Categorizations and annotations of Citation in Research Evaluation

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Abstract

Scientific evaluation is based for the most part on citation analysis. However, citation is a phenomenon that is not yet well studied. The use of the Contextual Exploration technique that allows the automatic semantic annotation of the relations between authors, gives some of the answers. New bibliosemantic indicators can be considered in order to provide a better perception of citations through the study of semantic categories. The program implementation proposed in this article raises the question of the evaluation of this approach.

Introduction

We will propose in this article a framework of a new, qualitative approach to citation analysis, which is at the core of research evaluation. The necessity of new approaches in research evaluation has also been underlined by (Moed 2005) in his book Citation Analysis in Research Evaluation , where he suggests that the efforts in the development of science evaluation should be directed towards qualitative citation analysis through contextual and cognitive-relational analysis . We agree with his point of view on the perspectives in citation analysis:

> "Quantitative analysts of science could develop more 'qualitative' citation based indicators, along contextual or a cognitive-relational viewpoint, thus abandoning the principle underlying most citation analyses that all citations are equal. [...] It would be necessary to develop initially simple, and in a later phase more sophisticated, classifications of 'how' documents are cited from the perspective of research evaluation rather than from that of information retrieval."

Presently, according to (Moed 2005), there exist two major problems that block all the developments in this direction.
The first one is the difficulty to find databases of scientific articles that give access to the text content, in a format that permits a full text analysis. Probably the on-line journals and the new services will meet this demand in the next several years, but for the moment such databases are still marginal for the needs of a large-scale implementation.

The second problem for the development of new refined approaches to citation analysis lies in the conceptual difficulty associated with the automatic classification of citations according to the context. Such systems do not exist yet. (Moed H.F. 2005).

We will discuss here in detail the approach to citation analysis that we propose. It is based on the idea that the citation is not a simple unit, but rather the product of a complex phenomenon. We assume, as a starting hypothesis, that the bibliography presents information that is essential for the evaluation of a publication. As mentioned above, it is necessary to develop new methods that will allow the automatic identification of the different relations between authors, namely how a given author is cited by others. We will therefore propose a methodology for the development of linguistic resources for the automatic annotation of the relations between authors.

Methodology

The approach that we will propose takes into consideration the above-mentioned limitations of the actual methods for citation analysis. It is based on the automatic annotation of the textual segments containing bibliographic citations according to a number of semantic categories. The automatic semantic annotation is realized by the Contextual Exploration method (Desclés 1991;2006).

Bibliographic citations in texts can be presented in various ways. They are sometimes in numerical form and other times they contain the name of the author. To take into account these variations, we have created a classification of the different numerical and alphanumerical families of bibliographic citations. The localization of the bibliographic citations in the text is made by regular expressions.

For the purpose of experimentation, we have based our analysis on a bilingual corpus of scientific articles in French and in English. After a first stage of automatic segmentation into sentences, paragraphs, etc., the segments in the text that contain bibliographic citations are identified by regular expressions. Then, Contextual Exploration rules locate contextual linguistic markers in the segments in order to carry out the semantic annotation.

We will use the semantic annotations obtained in this manner in order to make up a bibliographic database that will serve as a source for the construction of the bibliometric indicators.

The semantic categories with which we annotate the segment are significant of the way the author has been cited in the text. The categorization we use is defined after the linguistic study of the discourse markers present in the textual segments that contain bibliographic citations.

The semantic annotations make possible to access automatically the semantic content of the textual segments containing the bibliographic citations. The different categories for the annotation have been identified by Yordan Krushkov (Krushkov and Descles 2005). On Fig. 1 we present for information the semantic map that we use here. The linguistic resources are organized according to this semantic map.

Quotation				
Point of view (Other|himself)	Comparaison (Other|himself)	Information (Other|himself)	Definition (Other|himself)	Appreciation
Position	Resemblance| Disparity	Analyses| Citation| Counterexample| Hypothesis| Method| Result|		Agree| Disagree

Figure 1. Semantic map for bibliosemantics

We consider that the phenomenon of auto-citation is especially important for the development of science evaluation methods. That is why, in our framework we make the distinction between the textual segments that contain citation of other authors, and the segments that contain auto-citations. Each of the categories in the semantic map can apply to both types of segments. We believe that this distinction is essential for the better understanding of the phenomenal of citation.

Implementation

The program implementation of our approach is based on two modules developed in the LaLIC laboratory: SegaTex and EXCOM. The figure 2 presents the general architecture of the system.

