TFC 2018 – List of Abstracts

Table of content

A TRIZ-based Behavioral Modeling of Technological Systems

Paper ID: 1

Victor Fey

TRIZ, Function modeling, Failure analysis, Automated FMEA, System modeling, Behavior model

The paper describes a novel TRIZ-based method for automated modeling and simulation of technological systems. The method involves capturing all of system's interactions – both normative and faulty – in a behavioral model. The behavioral model contains the functional and physical interactions among the system's components and among these components and those of adjacent systems and the system's physical environment. Overall system behavior is represented as a sum total of functional "streams," as well as "streams" of energy and materials (i.e., physical/chemical phenomena) that "flow" through its components. The system's components and physical/chemical phenomena are represented as transfer functions assembled into cause-effect chains. These chains allow for automated modeling and simulation of various system's behaviors.The method is applicable to different types of analyses used in TRIZ-based projects: function modeling, cause-effect analysis, and automated FMEA. Themethod has been implemented in a software application that will also be discussed.

GamiTRIZation - Gamification for TRIZ education

Paper ID: 2

Claudia Hentschel, Christian Thurnes and Frank Zeihsel

Gamification, GamiTRIZation, Game, Simulation, Case, TRIZ, Learning TRIZ, Teaching TRIZ, TRIZ education

TRIZ provides tools and methods to meet complex challenges. Since most TRIZ-capabilities are based not only on theory but also on practical application, today's challenge is to make people not just learn about the TRIZ-method, but to learn actual skills and to get something done with them in a given time frame.

Learning TRIZ needs interactive settings to quickly transfer knowledge and methods into action. TRIZ-experts usually can rely on a long-term practice. Games and cases allow to teach and multiply this experience by activating learners and emphasizing individual capabilities – even by adding a fun factor. That's why gamification actually is a recognized learning and teaching approach.

The authors have reviewed and analyzed a number of games and cases that offer playful learning of a variety of different TRlZ-tools. The article gives an overview about the used settings and types of games, simulations, and cases.

Paradoxes and Organizational Learning in Continuous Improvement Approaches: Using the TRIZ Principles for Developing Problem Solving Performance in a Michelin Plant.

Paper ID: 3

Zahir Messaoudene

Paradoxical management, Organizational tensions, TRIZ, Problem solving performance, Continuous improvement, Production workshop

Continuous improvement approaches advocate the development of organizational learning to support problem solving. For this, companies use different strategies for implementing continuous improvement. A survey has been conducted showing that these strategies can have a paradoxical impact on the performance of problem solving. How can one explain the difficulties faced by companies in organizing and developing problem solving? As a first step, this paper will outline the objectives and results of the survey. In a second step, the author will highlight the relationship between problem-solving practices and organizational learning. These relationships will highlight the emergence of paradoxes within problem-solving learning loops in the form of barriers and sources of organizational tension. Finally, this article will present a concrete case of using TRIZ in a Michelin plant to improve the performance of continuous improvement by solving these paradoxes.

Vinaigrette Variations

Paper ID: 4

Christoph Dobrusskin and Loes Wijnoltz

TRIZ, Secondary School Education, Teaching, Cooking, Vinaigrette, Chemistry

A Vinaigrette is an emulsion of oil and vinegar, with some added spices, and is a well know ingredient of many different salads. It has a number of interesting properties, ranging from intriguing looks - the little green bits of spices seemingly floating in the oil and vinegar - to its purpose for the salad itself, adding taste and helping the digestive system to absorb valuable ingredients. The authors have set out to explore alternatives for a classic vinaigrette using TRIZ tools. The purpose of the investigation is threefold: Firstly, could this exercise be used in chemistry classes of secondary education? Secondly, can viable alternatives be discovered? And thirdly, how easy is it to use TRIZ tools in the kitchen (chemistry)?

LOBIM – a computer game based training for inventive principles

Paper ID: 6

Nick Eckert

LOBIM, inventive principles, Game based training

The inventive principles are a very strong TRIZ-tool. They are the source of inspiration to solve the technical contradictions. Used either as a selection with help of contradiction matrix or used as sequential screening of all principles. The author means that it is necessary to understand all principles and to memorize them. This should be done because of a fluently inventive thinking and imagination during the search for solutions. With LOBIM-game based training the player can easily learn to memorize the 45 inventive principles from LOBIM (TRIZ + Bionic). It contains basic game design rules like interaction, scores and ranking. This game improves the acceptance of the inventive principles and brings more fun to the entire problem solving process which other modern invention methods (e.g. Design Thinking) have implemented already. Background, game procedure and first experiences will be presented.

TRIZ methods applied to the analysis of disruption in the marketplace

Paper ID: 7

Michael Ohler, Phil Samuel, Riaan Brits and Andrea Beert

S-Curve, Disruption, Technology Trends

Since it's introduction by Everett Rogers in 1962, the "S-curve" has been known and used for more than 50 years. The S-curve model has allowed for the prediction of market disruption but has consistently failed to predict the timing of when disruption would occur. Adner and Kapoor provided a framework linking the evolution of an incumbent challenged by a new technology to the evolution of the ecosystem, providing a better predictive model for the occurrence of disruption. According to the authors, the "mode" and timing of a disruption may be reasonably predicted. From a practitioner's point of view, the question at hand is how to identify the right strategies and subsequent tactics to respond to each of these disruption scenarios, for both the position of the incumbent and new entrant. We propose these answers can be found within the body of knowledge TRIZ offers in its analysis of trends as well as inventive and separation principles. The utilization of these practices can guide both the incumbent and contender to the strategies best employed when engaging with each scenario of disruption. We have demonstrated this approach through the following case study.

Triz in ecodesign: an alternative in the choice of environmental solutions without pollution transfer

Paper ID: 8

Ahmed Cherifi and Mickael Gardoni

Ecodesign, EcaTriz, Triz matrix, Inventive priiciple, eco-efficiency parameters

In the context of product innovation, the environmental dimension takes a new dimension and can not be separated from other product requirements which make it competitive. Tools are available but unfortunately proficiency levels required for their use are at the expert's level, since it requires also expertise and time. In the present work we have

adopted an approach using a qualitative evaluation matrix including parameters related to the ease of use of the product related to the organizational preparation for the appropriation of an eco-design approach, in addition to the standard factors of eco-fficiency. In order to help the designer to make a decision, an adapted TRIZ, named EcaTriz method is proposed. The applicability of this method is justified by the many contradictions in the choices in a study of the life cycle and can help designers and companies to choose an approach to attain a satisfying level of eco-design for the resources invested in it.

