Computer-Aided analysis of patents and search for TRIZ contradictions

Gaetano Cascini, Davide Russo

Università degli Studi di Firenze, Dip. di Meccanica e Tecnologie Ind.li
via S. Marta, 3 - 50139 Firenze, Italy
E-mail: gaetano.cascini@unifi.it, davide.russo@unifi.it

Abstract: TRIZ, the Soviet initiated Theory of Inventive Problem Solving, is gaining acknowledgement both as a systematic methodology for innovation and a powerful tool for technology forecasting. Nevertheless, the analysis of patents necessary for gathering the data to be used for the previsional activity is very cumbersome and sometimes unworthy due to the intrinsic low reliability of forecasting tasks. With this perspective it is necessary to speed up the identification of the technical/physical conflict(s) overcome by an invention, according to its textual description. Although text-mining tools have reached relevant capabilities for extracting useful information from huge set of documents, no specific means are available to support the analysis of patents with the aim of identifying the contradiction underlying a given technical system. This paper proposes a computer-aided approach for accomplishing such a task: the algorithm is described and validated by means of practical examples.

Keywords: Text mining, Patents Analysis, TRIZ, Analysis of Contradictions, Technology Forecasting.

Biographical note: Gaetano Cascini completed his PhD in Machine Design in 1999 and is Researcher at the University of Florence, Faculty of Engineering. He is vice-chair of the "Computer-Aided Innovation" Workgroup of the IFIP (International Federation for Information Processing) TC-5 Committee (Computer Applications in Technology) and member of the ETRIA (European TRIZ Association) Executive Committee. His main fields of activity are methods and techniques for Systematic Innovation, Knowledge Based CAD/CAE tools, Knowledge Management.

Davide Russo took his master degree in Mechanical Engineering in 2003 and is a third year PhD student at the Faculty of Engineering of the University of Florence. His research activity is mainly focused on the application of TRIZ in different engineering tasks and its integration with other design methodologies and tools.

1. Introduction

The analysis of the potential of new technologies as well as the identification of the evolutionary stage of a product are crucial activities for today's economies, societies, and companies: such analyses inform critical choices ranging from the multinational level to the individual organization (Porter et al., 2004).

Most Technology Forecasting methods rely on qualitative insights or the synthesized discussion of experts, while statistical analyses (e.g. patents bibliometrics) aim at providing quantitative means for evolutionary studies. Actually, both qualitative and quantitative approaches present several limitations: cumbersome, difficult to apply, difficult to learn, unreliable etc., each existing technique is characterized by at least one of those sores and even present combinations of methods do not provide satisfactory results since new forecast errors can appear as a result of the synergy effects (Kucharavy, 2005).

Among all the techniques for Technology Forecasting, a growing acknowledgement is recognized to TRIZ based approaches (Clarke, 2000; Porter et al., 2004; Pilch, 2004). Nevertheless, identifying the stage of evolution of a given technical system according to the criteria proposed by Altshuller, the father of TRIZ (Altshuller, 1988), and all derivatives methods, is a rather complex and time consuming task. In facts, the analysis is based on the number of the inventions, their innovation levels and their profitability.

Identifying in a patent database the relevant inventions about the evolution of a specific technical system is not a trivial task, since standard keyword based search methods provide long lists of "noisy" results that require a careful manual selection. Besides, more advanced text mining tools can provide an effective support to accomplish this task. Besides, the assessment of the level of the invention disclosed by a patent is rather harder and no computer-based means are available to speed-up these kind of analyses.

The aim of this work is to present an algorithm for performing automatic patent functional analyses and a computer-aided approach for identifying the contradictions overcome by a patented invention, as a means for assessing its inventive level.

The next section is dedicated to a brief resume of the correlation between innovation activity and the stage of evolution of a technical system. Then follows a survey of available technologies for patent analyses. The fourth section describes the authors' approach to patent analysis and introduces a novel algorithm for identifying TRIZ contradictions. An exemplary application of the algorithm is shown in section five.

2. Stage of evolution and innovation activity

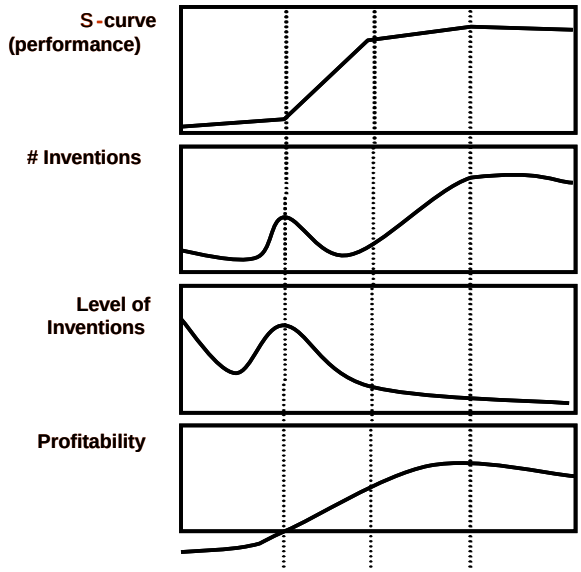
According to the results of Altshuller's studies, the four typical stages of evolution of a technical system, i.e. infancy, rapid growth, maturity, obsolescence (fig. 1, above), can be correlated with the innovation activity associated to the development of the selected technical system in terms of number of inventions, level of the inventions, profitability.

