

# The Role of Multidisciplinary Integration in Solving Complex Engineering Problems in Automation Specialty

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**Abstract:** This paper studies the role of multidisciplinary integration in solving complex engineering problems in automation specialty. Complex engineering problems in automation require the integration of control theory, electronic technology and mechanical design and other multidisciplinary knowledge. Traditional solutions often fail to fully address these issues. Multidisciplinary integration provides more comprehensive problem analysis and solutions by integrating knowledge and technology from different disciplines. It enables a deeper understanding of the nature and context of the problem and takes into account the impact of different factors to find a more optimal solution. In addition, multidisciplinary integration promotes innovation and interdisciplinarity. Exchanges and cooperation between different disciplines can stimulate innovative thinking and bring new methods and approaches to problem solving.

**Keywords:** Multidisciplinary integration; Automation specialty; Complex engineering problem solving

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## Fund Project:

The “Four New” Research and Reform Practice Project of Anhui Province in 2022, “Research and Practice of School-enterprise Collaborative Education Mechanism for Industrial Process Automation Facing the needs of the Automobile Industry” (2022sx143); 2022 University-level teaching research project “Control Theory course Group teaching Reform for Cultivating ability to solve complex engineering problems” (2022JXYJ40).

## 1. The concept and significance of multidisciplinary integration

Multidisciplinary integration is the organic combination of knowledge and methods in different subject areas to achieve a more comprehensive, in-depth and innovative solution to the problem. Its significance is to make up for the knowledge gap between disciplines, expand the ideas and methods of problem solving, and improve the ability to solve complex problems. Multidisciplinary integration can be divided into different categories. One classification is based on the relationship between disciplines, such as horizontal integration (integration of equally important disciplines) and vertical integration (integration of disciplines at different levels); Another way of classification is based on the goals and methods of fusion, such as interdisciplinary research, fusion field research and comprehensive subject research. The theoretical basis of multidisciplinary integration includes the complementarity and intersections of disciplinary knowledge, the importance of interdisciplinary cooperation and exchange, and the methods and techniques for solving interdisciplinary problems. Theoretical frameworks and models can be comprehensive, such as system theory, network theory, etc., or they can be specific to a specific problem or domain, such as complex systems theory, integrated design methods, etc. These theoretical frameworks and models provide a systematic and structured approach to guide multidisciplinary integration of practice and research.

## 2. The role of multidisciplinary integration in solving complex engineering problems of automation specialty

Multidisciplinary integration plays an important role in solving complex engineering problems in automation specialty. It is able to provide comprehensive problem analysis and understanding, while providing a wealth of knowledge and the ability to integrate dif-

ferent factors for the generation of solutions. In addition, multidisciplinary integration can promote innovation and cross-disciplinarity, stimulate innovative thinking and find new solutions. First, multidisciplinary integration can provide comprehensive problem analysis and understanding. Complex engineering problems often involve multiple subject areas, each with its own unique perspective and knowledge. By integrating the knowledge of different disciplines, the nature and key factors of the problem can be deeply analyzed from multiple aspects to fully understand the complexity and challenge of the problem. Secondly, multidisciplinary integration can provide comprehensive solutions. Knowledge and technology from different disciplines complement each other to provide more comprehensive, accurate and innovative solutions. By comprehensively considering the influence of different factors, multidisciplinary integration can better optimize system design, improve engineering efficiency, and solve problems that are difficult to be solved by traditional disciplines. In addition, multidisciplinary integration can promote innovation and interdisciplinarity. The communication and cooperation between different disciplines is the core element of multidisciplinary integration. Through the collaboration of interdisciplinary teams, experts from different disciplines can share knowledge, exchange experiences, and unite for innovation. This cross-cutting and collaboration helps to expand problem-solving ideas, stimulate innovative thinking, and drive progress and development in the field.

In a word, multidisciplinary integration plays an important role in solving complex engineering problems in automation specialty. It is able to provide comprehensive analysis and understanding of problems, provide comprehensive knowledge for the generation of solutions and the ability to integrate different factors. At the same time, multidisciplinary integration can also promote innovation and cross-disciplinarity, stimulate innovative thinking and find new solutions.

### **3. Practical application cases of multidisciplinary integration**

#### **3.1 Automation control system design case:**

In the design of automatic control system, multi-disciplinary integration can be integrated application of electronic engineering, computer science, mechanical engineering, control theory and other disciplines. For example, in the design of aircraft flight control system, it is necessary to consider the knowledge of aircraft mechanics, control theory, signal processing and other disciplines. Multi-disciplinary integration can help engineers obtain a more comprehensive problem analysis and in-depth understanding of the performance requirements and design constraints of flight control systems to provide more accurate and reliable solutions.

#### **3.2 Robot engineering cases:**

In the field of robot engineering, multidisciplinary integration can involve electronic engineering, mechanical engineering, computer science, human-computer interaction and other disciplines. For example, in the design of intelligent robots, it is necessary to apply the knowledge of multiple disciplines such as mechanical structure, sensor technology, control algorithm and human-computer interaction interface. Through the integration of multiple disciplines, the robot's perception, decision-making and execution functions can be realized to meet the task requirements in complex environments. For example, a robotic system for environmental cleaning needs to obtain environmental information from vision sensors, use mechanical design for movement and manipulation, and use control algorithms for path planning and job execution.