Study on establishing Functional Periodicity of new products based on TRIZ

Paper ID: 11

Yafan Dong, Peng Zhang, Runhua Tan, Wei Liu and Ruiqin Wang

functional periodicity, automatic innovation, new products, function model, TRIZ

Functional periodicity pljusays an important role in the process of product automatic innovation for ensuring stable systems. But there is no method of establishing Functional Periodicity. In order to establish the functional periodicity of a new product, an existed product called the goal product is firstly chosen, if it is similar to the new product on aspects of function, effect or structure. Subsequently, difference between the new product and the goal product is identified by establishing the mapping relationship between the functional requirements and design parameters. Using the tools from TRIZ, the function model of the new product is formulated based on the above-mentioned mapping relationship. Afterwards, the system functional periodicity of the new product is proposed in form of TRIZ function model by combining the results of proposed function model and the relationship among functions. Finally, the feasibility of the proposed method is verified with a specific design case.

Innovative Design Thinking Process with TRIZ

Paper ID: 12

Kyeongwon Lee

Innovative Design Thinking, Simplified TRIZ, Step-by-step TRIZ

This paper describes an innovation design thinking process with simplified TRIZ that can be used to resolve contradictions in all domains with words such as "dilemma", "conflict", "contradiction" and "paradox". The design thinking process that have been used at Hasso Plattner d.school at Stanford and Potsdam University are popular as human-center innovation with "Empathy" and "Define" stages for problem finding. However, many results may be not innovative because it uses mostly "Group brainstorming" at "Ideate" stage. Design thinking users have complained that convention Russian style TRIZ is so difficult to learn and use. They consider that it is useful to manufacturing and mechanical fields mostly. This paper suggests an innovative design thinking process with simplified and generally usable the step-by-step TRIZ with information/ patent search, business model canvas and user's journey map.

Standard VDI 4521 "Inventive Problem Solving With TRIZ" Completed

Paper ID: 15

Kai Hiltmann, Christian Thurnes, Robert Adunka and Daniela Hein

Standard, VDI 4521, VDI Standard, Nomenclature, Terminology, Glossary,

The project of establishing an industrial standard for TRIZ has entered its final stage with the edition of VDI 4521 pt. 3 in draft version. The objectives of the standard mainly are
. standardization of TRIZ terminology to foster common language and understanding among TRIZ users and researchers
. preservation of original TRIZ conceptions
. providing reference material for TRIZ training
. providing standard contents for technical education in schools
. providing an overview on TRIZ and references to recommendable literature for students
. qualifying TRIZ as an established technical procedure for engineers

The paper explains the structure and the contents of the three parts of the standard and appeals for using it.

Development of Automobile Light Guide for Lighting Image Enhancement Using Retro-Reflection Principle

Paper ID: 18

Hyoeongseon Kim, Kyeongwon Lee, Hyeong Un No and Gun Soo Jin

Retro-Reflection. Light Guide, TRIZ, Chain Effect Cause Analysis

In recent years, most automobile manufacturers have been using slim light source images to imprint brand images. A light guide type lamp is widely used for a slim light source image. A light guide lamp uses a LED light source at one end of a long cylindrical pipe. The light from the LED light source moves through the pipe by total reflection principle. Moving light is moved forward by applying various optic structures in the cylinder to emit light. However, the light guide lamp has a problem that the image of the light differs depending on the viewing direction, and in some cases there is a dark section. In this paper, trying to improve the fundamental problems of the light guide mentioned above by using various TRIZ methods. Through functional modeling, estimating the factors affecting the light in the light guide lamp and make various ideas to improve the lighting image using the chain effect cause analysis, clone problem, scientific database techniques. Using various TRIZ techniques, finally find solutions that can improve the brightness and lighting uniformity of the light guide lamp. The ideas obtained in this paper were applied to actual vehicle development, and several patents achievements were obtained. In conclusion, we can see that the TRIZ method is useful for making ideas in the actual automobile industrial field and is also a useful method for acquiring patents.

Ways of an estimation of efficiency of intermediate and final decisions at target invention by means of software Solving Mill and technologies OTSM-TRIZ «Networks of flows of problems»

Paper ID: 19

Anton Karlov and Nikolay Shpakovsky

target invention, software Solving Mill, technologies OTSM-TRIZ

For support of process of the decision of not trivial technical problems from the analysis of a problem situation before check of efficiency of the received decisions it is created software Solving Mill. New technologies at factories often cause negative effects and difficultly predicted in advance consecutive lacks. N. Khomenko noticed that widespread the stereotype of the decision of a creative problem which consists that the correct or suitable system of decisions can be chosen only after generating as it is possible greater quantities of various decisions. On the other hand, the research spent by G. Altshuller and I. Vertkinym, shows, that the more innovative the decision is, the greater resistance is met by it from experts and community as a whole. Solving Mill generates preparation of the formula of the invention which is automatically formed on the basis of the fixed data.

TRIZ Evolutionary Trends in E-commerce Business

Paper ID: 20

Kangrok Lee and Thanhbinh Dao

TRIZ, E-commerce, 40 Inventive Principle, Trend of Evolution

In the e-commerce business, it's the most important to know unexpected events and trends. For long time, people are struggling to find some products and services that they really want to buy and sell. Through these transactions between buyers and sellers, we find that psychological

inertia and contradictions are existed in the consumer's engagement and actual consumption. We need to analyze and see if there are any problems to do e-commerce business very well. With TRIZ methodology, it's possible to know not only the interaction between merchants and customers, but also evolutionary trends such as robots, drones, driverless vehicles. In this paper, we propose an approach to find TRIZ evolutionary trends in the e-commerce business. Finding the further future of e-commerce with TRIZ remains an important area of inquiry, worthy of continuous research and exploration.

TRIZ for University Career Development Education

Paper ID: 21

Kiyohisa Nishiyama

career education, university, international students

This paper presents the further development of the application of TRIZ to career development education with the details of the course, its concrete products, and its future prospects. The lecture focused to develop strategies how to survive job interviews, which are struggled by many of the international students according to the opinions gathered by Career Service Office, by using the basic TRIZ tools, the problem definition strategy such as If-Then-But statement and 40 invention principle. In addition, the solution concepts for the problem, how to integrate Japanese students and international students, which the students were asked to propose with TRIZ as the final assignment, were feasible expanding the possibility of university career education.