The level of an invention is a measure of its novelty; Altshuller distinguished five different classes:

- Level 1: slight modifications of existing systems, no contradictions (i.e. technical/physical conflicts) are overcome; usually involve a single sub-system; the solutions are confined to a narrow field of application.
- Level 2: simple contradiction are solved; a concept can be transferred from an engineering field to another, usually rather close.
- Level 3: a relevant system conflict is overcome by an original approach within one discipline (e.g. mechanics, electronics, chemistry, etc).

- Level 4: an interdisciplinary solution resolves a relevant contradiction and gives birth to a novel system.
- Level 5: pioneering inventions based on new scientific discoveries.

Figure 1. Stages of evolution of a technical system and correlation with innovation activity.



A detailed discussion about how the assessment of the inventive level can be achieved is out of the scope of the present contribution, but it is clear that a relevant role is played by the identification of the technical conflict that an invention claims to overcome.

In other words, within the context of TRIZ based evolutionary studies, a relevant topic is speeding up the analysis of a patent, by highlighting the parameters describing the contradiction overcome by the disclosed invention. Once that the conflicting parameters are identified from the prior art of the patent and the characteristics improved by the invention are highlighted, it is easier for a patent analyst to understand if a contradiction has been solved and whether the solution relies within the same discipline or not. It is clear that an invention assessment is much more effective if several patents of a given class of application are compared (i.e. the solutions are classified according to the conflicts they try to overcome).

3. State of the art of patent-mining technologies

Recently, text mining, which is used for drawing valuable information from large volumes of unstructured text, has been widely adopted to explore the complex relationship among patent documents.

Companies gain a strategic advantage over their competitors through “technology watch” activities. Nevertheless, patents databases are large and complex and cannot simply be “watched”. In fact, each patent is identified by specific codes that describe its

application areas, inventor and similar data, as well as by other free textual fields, which are rarely used for classification purposes. The alphanumerical codes are always partially overlapping and redundant, the free textual fields contain instead the true valuable information. Thus, it is not easy, even for an experienced researcher, to recognize the importance of a patent and its relationship with other patents, especially when the corpus consists of hundreds of documents.

Commercially available patent databases provide basic means for information retrieval and citations tracking, but patents searches are still time consuming and require big efforts for being accomplished. In facts, citation analyses are the most used techniques for identifying within a company's patent portfolio the small number of valuable, high-impact patents against the large number of patents of marginal importance (Breitzman, Mogee, 2002).

It is believed that a statistical analysis of the rate of publication of patents pertaining to a certain field or assigned to a certain company, provides information about technology maturity and corporate technology strategies. Typically, the analysis is performed by counting in an online database the number of patents issued annually in a set of calendar years (Bigwood, 1997). Besides, it normally takes five or more years from publication before a patent begins to be cited to any great extent. In general, 70% of all patents are either never cited, or cited only once or twice, so that even ten citations place a patent in the top few percent of ever cited patents (Cascini et al. 2005).

Therefore, the analysis of the free textual description is assuming a greater relevance for getting major advantages from disclosed inventions. Text Mining applications provide effective means for content searches in the textual fields of patent databases, but they are typically not tailored for patent analyses and too often require a deep expertise about how to gain major advantages from this technology.

Preliminary steps have been accomplished towards specific patent search functionalities (Cascini et al., 2004): table and figure reference extraction (Hull et al., 2001); multilingual information access (Wisper, 2004); citation based (Cascini et al., 2005) and text-mining based (Yoon, Park, 2004) patent networks; use of syntactic criteria for extracting concepts instead of keywords. A commercial system implementing the last feature is the well known Invention Machine Goldfire platform (www.invention-machine.com). Indeed, such an analysis allows a rather powerful classification of the concepts contained in a patent description by means of Subject-Action-Object triads; nevertheless, as well as for more traditional keywords based tools, no systems are available on the market for capturing the role of a component in an invention or for grouping patents according to the claimed functionalities apart from their fields of application.

Previous works by the authors aimed at speeding-up patent analyses by identifying the architecture of the claimed invention and distinguishing the functional (semantic) role of each component. In the next paragraph a resume of the previous results is reported. Then a step forward to the identification of the technical conflicting overcome by an invention will be presented.

