

## Structure and content of the thesis abstract

# TRIZ: Generative AI Application

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**Keywords:** TRIZ, Generative AI, Artificial Intelligence, Innovation, Problem-Solving, Prompt Engineering.

### 1. General characteristic of the thesis

The thesis introduces a systematic algorithm for integrating Generative AI with TRIZ tools, enhancing the accessibility and effectiveness of TRIZ problem-solving. The research demonstrates the algorithm's efficacy through iterative prompt refinement and diverse case studies, showcasing AI's potential to augment TRIZ in various domains. The findings highlight AI's ability to streamline TRIZ learning, accelerate problem-solving, and foster innovation, while emphasizing the continued importance of human expertise in evaluating and refining AI-generated outputs. The thesis concludes by advocating for further research and development in AI-powered TRIZ to unlock its full potential in revolutionizing engineering problem-solving and innovation.

### 2. Practical significance of the thesis topic.

The practical importance of this thesis is its potential to change how TRIZ is learned, used, and grown. The new algorithm for combining AI with TRIZ tools can bring these benefits:

- Easier AI Use: The algorithm gives a clear and reliable way to add AI to TRIZ tools,

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making it easier for more people to use. The process of improving prompts, based on the algorithm and user feedback, makes AI-generated results better and more accurate.

- **Better TRIZ Tools:** Adding AI lets TRIZ tools do routine tasks automatically, analyze complex data, and come up with new ideas, making them better at solving problems and speeding up innovation. The case studies show that AI can give useful information, find root causes, and suggest creative solutions, making different TRIZ tools more useful.
- **Faster Tool Creation and Wider Use:** The algorithm makes it easier to create new TRIZ tools, saving resources and time. It can be used with many TRIZ tools, so AI-powered problem-solving can be used in more areas and industries, helping with innovation and solving tough problems in different fields. The case studies show how AI-powered TRIZ tools can be used in areas like food production and social media, showing how widely they can be used.
- **Clear Evaluation:** The thesis stresses the need for clear ways to measure how well AI works with TRIZ and to compare results. Using numbers like time saved and user satisfaction shows the real benefits of AI-powered TRIZ tools. Case studies and user surveys also prove that the approach works in the real world and helps people solve problems.
- **Focus on New Ideas:** The thesis shows that AI can create truly new solutions by giving examples where AI suggests unique ideas that go beyond what we already know or combine ideas in new ways. The focus on creativity and using techniques like "Systematic Idea Generation" shows that AI can help us see problems in new ways.
- **Comparison with Others:** The thesis clearly explains how the new algorithm is different from other AI-TRIZ tools like AutoTRIZ, showing its unique features, better performance, or wider use in certain areas. The comparison in Case Study 3 also shows the strengths and weaknesses of different AI-TRIZ tools, helping users choose the right one.

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### **3. Objectives and tasks of the work**

#### **Development of a Generative AI Application Algorithm for TRIZ Tools**

Develop a systematic algorithm to integrate Generative AI capabilities, particularly Large Language Models (LLMs), with TRIZ tools, enabling a consistent and effective application of AI to enhance problem-solving and innovation processes.

### **4. Main provisions to be discussed at the thesis defense**

The main provisions to be discussed at the thesis defense will revolve around the following key points, with the core focus on the efficacy of the proposed algorithm:

**The Algorithm's Effectiveness:** The discussion should focus on how well the algorithm guides the creation of effective prompts for Generative AI in the context of TRIZ tools. The evolution of prompts in the case studies, along with user feedback, can be used to demonstrate the algorithm's adaptability and its ability to improve the quality and relevance of AI-generated outputs. The transition from simple guidelines to a structured 10-step methodology is a key point to highlight, showcasing the algorithm's ability to learn and adapt based on real-world application and user interaction. The defense should emphasize the iterative nature of prompt refinement and the algorithm's capacity to incorporate user feedback and domain-specific knowledge to enhance AI-generated outputs. The positive user feedback and time-saving benefits observed in the case studies can be used to support the algorithm's effectiveness.

**AI-Generated Outputs:** The quality, relevance, and creativity of the AI-generated outputs in the case studies should be critically evaluated. The discussion should address the AI's understanding of TRIZ tools, its ability to generate feasible and innovative solutions, and the clarity and coherence of its responses. The limitations of AI, such as the occasional lack of deep contextual understanding and the need for expert validation, should also be acknowledged. The defense should focus on the AI's ability to provide valuable insights, identify root causes, and propose creative solutions, as demonstrated in the case studies. The varying levels of novelty and the occasional

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ambiguity in outputs should also be addressed, highlighting the need for human expertise in evaluating and refining AI-generated solutions.

**Comparison and Benchmarking:** While direct comparisons with human experts might be limited, the case studies offer insights into the relative strengths and weaknesses of AI-powered TRIZ tools compared to traditional methods or other AI-TRIZ integrations like AutoTRIZ. The discussion should highlight the unique features and potential advantages of the proposed algorithm and AI-powered TRIZ tools, as well as areas where human expertise remains crucial. The defense should emphasize the comparative analysis in Case Study 3, which demonstrates the strengths and weaknesses of different AI-powered TRIZ tools, and how the proposed algorithm contributes to improved performance and expanded applicability.