Innovative technical creativity methodology for Bio-Inspired Design

Paper ID: 22

Pierre-Emmanuel Fayemi, Gilles Martin and Claude Gazo

Bio-Inspired Design, TRIZ, CK-Theory, Methodology, Innovation

The present research primarily focuses on building an effective rationalization of the knowledge which can be extracted from biological experts. To achieve such results, a structural framework, allowing knowledge integration from different fields at specific phases of the creative process is proposed. The formalized methodologies along with its associated frameworks relies on principles from C-K Theory, TRIZ, and their links with biologically inspired design. To assess such design process methodology, an initial application within a case study has been implemented. This case study has been conducted through an industrial partnership with a Research & Development service department from a company working in the offshore oil production sector. More than the generated concepts themselves, the new approach of biologically inspired design has emphasized, within this study case, an interesting potential in its propensity to quickly guide designers in accessing the most relevant knowledge from the biological field.

TRIZ as general problem solving tool in secundary school teaching

Paper ID: 23

Hans Baaijens and Christoph Dobrusskin

TRIZ for schools, general problem solving tool, productivity of solutions

Since 2014, we have developed a workshop for teachers of secondary schools on learning TRIZ as a general problem solving tool. We have given our 2 hours workshop already to 700 participants, with the number of participants steeply rising since 2016. Interest in our workshop is increasing, also on the university level. The TRIZ theory we use is based on explaining te problem analysis and applying 10 TRIZ inventive principles. For that purpose we use a case that can be solved by many without specific science knowledge. In a field study, we have compared the effectiveness of the training by letting a group of teachers solve a case before and

after explaining the TRIZ theory and another group of teachers after explaining the TRIZ theory only. A comparison between the productivity of solutions (number of solutions found) has been made for the two groups of teachers.

Application of standard solution to man-machine-environment coupling effect

Paper ID: 24

Junlei Zhang, Runhua Tan and Guozhong Cao

Man-Machine-Environment System, constraint factor, coupling effect, Substance-Field Analysis, Standard Solution

The reasonable design of man-machine-environment system is closely related to the automation and intelligence of industries. However, there is a lack of suitable analytical method and indicative solutions to the problems when the coupling of man, machine and environment failure to achieve the design.This paper compares the coupling as the Su-Field model, then the problems can be solved under the guidance of the standard solutions. Firstly, the set of constraint factors of the man, machine and environment are established respectively and the coupling between them are carried out. Secondly, the Su-Field model composed of people, machine and environment are established to analyze the problems in the coupling by analogy. Finally, under the guidance of the standard solutions ,the problem are solved and the ideal coupling effects are realized. This method effectively solves the problem in the coupling of man,machine,environment and improves the rationality and effectiveness of the system design.

xPERT-O, a collaborative tool to enlighten key challenges in a complex situation

Paper ID: 26

Xavier Lepot, Axel Neveux, Stéphane Badts, Yves Guillou, Séverine Baudrux and Nadia Lelandais

Interactive web tool, Co-construction, directed network, Centrality algorithm, Virtual reality

Therefore, we developed xPERT-O, an interactive webtool to analyze situations on a collaborative frame. Principle is simple: challenges harvested during the analysis are introduced by participants in the form of documented nodes logically linked in cause-and-effect relationships. 2017-award winning xPERT-O allows more than 40 people, not necessary located at same place, to simultaneously collaborate on case studies and build directed networks by applying simple heuristics. Centrality algorithms help to determine which nodes have the greatest impact. By using multiple filtering /sorting possibilities, the network is made clearly understandable by human eye. A 3D Virtual Reality mode is currently developed to better explore complex situations and pin up key issues.

Investigating the capabilities of TRIZ to achieve organizational ambidexterity

Paper ID: 27

Johannes Hofweber, Armin Lau, Oana Buliga and Julian Müller

organizational ambidexterity, theory of inventive problem solving, contradiction analysis, inventive principles, separation principles

This paper investigates the application of TRIZ tools for systematically addressing the management problem of achieving organizational ambidexterity. Organizational ambidexterity refers to the capability of an organization to exploit the existing business while simultaneously exploring new business opportunities. Handling this contradiction of exploitation and exploration represents a major challenge for established companies, especially in currently ongoing transformation processes with rapidly changing business environments. This study assesses the potentials of TRIZ tools, e.g. the contradiction matrix, the 40 inventive principles or the separation principles, by developing new and evaluating existing solutions for conflicting objectives regarding exploitation and exploration. The method is based on qualitative-empirical

data. The results extend the current state of research on organizational ambidexterity as well as the application of TRIZ in a non-technical context. In particular, the study provides valuable insights into the practicability of using contradiction-based problem solving in managerial practice.

Implementation Process of Low-end Disrupive Innovation based on OTSM-TRIZ

Paper ID: 28

Yu Wang, Runhua Tan, Jianguang Sun and Kang Wang

low-end disruptive innovation, OTSM-TRIZ, multiple contradictions, process tree

Low-end disruptive Innovation is a product technological Innovation that making product technology evolution temporarily retrogression,declining performance in a short-term for reducing product prices.Disadvantaged enterprises can use it to attract a large number of low-end users with small investment, and set up their own market system.At present,The process model of disruptive technology that based on Classical TRIZ are rarely involved in resolving multiple contradictions.In this paper, based on OTSM-TRIZ,a deep research on multiple contradictions of product complex systems was made in the process of low-end disruptive innovation.Combined with the process tree theory,a realization process model of low-end disruptive innovation that based on OTSM-TRIZ was established.Finally, the theory was verified by the innovative case of the portable tire breaker.