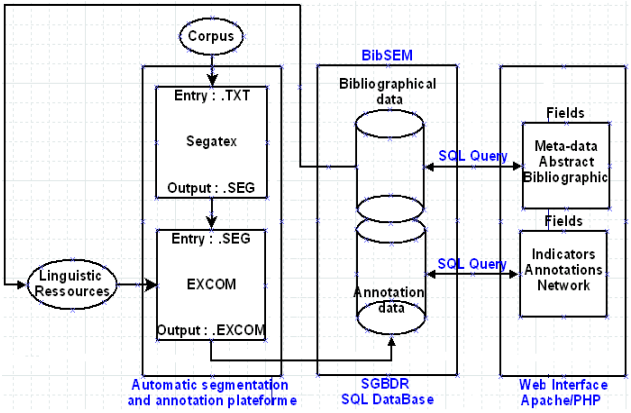

Figure 2. The architecture of our implementation

SegaTex

This is the module that carries out the automatic segmentation of texts into sentences, paragraphs, sections, etc. by using the work of (Mourad 1999;2001). The segmentation rules of SegaTex, developed initially for French, apply successfully to texts in English. The result of the application of these rules is an annotated text in the XML format. Fig. 3 presents a part of a segmented text.

```
−<para ID="12">
 −<title>
    <phrase ID="58">4.2Induced resistance</phrase>
  </title>
 </para>
−<para ID="13">
 −<phrase ID="59">
    In the early 1990s, the first evidence disputing the role of Si as a mechanical barrier
    was reported in dicotyledonous models.
  </phrase>
 −<phrase ID="60">
    Samuels et al. [39], using the cucumber-powdery mildew pathosystem, showed that
    within a short period of time after Si feeding was stopped, all prophylactic effects
    were lost.
  </phrase>
 −<phrase ID="61">
    Thus, the interruption of Si feeding led to a loss of resistance even though opal had
    irreversibly accumulated and, according to the mechanical barrier hypothesis,
    should have slowed the pathogen development.
  </phrase>
```

Figure 3. Segmentation of structured documents

EXCOM

The EXCOM system, developed by (Djioua 2006; Djioua and Desclés 2007), allows the automatic semantic annotation of the segmented texts. The annotation is added to the XML file in the form of new elements and attributes of the sentences. The semantic meaning of the annotations is related to the organization of each category recognized by the EXCOM system.

```
<?xml version="1.0" encoding="UTF-8" ?>
<regles type="annotation_semantique">

 <!--**************************************************************************-->
 <!--    Regles pour la bibliosemantique                                       -->
 <!--    Auteur BERTIN Marc                                                    -->
 <!--**************************************************************************-->
<regle nom_regle="RegleInfo1" tache="bibliosemantique" point_de_vue="definition" type="annot
    <conditions>
    <motif espace_de_recherche="phrase" type="regex" valeur="@RenvBiblio"/>
    </conditions>
    <actions>
    <annotation type="ajout_element" espace="identique" annotation="RenvBiblio"/>
    </actions>
</regle>
 <!--**************************************************************************-->
 <!--    Regles pour identifier INFORMATION.METHODE                            -->
 <!--    Auteur BERTIN Marc                                                    -->
 <!--**************************************************************************-->
 <!-- RegleInfMet2 : Phrase Id 62 -->
<regle nom_regle="RegleInfMet3" tache="bibliosemantique" point_de_vue="information" type="E
    <conditions>
    <indicateur espace_de_recherche="phrase" type="annotation" valeur="RenvBiblio"/>
    <indice contexte="droite" espace_de_recherche="." type="liste" valeur="IdAuteur"/>
    <indice contexte="droite" espace_de_recherche="." type="liste" valeur="IdMethode"/>
    </conditions>
    <actions>
    <annotation type="ajout_attribut" espace="identique" annotation="methode"/>
    </actions>
</regle>
<regle nom_regle="RegleInfMet1a" ordre_entre_indices="suite" tache="bibliosemantique" point_
    <conditions>
    <indicateur espace_de_recherche="phrase" type="annotation" valeur="RenvBiblio"/>
    <indice contexte="droit" espace_de_recherche="." type="liste" valeur="IdMethode"/>
    <indice contexte="droit" espace_de_recherche="." type="liste" valeur="IdProposition"/>
```

Figure 4. EXCOM Rules

The rules for the system are presented in the form of an XML file, structured as in the example on Fig. 4.

