Relevance Levels for Patent Mining

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Abstract

This paper presents a proposal for relaxed relevance for patent mining. The essential argument is that assignment of a complete international patent classification (IPC) to a document is a difficult task and that because the IPC code has several levels of hierarchy, relaxed relevance judgments as higher levels may provide better performance of the same classification algorithms.

Keywords: *Patent Mining, Patent Classification, Relaxed Relevance.*

1. Introduction

The NTCIR-7 Patent Mining task [1] is essentially about taking science and engineering articles and assigning them International Patent Classifications (IPC) to them. The purpose is to utilize associations from actual patents to scientific discoveries for assessment of prior art and for new discovery. The current relevance assessment consists of assigning a few exact IPC classifications to the articles from the NTCIR-1 and NTCIR-2 document collections. The patent mining task proceeds by using the articles as queries to the patent databases, and mining the ranked patent lists for classifications which would be most likely to classify the article. According to the IPC definitions:[1]

> Every subdivision of the IPC is indicated by a symbol and has a title. The IPC divides all technological fields into eight sections designated by one of the capital letters A through H. Each section is subdivided into classes which symbols consist of the section symbol followed by a two-digit number. In its turn, each class contains one or several subclasses which symbols consist of the class symbol followed by a capital letter, for example, A01B. Each subclass is broken down into subdivisions referred to as "groups", which are either main groups or subgroups. Main group symbols consist of the subclass symbol followed by a one- to three-digit number, the oblique stroke and the number 00, for example, A01B 1/00.

However, because the WIPO classifications follow a hierarchical structure of Class/Subclass-Group. Our argument is that the NTCIR Patent Mining Task should include relaxed levels of relevance evaluation for patent classification of scientific/engineering articles by using higher level parts of the classification rather than the entire classification. Thus the Class/Subclass would be the broadest (and most relaxed relevant judgment) while Class/subclass/Group would be more exact than the higher level, but not as rigid as the entire classification.

[1] http://www.wipo.int/classifications/ipc/en/general/intro.html

2. A Patent Topic Example

Consider, for example, Patent dry run topic 103:

<TOPIC>
<TOPIC-ID>103</TOPIC-ID>
<TITLE>Development of a Portable Magnetic Fields Exposure Meter and Magnetic Fields Measurements**</TITLE>**
<ABSTRACT>There has been an increasing interest in effects for electronic equipments and human health by electromagnetic fields radiated from electric facilities. In order to understand AC magnetic fields exposure characteristics of the living environments, a portable magnetic fields meter was developed. Some measured results are shown in this report. Intensity and phases of three orthogonal axis component and frequency at power frequency bands can be measured at interval of 1 second or more and memorized on SRAM board. It has wide dynamic-range from 0.1 mG (milligauss) to 50 G. It has proved that it was sufficiently operated under high electric fields. **</ABSTRACT></TOPIC>**

According to the patent track organizers, the correct classification for this article is: G01R 33/00 (**Arrangements** or instruments for measuring magnetic variables) which was found in the dry run evaluation by the Berkeley system run (method BRKLY03) at rank 29, while G01R 33/20 is found at rank 3.

2.1. Aggregation to Class-subclass-main-group level:

If, however, we were to only consider the class-subclass-main-group, a re-aggregation of results for correct classification G01R 33 changes the rank to second (as shown below):

Table 1: Class-subclass-group rank example

Rank	RSV	Classification
1	51	G01V 3
2	39	G01R 33
3	26	A61N 1
4	24	H01Q 1
5	21	A61B 5

2.2. Aggregation to Class-subclass level:

If we further restrict our classification to class-subclass (i.e. remove the trailing group number above and again re-aggregate, the correct class-subclass G01R (MEASURING ELECTRIC VARIABLES; MEASURING MAGNETIC VARIABLES) moves to the top ranked classification (as shown below):

Table 2: Class-subclass rank example

Rank	RSV	Classification
1	92	G01R
2	54	G01V
3	52	H01J
4	50	H01Q
5	43	H05B

Thus we see that a methodology which performs marginally at a rigid level of evaluation of patent classification may perform much better on higher levels of classification.