Solving Lab : Inventive problem-solving laboratory

Paper ID: 30

Carine Frerard, Vincent Lenaerts, Bernard Rausin and Xavier Lepot

Education initiative, SME's case study, Triz based methodologie

The polyvalent industrial engineers studying in HELMo Gramme school develop their skills on concrete cases from companies since always in an active pedagogy frame. The encounter of some professors with xFIVE and with TRIZ and its multidisciplinary approach led to the idea

of creating a powerful pedagogical lever. Combined with the desire to develop entrepreneurship in learning activities, HELMo Gramme sets up the Solving Lab project: a problem-solving laboratory serving the surrounding ecosystem (enterprises, students, alumni, research center, public entities ...). It is both an educational tool that will reinforce the integration of learning outcomes for students and professionals, and a practical tool that will reinforce the integration of creative scientific methods in regional enterprises (especially SME). This altogether pedagogical and practical tool will rely on specialized TRIZ partners such as xFIVE to develop methodological tools, to create, in addition to an educational value, a usable value for the society.

Strategic Patent Development Using TRIZ and Patent Information in Industry

Paper ID: 31

Sehoon Cho and Kyeongwon Lee

Patent search, Patent generation, TRIZ process, Strategy, Facilitator, Cross Functional Team

What patent do companies want to own? What are the characteristics of patents that create business performance? Companies need patents that are prepared for the past, present and future.
TRIZ is a very useful and excellent tool as a practical tool for realizing the patents. TRIZ Process provides a good methodology for developing patents.
We use patent information and market needs in the process of determining the topic or target we want. And extracts specific analytical products from the business areas that require price or technology competitiveness in the market.
The meeting leader evaluates the results of the analysis and selects ideas to be patented. The leader can plan and lead the development of patents that companies need through the TRIZ expert and facilitator role.
This verification was experimentally conducted at Samsung. In other words, you can actually make the necessary patents that your company needs in the IP department.

How to introduce TRIZ in a innovation department and increase the production of innovative solution

Paper ID: 32

Dominique Font

TRIZ Methodology, Inventive problem solving, Contradiction, Graph Problem, Expertise, Inventive Concept, Knowledge

Owens Corning is an international company historically recognized for its ability to innovate (creator of fiberglass for composites in 1934). Today the global competition and the emergence of Asian competitors at low production cost push the OC company to put even more effort on the research of new products and new processes.

The market and industrial multidisciplinary make traditional methods limited (brainstorming; Stage Gate).

Since few years, TRIZ is being tested at Owens Corning. This article attempts to describe the means to be implemented (expert training, connection with the TRIZ community); the difficulties encountered (reaction of experts in front of the problem, the time consumed). It will be interesting to share some partial results and some specific tools used during our internal workshops.

In conclusion, we will debate about the second potential use of TRIZ concerning the improvement and the management of the knowledge of a worldwide company.

TRIZ and Intellectual Property to strengthen the start-up spirit

Paper ID: 37

Pascal Sire, Eric Prevost, Yves Guillou, Alain Riwan and Pierre Saulais

Innovation design, intellectual property, start-up, TRIZ

How can start-ups benefit from business innovation good practices while enforcing the link between invention, innovation and intellectual property (IP) to contribute to this vital discussion for the survival of our industries? Some experts of the TRIZ France association drawn from their practical experiences, a path to illustrate the methodological and practical contributions of the Theory for inventive problem solving (TRIZ). This illustration highlights a specific focus on businesses where the "start-up spirit" facilitates ideation and accelerates the production of innovative products and services.

Multiphysics Analysis of Power Electronics Phase Module using TRIZ

Paper ID: 38

Tiziana Bertoncelli, Jorge Mari and Oliver Mayer

Power Electronics, Busbars, Multiphysics approach, TRIZ

The present work reflects a complete TRIZ analysis of power electronics component from a Multiphysics (Electric conduction, Electromagnetic, Thermal, Structural, Signal) point of view, taking account of real-life constraints. The object of analysis and improvement is a phase unit busbar, the part connecting the switches to the load in a power electronics converter, in a typical configuration. The project goal is to enhance the overall serviceability, increase performance and reduce cost as well; the notion of performance includes reducing electric losses and thermal load. The usual approaches are virtual prototyping and circuit simulation to define project specifications, reduce inductance influencing the current paths and verify if copper cross section sustains the current loads, adopting thicker laminations when needed. Neither a systematic nor an innovative approach is usually applied. This presented analysis will show results of the application of different TRIZ tools will be described, as well as the key learnings.

A TRIZ-based method for creative design driven by knowledge fusion

Paper ID: 40

Wei Liu, Runhua Tan, Yafan Dong, Guozhong Cao and Limeng Liu

TRIZ, Knowledge Fusion, Creative Design, Design Method

Knowledge is one of the most important inspirations for creative design. The fusion of knowledge that comes from various backgrounds is proven helpful for generating novelty solutions to engineering design problems. In this paper, a design method is proposed by combining the idea of knowledge fusion and methods from the theory of inventive problem solving (TRIZ). In order to formulate the proposed methods, the mechanism that fosters creative ideas based on knowledge fusion is firstly explained with its process divided into several stages. Subsequently, the approaches are discussed that transfer the problems in each of the above-mentioned stages into TRIZ problems. With these problems solved by corresponding methods from TRIZ, then a design process is formulated by integrating formerly discussed strategies.

Finally, there is a case study to verify the workability of the proposed method. The advantages of the proposed method are discussed in the final section.

Method of Design Transformer Based on Multiple Scenario

Paper ID: 42

Jinpu Zhang, Huangao Zhang, Runhua Tan, Guozhong Cao and Jianguang Sun

Transformation, Scenario Analysis, Product Design

Transformer are available in multiple scenarios,tansformation can improve the adaptability of the product.The systematic innovative design method of the transformation is helpful to the realization of the automatic invention.Three dimensions of space, time and conditions are used to analyze the scenarios of the product.Draw scenario - need - function hierarchical diagrams to analyze the specific functions of each scenario and the relationship between them.Determine the form of the scenario specific function through four rules.The theory is verified by the case of bridge erecting machine.

Computer aided collaborative patent evolution analysis

Paper ID: 43

Mijeong Song, Eunyoung Cho, Kunwoo Baek and Dongsub Jang

EMS(evolution map system), evolution map, multi-touch user interface, patent

To estimate unclear future direction, multidisciplinary team's collaboration is essential. The authors have developed a collaborative patent analysis system EMS(evolution map system), 'on' which multi-user(with multiple backgrounds) could read and categorize patents with various domains and arrange the categorized binders of technical patents along evolution hypothesis induced by collaborative workshop between the multidisciplinary analysts. To support multi-user's collaboration work at the same place, EMS provides an IR multitouch(30 touch) interface on the table top 60 inch display operated by a host computing server. EMS has 2 different modules for evolution analysis, the one is patent classification module, and the other

is evolution layouting module. In 2017, English to Korean translation has been added on the EMS, which accelerates the analysis time. Evolution map has been contributed to make a new business unit and a new product segment such as smart home business or family hub refrigerator in Samsung Electronics.