4. Computer-Aided patent analysis

With the aim of extracting detailed information about a disclosed invention and to speed up patent analyses, the authors have developed a software system, PAT-Analyzer, for

automatically translating the description of an invention into a functional diagram (Cascini, 2002). During the last three years the system has been further developed and integrated with other software tools.

4.1 Automatic patent functional analysis

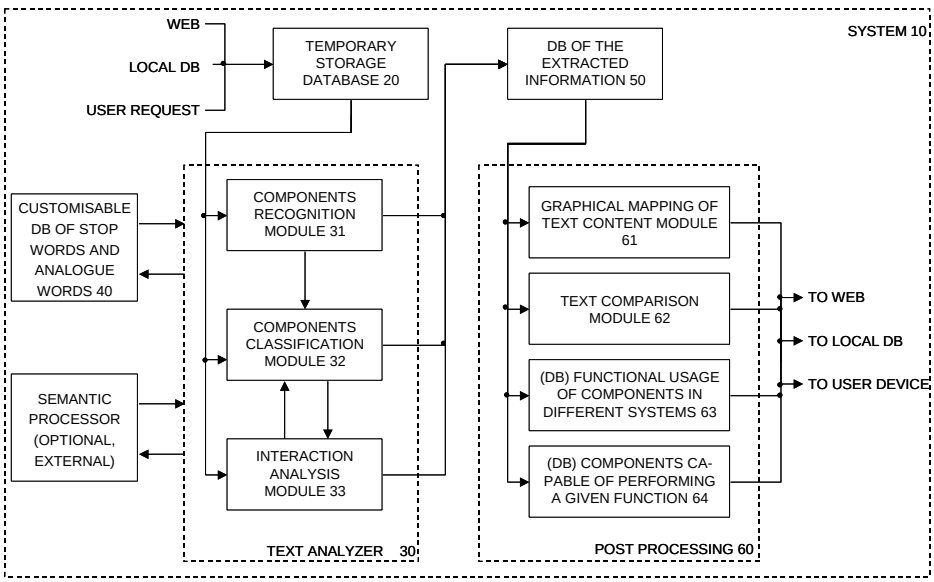
The methodology consists in two main tasks, text analysis and post processing, further subdivided in multiple steps, as depicted in fig. 2: the text analysis consists of three steps aimed at (i) identifying the components of the invention; (ii) classifying the identified components in terms of detail/abstraction level; (iii) identifying positional and functional interactions between the components both internal and external to the system. Several types of analyses can be performed by means of the post-processing module, in order to focus the invention peculiarities.

The components identification task is performed taking into account that they must be numbered univocally to be identified in the illustrations and by defining a set of rules that enable the system to recognize references common formats such as: 10, (10), 10a, 10a-d etc. (Hull et al., 2001). A lemmatizer and a set of filters and synonyms can be adopted in order to improve the quality of the results. Therefore a list of reference denominations and alternative denominations is extracted for each component.

The following analysis is dedicated to the search of descriptive locutions (e.g. the component X comprises…) and specification's expressions (e.g. the part X of the component Y) in order to identify subsystem/supersystem relationships, hence defining a hierarchy of detail/abstraction levels.

Finally, positional and functional interactions between the identified components are determined by filtering, from the list of (subject-action-object)s provided by a syntactic parser, the triads containing irrelevant verbs.

Figure 2. PAT-Analyzer data flow.



An exemplary diagram obtained by processing the US Patent 6,517,240 “Ultrasonic thermometer system” is shown in fig. 3, where:

1) each identified component of the system is represented by a rectangle labeled with its reference number and the representative name defined in the Components Recognition phase; each identified component or subject external to the system is represented by a grey rectangle labeled with a representative name;

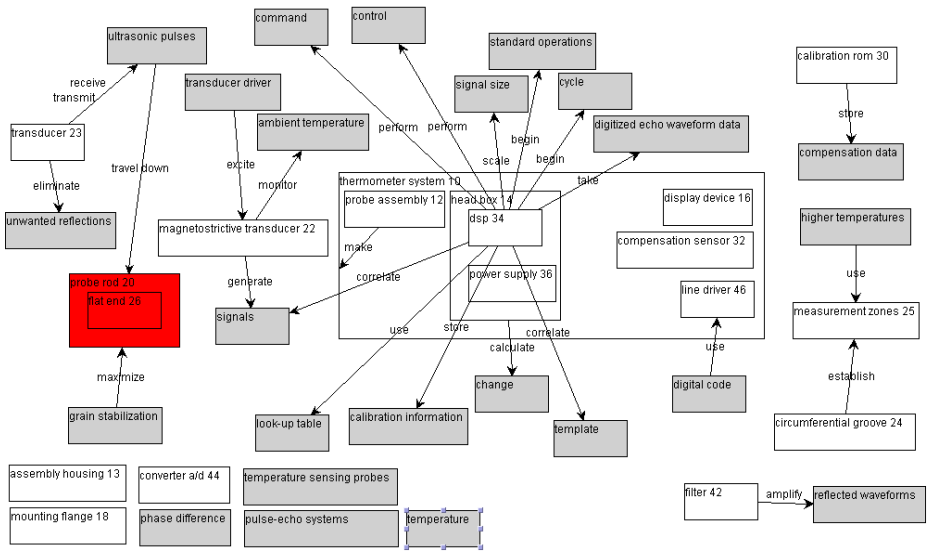
2) the detail level hierarchy is represented nesting the components at a deeper detail level inside the corresponding components at a more abstract level;