BibSEM

In general there is a certain number of errors when working with external bibliographic databases, that can arise, for example, from errors in the input of some of the fields. For this reason, we have developed our proper database, called BibSEM, with controlled input and update. The information for the database is partially obtained by the attributes of the XML annotation output of EXCOM.

Interface

The graphical user interface that we have developed for the presentation and exploitation of the results is based on a classical Apache/php/Mysql system. Fig. 4 presents the organization of the page displaying the results. Here we will explain in detail the function of each of the elements of this page.

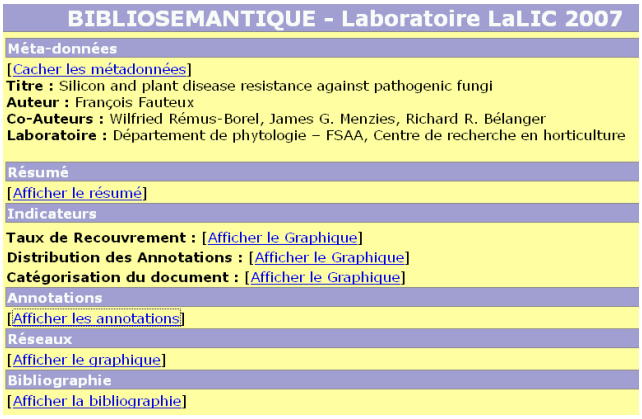

Figure 5. Graphical User Interface

Metadata. This is the information that can traditionally be found in bibliographical databases, containing fields like title, authors, co-authors, keywords, etc.

Abstract. This is the abstract of the article that can be visualized by a dynamic link. Eventually, an automatic summary of the article could also be integrated in the interface. An appropriate summarization technique has been proposed and implemented by Antoine Blais (Blais 2007) whose summarization strategy is based on the automatic annotation of discourse categories by the Contextual Exploration method.

Indicators. The bibliometric indicators based on the semantic annotations carried out by the EXCOM system allow a refined analysis of the bibliographic citations. Three types of indicators are presented. The corresponding Indicators graphics will be presented further on.

Annotations. The zone of annotations allows the visualization of the annotated segments. In the context of our study the possibility to display the textual segment together with its annotation is of importance for the further analysis. In this zone, each of the bibliographic citations can be displayed in this way.

Networks. This part has not yet been implemented because the publications in our corpus have not yet been related to each other. We will discuss the approach in more detail in the final part of this paper.

Bibliography. The bibliography can be a source, for each new publication, of new linguistic markers for the bibliographic citations. In fact, sometimes in texts we can find citations that do not contain bibliographic references. However, we consider that these citations are also important for our analysis and have to be taken into consideration by the system. This approach is especially important for human and social sciences, where the publications in general have a very large number of references.

In the following part, we will discuss in more detail the bibliosemantic indicators.

Perspectives in using annotations

There exist a great difference between the traditional approaches to citation analysis and the bibliosemantic approach issued by the linguistic analysis and the semantic categorization of the quotations. Here, we use the term quotation to designate all of the citations, references, and the bibliographic citations.

As we have already mentioned, the automatic annotation by semantic categories requires an access to the document that permits full-text search. It should be noted that our aim is not the annotation of all the textual segments, but rather the extraction and analysis of those segments that have been annotated.

Coverage rate. This bibliosemantic indicator presents two values: the bibliographic references identified in the article and the number of annotation which correspond to the number of bibliographic references that have been semantically annotated.

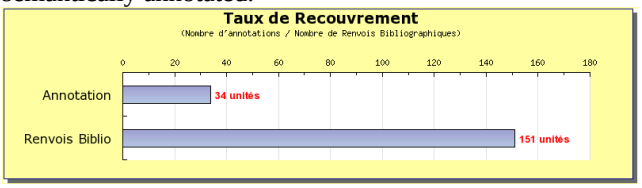

Figure 6. Coverage rate

This indicator is paramount in the evaluation of the system, because it shows the capacity of the system to annotate the bibliographic references.

Figure 5 shows an example of the value of the coverage rate for one scientific article. It can be seen that from the total of 151 bibliographic references only 34 have been annotated. The reasons why the rest of the bibliographic references are not annotated are the following:

- For the annotation we consider only the relation between authors among all the possible relations
- The basic segments for the annotations are the sentences. However, an author can include several citations in the same sentence.