Design entity recognition for Bio-inspired Design supervised state of the art

Paper ID: 44

Davide Russo, Pierre-Emmanuel Fayemi, Matteo Spreafico and Giacomo Bersano

Text mining, Patents Analysis, TRIZ, Bio-Inspired Design

In the last years the efforts spent for the enhancement of parsing engines led to several software more performant, in terms of both effectiveness in identification of syntax modules and speed of elaboration of the text, than the previous generation ones. Exploiting the benefits coming from such a new generation of software, nowadays the patent search can overcome the limits due to the classic FOS approach and performs it in a quasi-real-time way. This paper focuses on technical-problems identification methods based on syntactic dependency patterns, for ameliorating supervised state of the art and patent intelligence. Through parsing the patent text, very precise lists of technical problems are automatically extracted without the user being an expert in the problems of the sector. An exemplary case dealing with bio-inspired design is proposed, stressing what types of engineering problems are nowadays benefitting the most from the approach.

TRIZ Super-Effect Analysis and Secondary Conflict formulation as part of a structured technology development learning cycle

Paper ID: 46

John Cooke

TRIZ, Super-Effect, Secondary Conflict, Learning Cycle, Technology Development

For many years the rail industries in temperate countries have struggled to deal with the effects of low adhesion between the train wheels and track due to leaf fall in the autumn – the so-called problem of "leaves on the line". During autumn, it is common in the UK for this problem to lead to journey delays and service cancellations. Annually, low adhesion mitigation costs the UK rail industry over £50 million. This paper builds on work originally presented at TRIZ Future 2016 and describes the development of a proposed solution to low adhesion. A structured technology development learning cycle is presented and used to highlight key stages in the growth of the concept. The low adhesion solution is used as a case study to show how Secondary Conflict formulation and Super-Effect Analysis were applied; delivering a more robust final product and exposing further opportunities for rail industry innovation

TRIZ – Develop or Die in a World of Volatility, Uncertainty, Complexity and Ambiguity.

Paper ID: 47

Martin Kiesel and Hammer Jens

TRIZ, VUCA, TESE, Cynefin Framework, Three-Layered Product Architecture

In industry, companies must face the need for increasing developing speed in a volatile and uncertain market environment. Digitalization, cloud computing and artificial intelligence introduce a game changing situation. Classical TRIZ was derived from patent analysis, based on technical/mechanical problem solving. There is a bunch of methods and tools available for these issues. However, in a VUCA (Volatility, Uncertainty, Complexity, Ambiguity) world we face situations which are increasingly complex and potentially require different approaches. The paper discusses to which extent the TRIZ methods and tools are helpful in a VUCA world and how TRIZ should develop to adapt to the changing environment. The authors investigate where classic and modern TRIZ can provide helpful directions and in which dimensions TRIZ should evolve. They develop a potential "TRIZ Picture of the Future" based on literature review and long-term experiences in Lean development, TRIZ and foresight technologies.

Market complexity evaluation to enhance the effectiveness of TRIZ outputs

Paper ID: 48

Paolo Carrara, Davide Russo and Anna Rita Bennato

TRIZ, Patent, Patent Thicket, Business Intelligence, Market Structure

In the context of innovation consulting activity, it may happen working in technical fields characterized by a high competitiveness level. Although TRIZ allows reaching innovative ideas in any kind of industry, it does not suggest any tool in order to evaluate the success rate of the invention in the reference market. During the last years, TRIZ got methodological contributes to sharpen the matching between the inventive idea and the actual needs of the market. This paper introduces a specific methodology to measure the complexity of a market in order to evaluate the effective market accessibility. The analysis criterion bases on patent analysis, especially on the triadic citing relationship. Getting the complexity level in advance lets to adjust the innovation strategies and make conscious decisions. An example of application of the method on Machine Learning patent field is provided.

Innovation lab: how to generate patents in one day

Paper ID: 50

Davide Russo, Paolo Carrara and Matteo Marusi

TRIZ, teaching methods, consulting, patent analysis

Nowadays one of the biggest barrier to the TRIZ dissemination in SMEs concerns the time to develop ideas. For overcoming this problem, we involved companies to participate to a one-day problem solving activity, aimed at developing at least one patentable idea. In the first part of the meeting, the company guided by triz experts reformulate technical problems, market requirements and business model. In the second part identifies alternative solutions and generates ideas for the most promising directions (also taking into account a preliminary patent analysis for identifying white space opportunities). At the end of the day the company gets a technical report with a list of new ideas, including some potentially patentable (even if a secondary deeper patent analysis is needed).

Application of Selected TRIZ Instruments in Reliability Engineering

Paper ID: 51

Maksymilian Smolnik and Robert Pilch

reliability engineering, reliability formation, TRIZ instruments, designing

Reliability may be considered as the probability of proper operation of a technical object in certain time period and environmental conditions. Referring to such an assumption, lots of mathematical instruments for reliability evaluation were developed. These have a significant importance when one is aiming especially at the description of reliability of a technical object. But another problem is reliability formation which requires the search for proper constructional, systemic and process solutions according to the identified needs resulting from the reliability evaluation. Therefore, the aim of the analysis presented in the paper was to discuss the possibilities of application of TRIZ instruments while conducting a technology development process in terms of reliability formation and to compare the application of these instruments with the typical methods traditionally used in this field.

Formula of the concepts definition

Paper ID: 52

Evgeniy Smirnov

TRIZ, Definition, Concept, Term, System Approach, Functional Approach, Glossary, Terminology, Functional System, Contradiction

This is an article dedicated to the analysis of the rules of defining concepts. Concepts in science create an evidence picture of the world. The more accurately such picture reflects reality, the more predictable are the outcomes of changes. Today, in TRIZ there are alternative concepts that often contradict each other and sometimes simply make it impossible to build an adequate model of the object or conflict. The general principle of definition is shown by the example of the main concepts in TRIZ. The simple formula allows you to define from abstract (e.g. a function) to specific (e.g., pencil) concepts.