3. Aggregation of Query Relevance (qrels)

The authors took the relevance file (qrels) of the final test runs for Patent Mining supplied by the organizers and, to create new qrels files, aggregated up two additional levels: Class/Subclass and Class/Subclass/MainGroup. For the Class/Subclass aggregation, we found the following frequency count of unique codes within the official qrels file:

Table 3: Class-subclass aggregation count

Count of unique codes	Count of original qrel entries
7	5
6	4
5	5
4	22
3	82
2	304
1	1025

4. Experimental results

The authors took the results submitted to the NTCIR-7 patent mining task and aggregated them to two higher levels of IPC patent classification. For the highest level of Class/Subclass we have the following results (compared to the official Berkeley run for Patent Mining):

Table 4: Recall/Precision comparison for higher levels of IPC code assignment for BRKL03 run

Precision at Recall	B03 Class/ Subclass	B03 Class/ Subclass Group	BRKLY03 Official Run
0	0.5724	0.3746	0.1498
.1	0.5724	0.3746	0.1498
.2	0.5724	0.3737	0.1454
.3	0.5650	0.3589	0.1295
.4	0.5422	0.3202	0.1078
.5	0.5415	0.3179	0.1044
.6	0.4330	0.2243	0.0656
.7	0.4109	0.1987	0.0572
.8	0.4074	0.1942	0.0556
.9	0.4071	0.1923	0.0551
1.0	0.4071	0.1923	0.0551
MAP	**0.4851**	**0.2754**	**0.0937**

From this run we see that relaxing the relevance leads to substantial improvement in our system's performance of classification assignment.

Run BRKLY04 used the same retrieval algorithm as BRKLY03, but instead of aggregating counts of patent codes, we summed up the probability scores for all instances of a given patent code. The following table compares the performance at the higher levels of the patent classification to the official BRKLY04 run.

Table 5: Recall/Precision comparison for higher levels of IPC code assignment for BRKL04 run

Precision at Recall	Class/ Subclass	Class/ Subclass Group	BRKLY04 Official Run
0	0.5801	0.3802	0.1564
.1	0.5801	0.3802	0.1564
.2	0.5801	0.3793	0.1528
.3	0.5728	0.3638	0.1368
.4	0.5498	0.3255	0.1143
.5	0.5490	0.3232	0.1109
.6	0.4365	0.2261	0.0700
.7	0.4142	0.2005	0.0609
.8	0.4107	0.1956	0.0593
.9	0.4105	0.1936	0.0588
1.0	0.4105	0.1936	0.0588
MAP	**0.4909**	**0.2787**	**0.0990**

Run BRKLY02 used a different retrieval algorithm from both BRKLY03 and BRKLY04, a classification and clustering algorithm described in our report for the Patent Mining task [2].

The following table compares the performance at the higher levels of the patent classification to the official BRKLY02 run. BRKLY02 was our best-performing official run.

Table 6: Recall/Precision comparison for higher levels of IPC code assignment for BRKL02 run

Precision at Recall	B02 Class/ Subclass	B02 Class/ Subclass Group	BRKLY02 Official Run
0	0.5698	0.3655	0.2108
.1	0.5698	0.3655	0.2108
.2	0.5698	0.3649	0.2057
.3	0.5618	0.3496	0.1787
.4	0.5390	0.3052	0.1466
.5	0.5376	0.3032	0.1434
.6	0.4401	0.2165	0.0848
.7	0.4207	0.1917	0.0723
.8	0.4193	0.1869	0.0697
.9	0.4190	0.1848	0.0687
1.0	0.4190	0.1848	0.0686
MAP	**0.4875**	**0.2663**	**0.1265**

It is interesting to note that for the broadest level of classification tested, method BRKLY04 performs equivalently to BRKLY02, while there is a substantial difference in performance between the two at the most detailed classification assignment task.

5. Summary and Conclusions

In this paper we have proposed new levels of relaxed relevance for the Patent Mining task. Our motivation was to see whether our patent classification algorithms which performed relatively poorly at the most specific level of automatic assignment of International Patent Classification (IPC) code would show better performance at higher levels of the IPC classification hierarchy. Our experimental results demonstrate that using a relaxed level of relevance judgment for broader patent classification levels shows substantially better performance. There may be other factors affecting our Patent Mining performance. For a description of those factors, please refer to our paper on the task [2].

References

[1] Hidetsugu Nanba, Atsushi Fujii, Makoto Iwayama, and Taiichi Hashimoto. Overview of the Patent Mining Task at the NTCIR-7 Workshop. *Proceedings of the 7th NTCIR Workshop Meeting on Evlauation of Information Access Technologies: Information Retrieval, Question Answering and Cross-Lingual Information Access*, 2008.

[2] Gey, F and R Larson, Patent Mining: A Baseline Approach, *Proceedings of the 7th NTCIR Workshop Meeting on Evlauation of Information Access Technologies: Information Retrieval, Question Answering and Cross-Lingual Information Access*, 2008.