**Future Research and Development:** The thesis concludes by recommending further research and development in AI-powered TRIZ. The discussion should explore these recommendations, including expanding AI integration to other TRIZ tools, refining prompt engineering techniques, enhancing human-AI collaboration, and addressing ethical considerations. The potential impact of these future developments on the field of engineering problem-solving and innovation should also be discussed. The defense should highlight the thesis's contribution as a foundation for future advancements in AI-powered TRIZ, emphasizing the need for ongoing research to fully unlock its potential in revolutionizing problem-solving and innovation across various domains.

## **5. Personal Contributions to the Field.**

I have made the following distinct contributions to the field of integrating AI with TRIZ:

**Pioneering Research and Algorithm Development:** My journey in this field began in June 2023 with the publication of the first public paper exploring the intersection of TRIZ and Generative AI through prompt examples. This was followed by an updated version in July 2023 and a significantly refined third version co-authored in April 2024. These publications not only established a foundation for further research but also culminated in the development of a novel algorithm for integrating Generative AI with TRIZ tools. This

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algorithm, a product of my extensive experience in both TRIZ and Generative AI applications, represents a significant advancement in the field, offering a structured and efficient approach to leverage AI's capabilities within the TRIZ framework.

**Innovative AI-Powered TRIZ Prompts:** In addition to the algorithm, I have created a collection of innovative AI-powered TRIZ prompts. These prompts, designed to enhance the effectiveness of learning and utilizing TRIZ methodology, are a testament to my deep understanding of both TRIZ and Generative AI. They provide users with a powerful tool to harness the capabilities of AI in their problem-solving and innovation endeavors.

**Insights and Recommendations for the Future:** Through my research, algorithm development, and prompt creation, I have gained valuable insights into the nuances and potential of AI-TRIZ integration. These insights have led to a series of recommendations that contribute to a deeper understanding of how AI can be effectively harnessed to enhance TRIZ processes and outcomes. My work not only addresses current challenges but also paves the way for future research and development in this burgeoning field, fostering a collaborative environment for the exchange of prompts and the development of higher-level application tools.

I am committed to continuing my exploration of AI-TRIZ integration, pushing the boundaries of what is possible and contributing to the ongoing evolution of this exciting field.

## **6. Implementation of the main provisions of research**

The main provisions of this research, which center around the integration of Generative AI with TRIZ tools through a systematic algorithm and prompt refinement process, have been successfully implemented and demonstrated. The practical application of these provisions is showcased through a series of detailed case studies and user surveys. The **case studies** serve as concrete examples of how AI-powered TRIZ tools can be effectively utilized in diverse domains, ranging from plant-based food production to social media content creation. These studies highlight the tangible benefits of AI integration, such as enhanced problem-solving capabilities, accelerated idea generation, and improved innovation processes. The case studies provide evidence of the AI's

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ability to generate valuable insights, identify root causes, and propose creative solutions, showcasing its potential to augment and enhance the functionality of various TRIZ tools. The **user surveys** offer valuable feedback from individuals with TRIZ experience and familiarity with Generative AI who have employed both TRIZ and AI assistance. The survey results demonstrate positive user experiences, highlighting the perceived benefits of AI-powered TRIZ tools in terms of time savings, efficiency, and the generation of novel ideas. The feedback also underscores the importance of human expertise in evaluating and refining AI-generated outputs, ensuring their feasibility and applicability in real-world scenarios.

The **iterative prompt refinement process**, a core component of the proposed algorithm, ensures the continuous improvement and adaptability of the AI-powered TRIZ tools. By incorporating user feedback and domain-specific knowledge, the prompts are refined to elicit more accurate, relevant, and creative responses from the AI, further enhancing its effectiveness as a problem-solving and innovation tool.

The implementation of these main provisions, encompassing the algorithm, case studies, and user feedback, demonstrates the transformative potential of Generative AI in the field of TRIZ. The research showcases how AI can be leveraged to streamline TRIZ learning, accelerate problem-solving, and foster innovation across various domains. The emphasis on human-AI collaboration ensures that the AI serves as a powerful assistant, augmenting human expertise and enabling more efficient and impactful problem-solving outcomes.

## **7. Structure and volume of the work.**

The thesis comprises 91 pages and is structured into 13 distinct sections. These sections encompass an introduction, a literature review, a detailed problem statement, methodology, results and analysis, personal contributions, conclusions and recommendations, a list of published works, references, Appendix. The thesis also includes two detailed examples illustrating the integration of Generative AI with various TRIZ tools, showcasing the practical application of the research findings. Additionally, a survey of experienced TRIZ users is presented, providing insights into the perceived benefits and challenges of using AI in TRIZ.

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