On the efficiency of TRIZ application for process intensification in process engineering

Paper ID: 53

Pavel Livotov, Mas'Udah and Arun Prasad Chandra Sekaran

TRIZ efficiency, process engineering, process intensification

In recent years, the application of TRIZ methodology in the process engineering has been found promising to develop comprehensive inventive solution concepts for process intensification (PI). However, the effectiveness of TRIZ for PI is not measured or estimated. The paper describes an approach to evaluate the efficiency of TRIZ application in process intensification by comparing six case studies in the field of chemical, pharmaceutical, ceramic, and mineral industries. In each case study, TRIZ workshops with the teams of researchers and engineers has been performed to analyze initial complex problem situation, to identify problems, to generate new ideas, and to create solution concepts. The analysis of the workshop outcomes estimates fulfilment of the PI-goals, impact of secondary problems, variety and efficiency of ideas and solution concepts. In addition to the observed positive effect of TRIZ application, the most effective inventive principles for process engineering have been identified.

Method of innovation assessment of products and processes in the initial design phase

Paper ID: 55

Sebastian Koziołek, Marek Mysior and Bartosz Pryda

Innovation assessment, TRIZ, Conceptual design, Creativity

A key for economic success of an enterprise is proper decision making regarding product and process planning. The aim of this study was to develop a method of innovation assessment of products and processes that will be applicable at early stage of design and throughout life cycle of a product. The effectiveness of proposed method was examined on real-life case studies. The method is based on systematic, quantitative analysis of parameters, unlike current approaches

that concentrate rather on subjective opinions or assessment of the design process, not the design itself. Proposed method comprises some already known tools regarding functional modelling including TRIZ and adopts them to innovation assessment environment. Innovation assessment using proposed method allows to facilitate decision making process regarding choice of concept to be further developed at an early stage of a design process, reducing cost and time of development of new products and processes.

Environmental problems and inventive solution principles in process engineering

Paper ID: 57

Pavel Livotov, Arun Prasad Chandra Sekaran, Mas'Udah, Arailym Sarsenova and Shahin Sayyareh

eco-innovation, process engineering, patent analysis, inventive principles, TRIZ

Economic growth and ecological problems have pushed industries to switch to eco-friendly technologies. However, environmental impact is still often neglected, since production efficiency remains the main concern. Patent analysis in the field of process engineering shows that, on the one hand, some eco-issues appear as secondary problems of the new technologies, and on the other hand, eco-friendly solutions often show lower efficiency or performance capability. The study categorises typical environmental problems and eco-contradictions in the field of process engineering involving solid handling and identifies underlying inventive principles that have a higher value for environmental innovation. Finally, existing 42 eco-innovation methods adapting TRIZ are chronologically presented and discussed.

Agile'TRIZ Framework: towards the integration of TRIZ within the Agile Innovation Methodology

Paper ID: 58

Didier Casner, Achille Souili, Rémy Houssin and Jean Renaud

TRIZ, Agile framework, Iterative development cycle, Innovation skills

Applying TRIZ is difficult, time-consuming and therefore requires implies important development costs: designers spend a lot of time to analyze the problem, to identify the contradictions, and then to develop innovative concepts and propose technical solutions. The efficiency of TRIZ strongly depends on the level of completeness of the problem and the experience of the designer with the TRIZ tools. Agile methodologies are commonly used to efficiently develop new products toward an iterative, incremental and adaptive development cycle. They allow to rapidly provide a first technical solution and break the product development work into small increments for minimizing the amount of up-front planning and design. Agile'TRIZ is a Agile-based framework for TRIZ intended for enhancing the innovative skills and the efficiency of the designers, and to provide an efficient approach for quickly analyzing a problem and rapidly developing new innovative solutions using the TRIZ tools through an iterative development cycle.

An ontology of biomimetics based on TRIZ

Paper ID: 59

Julian Vincent and Denis Cavallucci

contradiction matrix, symmetry of the natrix, trade-off, biomimetics, design solutions

Biomimetics, the transfer of techniques and functions from biology to technology, can be viewed as a system of design solutions. In its simplest form, a problem is defined as a conflict, a solution to the conflict derived from biology with the Inventive Principles translated from biology into technology. However, it turns out that the standard TRIZ Contradiction Matrix is at least 50% symmetrical about the diagonal. In other words it deals in trade-offs, not conflicts. Trade-offs are commonly researched in biology, when the variables that control the trade-offs are defined and explored. And most of technology is really concerned with trade-offs, not conflicts. The commonest trade-off in biology - accuracy versus speed - is presented and the various ways in which nature resolves this trade-off compared with the technological solutions. This exercise is repeated for other common trade-offs found in the world of engineering.

Automatic extraction and ranking of systems of contradictions out of a Design of Experiments

Paper ID: 61

Hicham Chibane, Sebastien Dubois and Roland De Guio

Generalized Systems of Contradictions, Design of Experiments, Cross-fertilization optimization-invention

This paper shows to what extent data used in design optimization process and TRIZ based models of contradictions can benefit from each other. New design often starts by optimizing existing systems by experimental and numerical means. This approach requires building a model linking a set of Action Parameters and Evaluation Parameters measuring the quality of a solution. When none of the solutions satisfy the objectives, a redesign of the system is required. Our hypothesis in this paper is that the analysis of experimental or simulation data, can be used as input to automatically extract systems of contradictions, and moreover that it can help to make a ranking of these systems of contradictions. In the article 3 ways to extract, out of Design of Experiments, and to prioritize Generalized Systems of Contradictions will be presented. These methods will be illustrated throughout a case study related to a cutting process.

A feedback on an industrial application of the FORMAT methodology

Paper ID: 62

Roland De Guio, Sebastien Dubois, Aurélien Brouillon and Laetitia Angelo

Long-term planning, FORMAT methodology, Kitchen hood

One of the main issue of industrial product evolution planning is the state of the art of the product, its competitors, and the available resources. Moreover, to plan evolution, it is required to understand how the performance of the product will be evaluated, on a future market, and surely it won't be the same performance criteria as today habits. This issue has been defined as Analysis of Initial Situation. A combination of TRIZ methods and Design of Experiments has been defined to clarify the problem to be solved. For long-term planning, a method, FORMAT, has been developed and proposed. The purpose of this article is to describe the application of this methodology on an industrial case, to plan the evolution of kitchen hoods. The article will state the different methods to perform the Analysis of Initial Situation but also the benefits and the difficulties of FORMAT application.