3) the functional interactions between the identified components are represented with straight arrows pointing from the Tool to the Artifact, labeled with the Field;

4) the positional interactions between the identified components are represented with dashed arrows pointing from the Tool to the Artifact, labeled with the Field.

The post-processing module allows to highlight the invention peculiarities by means of a set of ranking criteria, based on the detail level of the description, component recurrence, functional interaction recurrence and content distribution within the patent text. These criteria have been further developed in several works mentioned in the references list, but they will be omitted since they are out of the scope of the present paper.

Figure 3. Functional diagram of the US Patent 6,517,240 “Ultrasonic thermometer system” by Herbs et al., http://www.uspto.gov/patft/index.html, February 11, 2003.



4.2 Pattern-based search for contradictions

While the outputs of PAT-Analyzer described in the previous paragraph allow a quick comprehension of the structure of an invention and its peculiarities, therefore providing an useful means for understanding the relevance of a patent for a specific knowledge

search, no information is provided about the problematic situation the inventor(s) claim to overcome.

According to this purpose a novel algorithm has been developed, with the aim of extracting technical and physical parameters describing the specific improvement disclosed by the patent.

Figure 4 summarizes the basic steps of the procedure: the patent text is processed in two parallel tracks, the first related to the analysis of the claims on the basis of the results of the functional analysis described above; the second makes use of pattern search criteria (Hui, Yu, 2005) to extract complementary information from the full text:

1) First the claims are extracted from the full text and parsed into independent sentences.
2) The portion of the sentence where the novelty is detailed is identified by searching for specific patterns like "characterized in that", "wherein", "comprising" etc.
3) Adjectives, adverbs, nouns and multi-words are extracted from the sentences selected at step 2. The linguistic analysis of this free text is based on morphological and statistical criteria: with the aid of a digital vocabulary, the text is processed looking for terms or phrases that comply with a set of pre-defined morphological patterns (i.e.: noun+noun, noun+preposition+noun sequences etc.) (Raffaelli, 1992). The detected terms and phrases are then extracted and reduced to their "Part Of Speech" tagged base form. This step is accomplished by means of software libraries provided by Synthema srl (www.synthema.it).
4) The extracted words and multi-words are filtered with the list of reference and alternative denominations of the internal and external components of the invention (see paragraph 4.1). The basic concepts is that if a noun is mentioned in the part of the claim describing the novelty of an invention, most probably, if it is not a component of the system, such a noun is referred to an improved parameter or characteristic of the system itself. Similarly, it is expected that adjectives and adverbs are related to a variation of a parameter or to a characteristic of the technical system.
5) Search for parameters' variations: if a noun identified at step 3 has not been filtered at step 4 and it is the object of a certain verb, the pair verb-object define a candidate improving factor; similarly, if the adjective is in comparative form a candidate improvement of the system is highlighted.
6) On a parallel track the whole text is processed by searching specific patterns like those reported in Table 1, in order to gather information about the motivation of the invention, overcome problems, comparisons, tradeoffs, others.
7) The extracted concepts are integrated, possibly ranking the results according to the number of hits and/or to a specific weight to be assigned at each identification criterion. The ranking weights are still under definition, since wider statistics are necessary for a more reliable estimation.

Figure 4. Flow chart of the proposed algorithm.