- Segmentation in proposition have not yet been implemented in the system.
- The linguistic markers for the semantic annotation can be in another segment than the bibliographic citation.
- The last and most important reason is that a large number of citations are tacitly introduced in the text and therefore not possible to categorize semantically.

Distribution of Annotations. According to the annotations, we can present graphically the distribution of the bibliographical references in the publication. It is interesting to note that the segments annotated as definitions and results are very present in this article with a stronger concentration in the beginning and the middle of the publication. Moreover, in the middle of the article, almost at the same position, we see that there are segments annotated as information, comparison, similarity and point of view. This suggests that at this point in the article there is a discussion in which to position of the author is compared to other publications.

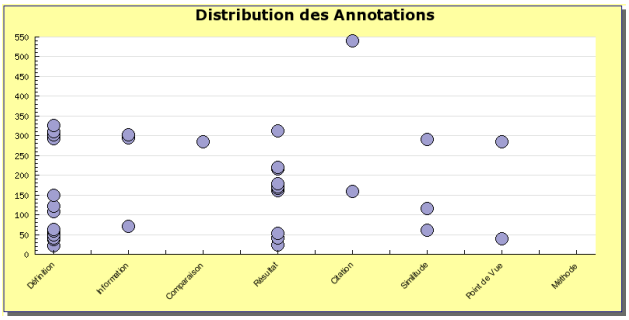

Figure 7. Distribution of annotations

In this type of approach we conceive the act of citation as a non-uniform phenomenon, carrying a semantic meaning and social and historical motivation. In this way of thought, the simple use of the bibliography as a measure unit is very restrictive. The distribution of annotations shows the structure of the citation in the text and the existence of non-homogeneous values of the citation according to their position in the text.

Publication Categorization. Scientific publications vary in nature. For example we can consider articles of synthesis or methodology. Using the semantic map, we can categorize the document according to the relative number of bibliographic references for each of the categories on the highest level in the semantic map.

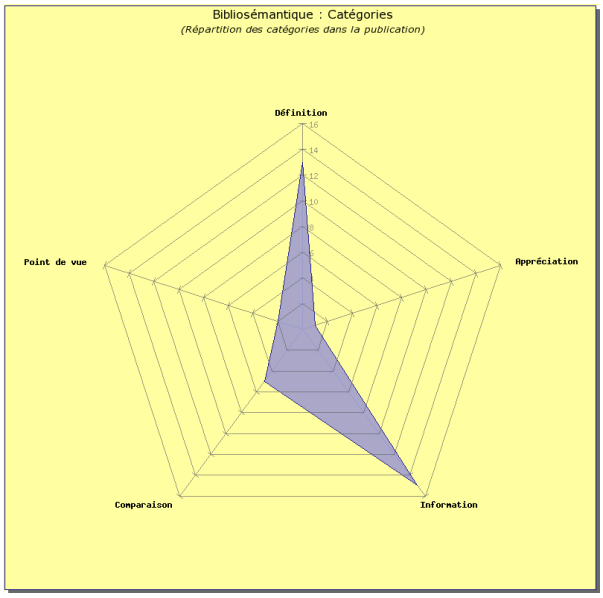

Figure 8. Publication Categorization

This approach makes it thus possible to consider bibliosemantic indicators based on the treatment of a single text and however remains compatible with statistical approaches. It also offers a greater facility for the development of new indicators. Nevertheless, in order to use the indicators for evaluation on larger scale, they must be normalized, which will allow the comparison of publications.

Relevance of the methodology in the context of citation analysis

So what is theory of citation ? Theory citation denote theoretical understanding contribution of evaluative bibliometrics tools such as research performance , impact factor or scholarly quality . It suggest that is theory accept only way showing utility of citation measure with difficulties to develop method to implement other point of view from citation analyses.

However, the citation is a complex phenomenon that is subject to various internal and external limitations. We will present in detail these influences in order to show some of the disadvantages of the actual approaches and why our approaches give pertinent informations.

So, the question that interests us here is whether all citations in an article have the same value. We don't think so and we cannot agree with Luukkonen and Zuckerman (Zuckerman, H., 1987; Luukkonen 1990) who state that:

> The existence of various cognitive meanings of citations and motivations for citing does not necessarily invalidate the use of citations as (imperfect) performance measures..

To understand the citation act, we have to show the

motivation of an author to cite their colleagues. We can consider the citation as a scientific tradition that has the purpose to identify a specific point located in the text of another author. We will notice that the act of citation is also and especially related to the motivation of the authors.