Discovery on purpose? Paradigm theory from the perspective of TRIZ

Paper ID: 64

Justus Schollmeyer and Viesturs Tamuzs

Paradigm Theory, Paradigm Shift, Thomas Kuhn, TRIZ, Discovery

This essay relates Thomas Kuhn's Paradigm Theory with Genrich Altshuller's Theory of Inventive Problem Solving (TRIZ for short). Despite their clearly divergent cultural roots, both understand paradigm shifts as the result of problem-solving processes — Kuhn in science and Altshuller in technology. In contrast to Kuhn, Altshuller used paradigm shifts to study creative problem solving in technology in order to make invention on purpose possible. He summarized his finding in the Algorithm of Inventive Problems Solving (ARIZ), which, as we will show, can be made explicit in a more general system theoretical framework. This allows for its application outside of the technological domain without relying on crutches such as metaphorical analogies. In order to demonstrate the application of this generalized version of ARIZ, we reconstruct one of the most famous paradigm shifts in the history of science — the shift from the Ptolemaic geo-centric system to Copernicus' helio-centric one.

Facilitating Engineers abilities to solve inventive problems using CBR and Semantic similarity

Paper ID: 65

Pei Zhang, Denis Cavallucci, Zhonghang Bai and Cecilia Zanni-Merk

TRIZ, Case-based reasoning (CBR), semantic similarity

Our industry is moving through a period of important changes. The era of computerization pushes companies to change not only through their organization but also through their internal physical functioning. Among the research performed around the notion of industry 4.0, a large part is dedicated to the computerization of workshops, machines, controls and computer flow that optimizes and feedback its physical functioning to customer demand. However, the R&D department of the company is little researched. Our research focuses on the computerization of the problem-solution couple when facing inventive situations. It consists of combining CBR with semantic similarity algorithms. The aim is to resolve a new problem based on its semantic

similarity with the old problems. Then the old solution can be adapted to solve the new problem. In this way, alternative solutions of the semantically similar problems, distant from their field of origin, can be brought to the R&D engineers.

Sustainable Education in Inventive Problem Solving with TRIZ and Knowledge-Based Innovation at Universities

Paper ID: 66

Iouri Belski, Denis Cavallucci, Claudia Hentschel, Kai Hiltmann, Norbert Huber, Karl Koltze, Pavel Livotov, Konstantin Shukhmin and Christian Thurnes

Education, TRIZ, Knowledge-based Innovation

Accelerated transformation of the society and industry through digitalization, artificial intelligence and other emerging technologies has intensified the need for university graduates that are capable of rapidly finding breakthrough solutions to complex problems, and can successfully implement innovation concepts. However, there are only few universities making significant efforts to comprehensively incorporate creative and systematic tools of TRIZ (theory of inventive problem solving) and KBI (knowledge-based innovation) into their degree structure. En-gineering curricula offer little room for enhancing creativity and inventiveness by means of discipline-specific subjects. Moreover, many educators mistakenly believe that students are either inherently creative, or will inevitably obtain adequate problem-solving skills as a result of their university study. This paper discusses challenges of intelligent integration of TRIZ and KBI into university curricula. It advocates the need for development of standard guidelines and best-practice recommendations in order to facilitate sustainable education of ambitious, talented, and inventive specialists.

Convergence and contradiction between Lean and Industry 4.0 for inventive design of smart production systems

Paper ID: 67

Rabih Slim, Rémy Houssin and Amadou Coulibaly

Industry 4.0, Lean, Design process, Production systems, Contradiction.

Due to the globalization, we have witnessed the emergence of new challenges, driven by a sharp drop in industrial production costs and a great ability to produce high quality products at competitive prices. To cope with these growing challenges, Industry 4.0 were launched in 2011. This concept represents the digitalization of the industry, integrating resources into production: people, machines and processes. These networked resources can interact with each other. Industry 4.0 optimizes the production system. The plant becomes agile, with flexible production methods, reconfigurable tools, and more efficient. Considering the Lean requirements during the early stages of production system design could facilitate the development of Industry 4.0. This paper mainly focuses on both Lean and Industry 4.0 by considering their requirements during the early stages of production system design. In this study, we analyze the convergence and contradictions for the implementation of these two concepts.

Towards a conceptual design and semantic modeling approach for innovative modular products

Paper ID: 68

Cherif Ahmed Tidiane Aidara, Bala Moussa Biaye, Serigne Diagne, Khalifa Gaye and Amadou Coulibaly

Inventive Design, Conceptual Design, Semantic Modeling, Modularity, Innovation

To meet a demand more and more personalized for different users, the products must be innovative but also reliable, modular with good maintainability. Considering all these requirements in the design and modeling process would facilitate an evaluation of the behavioral performance of the future product. Most works deal with aspects related to functional criteria whereas behavior is rarely taken into account in the search for solutions. In this paper, we propose a design approach for innovative modular products, easily maintainable and adaptable to different user profiles. In order to evaluate the modularity, we propose a method of semantic modeling. The semantic model obtained makes it possible to identify innovative modular solution concepts by solving technical contradictions taking into account both the functional characteristics and the behavioral performances. As an illustration, a case study is outlined.

Modelling CECA diagram as a state machine

Paper ID: 69

Jerzy Chrząszcz

Cause-Effect Chains Analysis, logical model, Boolean algebra, state machine, harmful process

The concept of transforming results of Cause-Effect Chains Analysis (CECA) into logical model was presented during TFC 2016 conference and significant enhancements of the approach were introduced during TRIZfest-2017 conference, preserving combinatorial nature of the model, i.e. outputs depending solely on inputs. Although the nature of causality implies that any effect must follow its cause, the original CECA concept does not address time explicitly. This gap has been indicated by Yoon, who proposed occasion axis to describe changes of system state upon meeting particular conditions. Such axis illustrates sequence in time, with additional requirement of interleaving nodes referring to parameters with those referring to states, originally dubbed as parameter-function pair   nexus.
This paper explores the idea of Occasion Axis and examines the possibility of converting a CECA model into a state machine with transitions between the states described by conditions referring to parameters of objects in the analyzed system.

Emergence of contradictions outcome from multi-users requirements

Paper ID: 73

Jean Renaud, Remy Houssin, Mickael Gardoni and Mhamed Nour

Usage, Multi-user, Contradiction, Design.