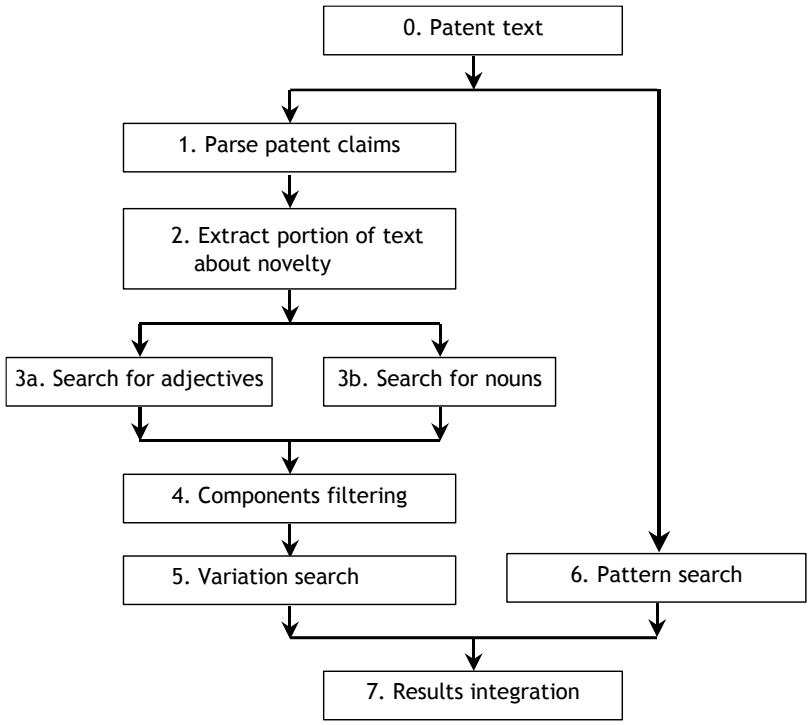


Table 1. Sample pattern for information gathering.

Scope	Location	Sample Pattern
Motivation	Full Text	"overcome"
		"in order to"
		"with the aim of "
		"aiming at"
		"scope of"
		"thus" + [verb, ing form]
Parameter variation	Full text	[adj]-er (comparative)
		[adj]-est (superlative)
		"more"
		"less"
		"most"
		Verbs related to quantities (e.g. "increase", "decrease", "reduce" etc.)
		Verbs related to judgment (e.g. "improve", "worsen")
Improving factor	Claims	[verb] + obj. noun (components excluded)
		[adj]-er / "more" + [adj] (comparative)
		[manner adv]
Worsening factor	Background of the invention / Prior art	"difficulty in"
		"tradeoff" / "trade-off"

Therefore, the output of the proposed procedure is constituted by the following highlights:

- (claim by claim) the motivation of the disclosed solution;
- (claim by claim) a list of candidate improving parameters or characteristics;
- other parameters/characteristics variations;
- (possibly) worsening features.

Two exemplary applications of the proposed algorithm to the analysis of patents related to different fields of application are discussed in the next section.

5. Exemplary test cases

The algorithm described in the previous section has been tested with a number of patents belonging to different industrial fields. Such a validation activity is aimed also at enriching the pattern database with less used linguistic expressions.

In order to demonstrate the advantages of the proposed approach two test cases are described, the first related to a measuring temperature device, the second to an electric lighting apparatus.

The test cases have been selected from author's direct experiences and by already published patents analyses in order to have comparisons means for a proper validation. In facts, the two examples here reported have been chosen among those published by Creax (www.creax.com) as "Patent of the month" on February and June 2003 respectively. Such a web page used to highlight once a month a just issued patent, by discussing about the contradiction overcome by the invention and the inventive principle(s) underlying the adopted solution, hence providing a suitable bench-test for the present work.

5.1 US 6,517,240 - Ultrasonic thermometer system

This invention is aimed at overcoming thermo-couples unreliability due to out of range temperatures and/or unfriendly environments. This "ultrasonic thermometer" constitutes a solution to the conflict between the need to make the device small in order to get good response and transient characteristics, and the parallel desire to make it robust enough to survive handling and fixing in aggressive atmospheres.

First the patent has been processed in order to extract its functional model according to the method described in paragraph 4.1; the output of such an analysis is shown in fig. 3.

Then, the algorithm pointing to the improved parameters, and possibly, the overcome contradictions has been applied.

In Table 2 the whole set of outputs of the claim 1 and the most relevant results obtained by the analysis of the following claims are reported.

The results of the first claim point to the transducer material on one side and to signal analysis parameters on another.

In facts, grain stabilizer ("addition of magnesia in the range of 50 to 400 ppm") is the solution adopted to "inhibit the growth of the grains in the microstructure of the material at high temperatures", therefore keeping "the acoustic transmission properties of the

sensing rod stable" and "maintaining the stability of the calibration of the sensing rod". In other words, material stability is the desired improving factor.

Moreover, in order to improve measurement reliability, the inventors propose "the use of correlation techniques to determine notch echo timing", so that "noise reduction and immunity from other external environmental effects on the echo signals" are ensured.

Claims 2 and 3 still highlight details about "information" management: data are encoded and a specific calibration is provided for each sensor rod. The features extracted from the fourth claim reveals temperature as a relevant parameter, while eliminating manufacturing variations is the improving factor emerging from claim 5.