### **4. Challenges and limitations of multidisciplinary integration in solving complex engineering problems in the automation profession**

In the complex engineering problem solving of automation specialty, multidisciplinary integration faces some challenges and limitations, including the difficulty of disciplinary communication and cooperation, the challenge of interdisciplinary team building and management, and the need for talent training and disciplinary integration. Difficulties in disciplinary communication and cooperation. Differences in terminology, methods and ways of thinking among different disciplines lead to difficulties in disciplinary communication and understanding. This makes it necessary to spend more time and effort between members of interdisciplinary teams to understand and communicate concepts and perspectives across disciplines. In addition, there is a gap in the research and teaching systems between disciplines, which limits inter-disciplinary collaboration. Interdisciplinary team building and management challenges, forming an interdisciplinary team requires finding the right professionals and coordinating the work between them. Members of interdisciplinary teams come from different fields and have different professional knowledge and skills, which will bring certain challenges to team management. At the same time, management needs to allocate resources and tasks properly to make full use of each member's expertise and potential. Talent training and discipline integration needs, training with interdisciplinary background and comprehensive ability of talents for multidisciplinary integration is very important. However, at present, many education systems still exist the separation of disciplines, and students lack the training of interdisciplinary thinking and cooperation ability in the training

process. Therefore, there is a need to increase opportunities for interdisciplinary teaching and project practice in the education system to develop students' multidisciplinary thinking and abilities. Despite the challenges and limitations, multidisciplinary integration is still of great value and significance in solving complex engineering problems in the automation profession. Through cooperation and joint efforts, interdisciplinary communication and cooperation can be improved, interdisciplinary team building and management can be carried out more effectively, and the demand for talent cultivation can be met through educational reforms.

## 5. Prospects and future development of multidisciplinary integration

The future development and prospect of multidisciplinary integration has broad prospects and trends. With the continuous progress of science and technology and the change of social problems, there is an increasing demand for comprehensive solutions, and the importance of multidisciplinary integration will be more widely recognized and applied. In the future, multidisciplinary integration will continue to play an important role in various fields. With the cross-border integration of technologies and the emergence of new fields, the crossover and integration between disciplines will become more frequent. For example, the development of artificial intelligence, the Internet of Things, biomedical engineering and other fields requires the collaborative work of multidisciplinary teams to integrate different technologies and expertise to solve complex problems. The policy level should encourage and support multidisciplinary research and practice. For multi-disciplinary cooperation projects, the corresponding financial support and policy support are provided to encourage cross-field cooperation between academic institutions, enterprises and governments. In addition, education should strengthen the interdisciplinary curriculum, cultivate students' comprehensive ability and innovative thinking, while providing opportunities for students to participate in interdisciplinary research and practical projects. Research limitations and development directions: multidisciplinary integration also has some limitations in the research, one of which is the ambiguity and challenge of disciplinary boundaries. Different disciplines differ in theory, methodology and knowledge, and the interdisciplinarity of emerging fields can lead to new challenges. Therefore, further research on theoretical models and methodologies of disciplinary integration is needed to provide more effective solutions. The future direction of expansion includes promoting cooperation and exchange in interdisciplinary research fields, and strengthening interaction and cooperation platforms among disciplines. In addition, the application of multidisciplinary integration in the fields of social problem solving, sustainable development and innovation can be explored. The development of multidisciplinary integration requires continuous research and practice to promote inter-disciplinary cooperation and innovation to provide better solutions to solve complex problems.

## Conclusion:

This paper mainly studies the role of multidisciplinary integration in solving complex engineering problems in automation specialty. By integrating knowledge and techniques from different disciplines, multidisciplinary integration can provide comprehensive problem analysis and understanding, comprehensive knowledge for the generation of solutions and the ability to integrate different factors. At the same time, multidisciplinary integration promotes innovation and interdisciplinarity, inspiring innovative thinking and new solutions. This paper emphasizes the important role of multidisciplinary integration in solving complex engineering problems in automation specialty. By combining knowledge and technology from different disciplines, multidisciplinary integration can provide innovative solutions that drive the development of the automation industry. In areas such as automated control system design, robotics engineering and logistics and supply chain management, multidisciplinary integration plays an important role in improving the efficiency and quality of problem solving. In the future, multidisciplinary integration will continue to develop and apply. With the continuous progress of science and technology and the change of social problems, there is an increasing demand for comprehensive solutions, and the importance of multidisciplinary integration will be more widely recognized and applied. Policies and education should encourage and support multidisciplinary research and practice, and strengthen interdisciplinary exchanges and cooperation. In addition, it is necessary to further explore the theoretical model and methodology of multidisciplinary integration in order to deal with the challenges and limitations of multidisciplinary integration. To sum up, multidisciplinary integration plays an important role in solving complex engineering problems in the automation profession. By integrating knowledge and technology from different disciplines, multidisciplinary integration is able to provide comprehensive problem analysis and solutions, promoting innovation and interdisciplinarity. In the future, multidisciplinary integration will continue to develop and be widely used in various fields.

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