation mining in the mentioned articles are provided. Finally we present our comments and interpretations of the results

2. Methodology

The citation mining methodology is based on the application of a combination of bibliometric techniques and text mining for the analysis of the bibliographic data [1] [3]. In this case study, the objective has been defined as the research papers on “solar energy” written between 2002 and 2012 excluding proceedings, reviews and editorials. The search resulted in 5,866 papers. Table 1 shows the countries with the most significant contributions to the area, those with a contribution of at least 1%.

From this table we selected the countries in Ibero-America: Spain, Brazil and Mexico, with overall contributions of 4.9, 1.77 and 1.06 per cent, respectively; adding up to 7.74%. We downloaded three sets of records, one per country.

The software tool that our research group has developed for this purpose analyzed each set [3]. Whilst the bibliometric stage is exclusively done by counting similar data from different fields on such bibliographic records, the text mining stage uses an entropy based algorithm to find the most relevant words in the abstracts of the records. This algorithm is based on the research done by Ortuno et al [4]. The distance between two occurrences of a particular word occurring in the text of an abstract was compared to the standard deviation of all words in all abstracts. A normalized standard deviation higher than 1 indicates that the distribution of the word within a particular abstract is not random allowing us to determine which words or strings of words can be considered relevant for that particular text. The reasoning behind this assumption is that the standard deviation is an analogous indicator to entropy [5] and can sometimes play a role as a measure of order (or disorder). The advantage of this particular technique is that it does not require a labor-intensive revision of individual words to extract the keywords from a text but rather provides a ready-made list of the most frequently occurring words and strings of words whose distribution within a text is not random and, therefore, likely to be significant. This technique has been recently used to analyze topics on highly visible science [6].

We based our prospective analysis on the notion that all biological, social and economic systems within a closed space have a natural cycle of birth, growth and saturation [7]. Hence if a time series has shown in the past a “natural growth”, then its cumulative growth in time must have the shape of an “S” curve, also known as the logistic function. We applied a logistic regression, which is a canonical link function, meaning that parameter estimates under logistic regression are fully efficient, and tests on those parameters are better behaved for small samples. So we analyzed the scientific production over time of the different sets we classified in the first place, and applied our interactive logistic fit algorithm to it.

Table 1. Papers published by country (individual contribution greater than 1% of total of paper)

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