A detailed analysis of all the 18 claims of the present patent is out of the scope of the paper, but the contribution to the identification of relevant parameters and improving features can be appreciated by the results reported in Table 2a. Besides, few more examples of extracted information from a general pattern search in the full text are reported in Table 2b: the first is referred to a parameter variation identified by means of a comparative form; then two cases of motivation of specific solutions; finally, a worsening factor that limited the adoption of ultrasonic thermometers in prior implementations.

All the above results fit with the comments provided by Creax experts: the adoption of a grain stabilizer allows solving e relevant contradiction even if within the same discipline (the solid rod still is present to support the transducer). As a consequence such an invention can be assessed as a third level solution, while the adoption of a customizable calibration system is a rather common solution (level 1).

5.2 US 6,573,663 - High intensity light sources

The second patent taken into account in this validation process is related to an apparatus constituting a high intensity light source which utilizes an electric discharge to generate light, to be used as an optical pump for lasers, as an UV light source for UV sterilization and UV polymer curing, or as a means for ozone generation.

The architecture of the system is rather simple, as confirmed by the functional diagram extracted by PAT-Analyzer and represented in fig. 5.

Besides, the invention represents an elegant solution that uses just a small amount of energy to initiate the discharge and a separate mechanism for building up and storing charge on a dielectric sheet.

A selection of the concepts extracted by means of the algorithm presented in section 4.2 is reported in Table 3. While at a more general level the contradiction is obtaining high illumination intensity without increasing reducing power consumption, as confirmed by the report published by Creax, the proposed algorithm points to the underlying physical conflict: among the improving features identified by the analysis of the first claim, emerges "apply rapid potential change" that is the basic principle adopted by the inventors. No worsening features have been extracted, but the background of the invention is extremely short (just two lines!) and the patent text does not contain any explicit reference to specific problems to be overcome. Nevertheless, the analysis of the other claims and the search for typical patterns reveals the rapidity of the voltage change as the trick for overcoming the problem.

In this case the assessment of the level of the invention would require a more careful comparison with other inventions in the same field, due to the lack of prior art description in the patent text; nevertheless, it emerges that the proposed solution still remains within

the paradigm of electric discharge based light sources and a level 2 is the expected value of the invention.

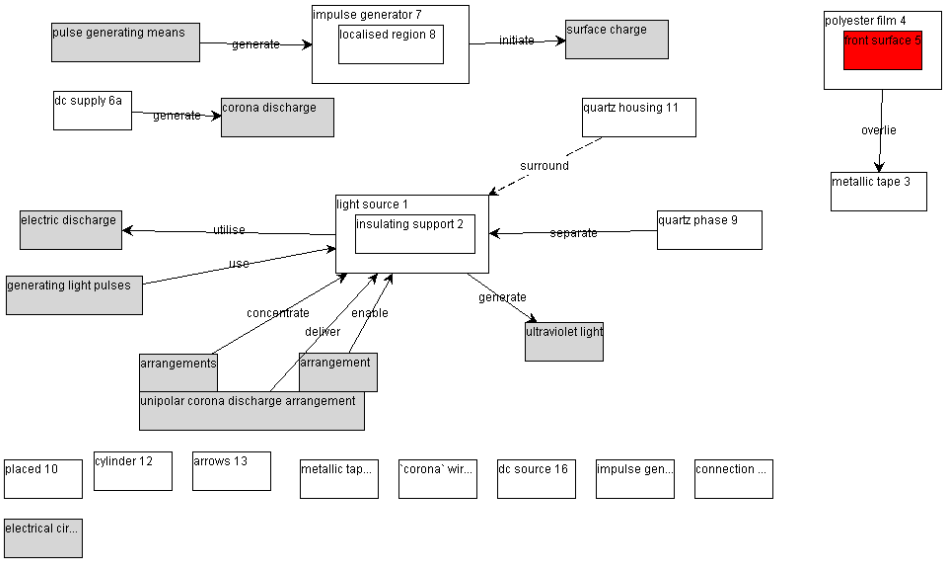
Table 2a. Exemplary analysis of the US Patent 6,517,240 "Ultrasonic thermometer system": outputs from the first 5 claims.