Motivation plays an important role in the citation act too. In 1964, and then in 1977, Garfield (Garfield 1977) proposes fifteen different reasons for citation. Similarly, in 1977, Small (Small 1977) distinguishes the following five categories of relations between authors and each of these relations can be categorized. So, Cozzens proposes to take into consideration the fact that an author has some external constraints related on one hand to norm, tradition and rules that act upon the domain, and on the other hand, to their personal knowledge and motivations. Moreover, citations could be used as a strategic element, for example be citing the editor of a journal or some reviewers. (Case and Higgins 2000).

However, according to Gilbert the citation is above all an act of persuasion: to cite somebody of authority permits to validate one's argumentation in order to convince. This leads us to consider the Mathieu effect. In 1995, Merton (Merton, 1995) explain The Matthew effect by this way :

> The Matthew effect is the accruing of large increments of peer recognition to sicentists of great repute for particular contributions in contrast to the minimizing or withholding of such recognition for scientists who have not yet made their mark.

Consequently, this effect is not a necessary condition to obtain certain visibility. If a paper is significant, it will have, finaly, an impact and find its place in the community.

There are two possible ways that an article is no more cited: either it is not significant enough and is therefore forgotten, either the article contains some new knowledge that is transformed into common knowledge .

Before becoming common knowledge, we can consider where citation could exist. In 1992, Coles (Coles 1992) distinguishes two types of knowledge: core knowledge and frontier knowledge . An article is more rarely cited if it is located in the frontier knowledge than in core knowledge .

The lifetime of a scientific article, i.e. It's existence in the bibliographies of other articles, varies according to its domain. Price (Price 1965) has shown that recent papers have a better citation rate than older papers. Van Rann shows that the average lifetime of an article according to his citation rate is no longer than three years after the paper's publication. This period of two or three years is generally considered as the average delay of penetration of the publication in the scientific community" (Courtial 1990). We note that this corresponds approximatively to the period used by the impact factor introduced by Garfield.

We can summary, by underlining that the analysis of the quotation can belong to two schools of thought: the one can be considered as normative, and the the other, bound to the relativist sociologists, who laud a more social function. The quotation would be a way of immunizing against the criticism.

After this macroscopic studies, we can look inside article and understand that distribution of citation is non-homogeneous. Citations have different meanings according to their position. Hargens 2000 et Voos and Dagaev 1976 (Hargens. L. L. 2000; Voos and Dagaev 1976) have shown that citations occur more frequently in the beginning of a publication. Indeed, in the introduction we can often find a brief state of art of the domain.

This theory meet numerous problems of different nature, such as sociological, psychological or historical, that have to be considered. But, today, we can only suggest to take in consideration limitation from this actual model.

It is difficult to measure the quality of scientific production by the existing methods because in the calculation of the bibliometrics indicators citations are considered as measure units, and not as a set of complex phenomena. Presently, it is essential to give, at this present day, some new impulsion. In fact, since impact factor, scientific use of system to have best evaluation.

Conclusion

The last few years, the attitude publish or perish appeared, leading to practices that could be unfavorable for the quality of the publications. One of the short term risks of this practice is undoubtedly an increased scientific production but of a lower quality, which obliges a reader to go through a large number of publications in order to study an idea or a concept. In a longer term, there is a risk of uniformity of scientific research, resulting in a decline of the diversity and a tendency of homogeneous research.

The report of Moed comes at a critical moment when the Impact Factor is subject to numerous criticisms. The difficulty in the categorization of quotations can be raised by the Contextual Exploration method. The platform EXCOM allows the automatic semantic annotation, and opens new possibilities for the citation analysis and the creation of new indicators. The conception of networks using this methodology will lead to a thorough analysis of the current indicators using the impact factor of Garfield and the evaluation of the science more widely.

We have proposed here a method that is innovative compared with the actual paradigm of citation analysis. We have discussed also the problem of evaluation. Our implementation shows this new method that uses the semantic annotation and structured information. This work in progress cannot be evaluated by using the traditional measures of precision and recall. According to the indicator Coverage rate, on figure 5, we have to develop new protocols for evaluation of the qualitative annotation. For the purpose of the evaluation, we have to specify how human annotations can be used in an evaluation protocol. Finally, the bibliosemantic indicators must be defined with caution as they are the means for science evaluation.

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