The use of product is randomly considered in the final phase of design process, which causes some iterations and difficulty in use.

Generally, designer considered costumer requirements without really knowing the end-user our sometime   end-users.
By analyzing the different users, it is a question of measuring the product functionality for each of them. The various functional analyzes have to take into account the needs of all those users.

So, it is necessary to identify: the expectations and cognitive brakes of each user in a competitive environment and to consider the evolution of use and performance of the product and his interaction with its users.

In this paper, from a concrete example (baby car seat), we propose an approach allowing us to focus on different users using needs and functional analysis to highlight the contradictions in order to solve them by using the principle of TRIZ approach.

World TRIZ Sites Project for Building and Maintaining a Compendium of Global TRIZ Resources

Paper ID: 75

Toru Nakagawa, Darrell Mann, Michael Orloff, Simon Dewulf, Simon Litvin and Valeri Souchkov

World TRIZ Sites Project (WTSP), Global collaboration, TRIZ information resources, Catalog of TRIZ Sites

For these three decades, TRIZ has been proliferated much across the world beyond ex-USSR to the extent that various activities, achievements, and accumulated knowledge are not viewable easily. We know that many researchers and practitioners are working on TRIZ actively and presenting/posting their activities and results in conferences, journals, Web sites, etc. In typical Internet search on TRIZ, however, a flood of not-so-high quality information actually hides valuable information resources. So we have recently started World TRIZ Sites Project (WTSP). Its initial goal is to build Catalogs of TRIZ-related Web Sites in the World. In various countries good and useful Web sites are operated in their own languages, including English. Thus we should work Together! Connected!! Once we build such catalogs in English, we can share them widely in various language editions. Such information sharing will raise a Global Network of Public Web Sites in TRIZ.

Automatic extraction of IDM-related information in scientific articles and online science news websites

Paper ID: 77

Oriane Nédey, Achille Souili and Denis Cavallucci

Inventive Design, Machine Learning, Knowledge Extraction, Text Mining, NLP, TRIZ

Previous studies have made it possible to extract information related to IDM (In-ventive Design Method) out of patents. IDM is an ontology-defined method de-rived from TRIZ. As its mother theory, IDM is primarily based on patent's ob-servation and aims at finding inventive solutions on the basis of contradictions. In this paper, we present a new approach for extracting knowledge, this time out of other types of science-related documents: scientific papers and science news arti-cles. This approach is based on a supervised Machine Learning model that classi-fies automatically the sentences of a text according to IDM's ontology concepts such as problems, partial solutions and parameters. We use two manually anno-tated corpora (one for each type of document) for the learning part as well as for the evaluation (with the percentage split method). Moreover, a set of semi-automatically selected linguistic features is involved in the model in order to im-prove the classification.

Text simplification of patent documents to improve information extraction

Paper ID: 78

Jeongwoo Kang, Achille Souili and Denis Cavallucci

Inventive Design Method, TRIZ, Information extraction, Text simplification, Syntactic analysis, Text mining

This work contributes to one of the projects in laboratory CSIP, whose goal is to extract IDM (Inventive Design Method) related knowledge from patent documents. Extracting elements of IDM's ontology from patents data involves training machine-learning model. However, an accuracy of the model is compromised when the given text is too long, hence the need of simplifying the texts to improve machine learning.

There have been preceding studies on automatic text simplification based on hand-written rules or automatic syntactic parsing. However, few researches addressed simplifying patent documents. Patent document has its particularity in its lengthy sentences and multiword expression terminology, which often hinder accurate parsing. Therefore, in this research, we present our method to automatically simplify texts in patent documents by analyzing their lexical and syntactic patterns.

Learning TRIZ with an application on case studies

Paper ID: 79

Thomas Nagel, Henryk Stöckert and Nina Defounga

Apollo 13, Ressources, OTSM-TRIZ, Contradiction, Ideality, TONGS Model, TOM's model, IFR, Most desireable result, Inventive principles, Problem Graph, Element-Name-Value Model, ENVP-Model, Active parameter, Passive Parameter, Structered Innovation, Simulation Game

This paper describes using case studies for the transfer of TRIZ knowledge. This used case study is the Apollo13 case which is a severe accident during a NASA mission to the moon in April 1970. The trainees play different active roles in their assignments to save the spaceship crew.

The paper reviews the tools used and the experience on case study simulations learning TRIZ and learning on the participants' feedback. Further, the combination with fast prototyping know from   Design   thinking   is   also discussed.

Parameter Deployment and Separation for Solving Physical Contradictions

Paper ID: 80

Daniel Sheu and Rachel Yeh

Physical Contradictions, TRIZ, Parameter

Physical contradiction is at the heart of TRIZ contradiction problem solving. Physical contradiction is based on two contradictory demands placing on a same parameter of the same system. Extending from the concept of Separation Principles and System Transition, this paper proposed a unified theory and concrete operational procedures based on Parameter Deployment and Parameter Manipulation to solve physical contradictions. The method of Parameter Manipulation includes Parameter Separation and Parameter Transfer. The idea of Parameter Separation is to delegate the satisfaction of the two contradictory demands to their two constituent parameters or two value ranges of a constituent parameter at the problem areas thus the contradiction can be eliminated. The idea of Parameter Transfer is to transfer one or both satisfaction of the two contradictory demands to one or two parameter(s) seemingly unrelated to the problem point thus avoiding the contradiction. The parameter deployment is used to identify the constituent parameters.

Combining the theory of inventive problem solving with discrete event simulation for solving supply chain problems

Paper ID: 82

Fatima Zahra Ben Moussa, Sebastien Dubois, Roland De Guio, Ivana Rasovska and Benmoussa Rachid

Theory of inventive problem solving (TRIZ), algorithm for inventive problem solving (ARIZ), supply chain, discrete event simulation, design of experiments, generalized system of contradictions

Supply chain challenges require not only effective management, but also a new innovative strategy to reduce costs and maximize its efficiency. Traditional problem-solving methodologies specific to the areas of supply chain management (SCM) find their limits when

confronted with an inventive problem or a problem containing a contradiction. TRIZ (theory of inventive problem solving) is an effective theory for systematizing innovation and solving complex problems containing contradictions. Thus, the use of the theory TRIZ can be considered as a way to meet future challenges in SCM fields and get innovative solutions.