Claim	Feature type	Extracted Features
CLAIM 1: *[An ultrasonic thermometer system comprising:]* *a solid rod of grain stable material, said rod having one or more circumferential grooves cut through the surface of the rod;* *a transducer bonded to one end of said rod;* *a head box for amplifying, filtering and conditioning signals generated by said transducer;* *a processor for correlating signals generated by said transducer and reflected by said grooves with a waveform template to determine periods in time where peak reflected energy occurs and to generate a temperature reading based on said periods in time where the peak reflected energy occurs, said waveform template being a single waveform template unique to said rod.*	[Noun(s)] and [adj/adv] (components excluded)	grain stable material signal periods in time peak reflected energy temperature reading single waveform template unique
	[verb] + [obj] (among the nouns above)	amplify signal filter signal condition signal correlate signal determine periods in time generate temperature reading
CLAIM 2: *[The ultrasonic thermometer system of claim 1 further comprising] a read-only memory mounted in a housing attached to said solid rod, said read-only memory including encoded information about said rod.*	[Noun(s)] and [adj/adv] (components excluded)	encoded information
CLAIM 3: *[The ultrasonic thermometer system of claim 2 wherein] said information is calibration information that is specific to said rod.*	[Noun(s)] and [adj/adv] (components excluded)	calibration information specific
CLAIM 4: *[The ultrasonic thermometer system of claim 1 further comprising] a temperature compensation sensor mounted in close proximity to said rod in a housing attached to said solid rod.*	[Noun(s)] and [adj/adv] (components excluded)	temperature close proximity
CLAIM 5: *[The ultrasonic thermometer system of claim 1 further comprising] an automatic gain circuit mounted in said head box for keeping signal levels constant to eliminate manufacturing variations*	[Noun(s)] and [adj/adv] (components excluded)	signal level constant manufacturing variation
	[verb] + [obj] (among the nouns above)	keep signal level constant eliminate manufacturing variation

Table 2b. Exemplary analysis of the US Patent 6,517,240 "Ultrasonic thermometer system": general patterns extraction.

Text	Feature type	Extracted Features
BACKGROUND OF THE INVENTION: *The larger physical size of the bare temperature-sensing rod material, along with selecting application compatible rod materials or materials resistant to very high temperatures, provide a much greater lifetime than with thermocouples*	[adj]-er (comparative)	*Parameter variation:* larger (physical size) greater lifetime
SUMMARY OF THE INVENTION: *Along the length of the rod, circumferential grooves are cut which reflect some of the ultrasonic energy back to the transducer thus creating a reflected or echo signal*	"thus" + [verb, ing form]	*Motivation*: create a reflected or echo signal
SUMMARY OF THE INVENTION: *As the temperature of the zone changes, the transition time of the ultrasonic pulse through the zone also changes, thus providing a measurable indication of average temperature and changes in average temperature of the temperature zone.*	"thus" + [verb, ing form]	*Motivation*: providing a measurable indication
BACKGROUND OF THE INVENTION: *Difficulty in installing probe calibration information, and the inability to integrate easily with an existing thermocouple monitoring infrastructure have made trials of an unproven ultrasonic temperature measurement technology difficult to evaluate by potential commercial customers.*	"difficulty in"	*Worsening factor:* install probe calibration information

Figure 5. Functional diagram of the US Patent 6,573,663 "High intensity light sources" by the University of Strathyclyde, http://www.uspto.gov/patft/index.html, June 3, 2003.



6. Conclusions

Technology forecasting capabilities are assuming a crucial role for improving the competitiveness of any size companies; therefore a growing interest is arising for the development of methodologies and tools for performing automatic, or at least computer-aided analyses of patents, aimed at the assessment of the evolutionary stage of a given product.

Within this context, the TRIZ approach to technology forecasting is gaining acknowledgement, even if a traditional human-based assessment is rather complex and time consuming.

In this paper, after presenting the authors' approach to automatic patent analysis, a specific algorithm dedicated to the identification of the motivation of an invention, its improvements and the problems overcome, is presented. Such an algorithm allows to speed up the identification of the contradiction(s) solved by the invention in order to assess its invention level to be correlated with other evolutionary parameters. Two exemplary applications of the algorithm have been reported in order to demonstrate its actual capabilities.

More specifically, the proposed method allows to highlight relevant details of a patent, most of all in terms of design parameters, improving features and their motivation. In some cases it is also possible to extract the characteristic that used to worsen before the introduction of the patented solution. Unfortunately, the latter result depends on the detail level of the background of the invention; therefore it is affected by the amount of information about the prior art provided by the inventors.

Table 3. Exemplary analysis of the US Patent 6,573,663 "High intensity light sources".

Text	Feature type	Extracted Features
CLAIM 1: *A high intensity light source comprising:* *a solid dielectric sheet having a front and a back surface;* *a conducting medium in contact with at least a portion of said back surface of the dielectric sheet, said conducting medium being electrically connected in use to a fixed potential;* *means for establishing electric charge of a first-polarity which is electrostatically bound to said front surface of the dielectric sheet at a potential which is different from said fixed potential; and* *selectively-operable means coupled to said front surface of the dielectric sheet for applying a rapid potential change to at least a localized region of said front surface so as to cause the charge build-up on the dielectric sheet to form an electric discharge with the consequential emission of light.*	[Noun(s)] and [adj/adv] (components excluded)	portion electrically connected use fixed potential electric charge first-polarity electrostatically bound different rapid potential change charge build-up electric discharge consequential emission light
	[verb] + [obj] (among the nouns above)	*Improving features:* establish electric charge apply rapid potential change cause charge build-up form electric discharge
CLAIMS 2: *[The high intensity light source as claimed in claim 1 wherein] the means for rapidly applying the voltage change to the dielectric sheet is any one of means for application of ground (earth) potential, or a pulse generating means.*	[Noun(s)] and [adj/adv] (components excluded)	rapidly apply voltage change application ground earth potential
BRIEF SUMMARY OF THE INVENTION: *The dielectric sheet may be photoconductive to achieve a more rapid discharge due to the increase in conductivity when discharge occurs.*	[adj]-er (comparative)	*Parameter variation:* more rapid
DETAILED DESCRIPTION OF THE INVENTION: *In order to discharge the charge built-up on the polyester film 4, an impulse generator 7 is provided (in this embodiment) which is electrically coupled to a localised region 8 at one end of the polyester film 4 at a point of contact which is just above one end of the metallic tape 3*	"in order to"	*Motivation:* discharge the charge built-up

The whole set of information extracted by the proposed system constitute a suitable starting point for assessing the invention level of a patent, without reading the full text in details: in facts, once that the conflicting parameters have been identified the patent analyst has a clearer idea about the complexity of the problem approached by the inventors and has the means for assessing if the proposed solution is derived by another field of application or another field of science etc. These data can be translated into a corresponding invention level, according to the definitions summarized in section 2.

Nevertheless, it is worth to mention that in case of complex tests, too many outputs might be proposed to the user and the efficiency of the whole process can be compromised.

In order to overcome this limitation, the authors are tuning a set of criteria for ranking the results of the analysis, mainly based on the number of hits and a system of weights as mentioned in section 4.2.

Further efforts will be dedicated also to a more extensive comparison (when possible) among the prior art and the claimed solution and to the identification and comparison of the different embodiments of an invention. The latter task is aimed at removing the parameters related to minor changes of the proposed solutions (i.e. the embodiments) in order to highlight those shared by all the solutions (i.e. the basic invention concept).

The whole procedure will be extensively tested by junior engineers with basic training about patent analyses in order to validate its usability and reliability.

References

Altshuller G. (1984) 'Creativity as an Exact Science', Gordon & Breach Science Publisher, New-York, London, Paris, 1984.

Bigwood M.P. (1997) 'Patent Trend Analysis: Incorporate Current Year Data', *World Patent Information*, Vol. 19, No. 4, pp. 243-249.

Breitzman A.F., Mogee M. E.(2002) 'The many applications of patent analysis', *Journal of Information Science*, 28 (3), pp. 187–205.

Cascini G. (2002), System and Method for performing functional analyses making use of a plurality of inputs. Patent Application WO 03/077154 A3.

Cascini G., Fantechi A., Spinicci E.(2004) 'Natural Language Processing of Patents and Technical Documentation', *Lecture Notes in Computer Science*, Springer-Verlag Heidelberg, December 2004, pp. 508-519.

Cascini G., Neri F. (2004) 'Natural Language Processing for patents analysis and classification', *Proceedings of the TRIZ Future 4th World Conference*, Florence, 3-5 November, published by Firenze University Press, ISBN 88-8453-221-3.

Cascini G., Agili A., Zini M. (2005) 'Building a patents small-world network as a tool for Computer-Aided Innovation', *Proceedings of the 1st IFIP Working Conference on Computer Aided Innovation*, Ulm Germany, November 14-15.

Clarke D.W. (2000) 'Strategically Evolving the Future: Directed Evolution and Technological Systems Development', *Technological Forecasting and Social Change*, n.64, pp. 133–153.

Hui B., Yu E. (2004) 'Extracting conceptual relationships from specialized documents', *Data & Knowledge Engineering*, n.54, pp. 29–55.

Hull D. et al. (2001) 'Language technologies and patent search and classification', *World Patent Information*, n.23, pp.265-268.

Kucharavy D., De Guio R. (2005) 'Problems of Forecast', *Proceedings of the ETRIA TRIZ Future Conference 2005*, Graz, November 16-18, Austria, (ISBN 3-7011-0057-8), pp. 219-233.

Pilch W. (2004) '25 years back: 25 years on', *World Patent Information*, n.26, pp. 77–78.

Porter A. L., et al. (2004) 'Technology futures analysis: Toward integration of the field and new methods', *Technological Forecasting & Social Change*, n.71, pp. 287–303.

Raffaelli R. (1992) 'An inverse parallel parser using multi-layered grammars', *IBM Technical Disclosure Bullettin*, 2Q.

Yoon B., Park Y. (2004) 'A text-mining-based patent network: Analytical tool for high-technology trend', *Journal of High Technology Management Research*, n. 15, pp. 37–50.

WISPER: Worldwide Intelligent Semantic Patent Extraction and Retrieval. EU Research Project, http://www.bmtproject.net/wisper/, 2004.