

# Exploration of Teaching “Motion Control System” Integrated with Curriculum Ideological and Political Education

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**Abstract:** Combined with the characteristics and talent training goals of the “Motion Control System” course for automation majors, this paper explores effective paths to organically integrate ideological and political education into professional teaching. By deeply excavating ideological and political elements such as philosophical thoughts, scientific spirit, family and country feelings, and sense of responsibility contained in the course content, and designing typical cases combined with core knowledge points such as “high precision, high dynamic response, and high reliability”, a diversified online-offline hybrid teaching model is constructed. Teaching practice shows that this exploration has effectively stimulated students’ learning motivation and innovative awareness. While imparting professional knowledge, it has cultivated students’ systematic engineering thinking, craftsman spirit, and sense of mission to serve the country through science and technology, realizing the organic unity of knowledge impartation, ability training, and value guidance.

**Keywords:** Curriculum, Ideological and political education; Motion control; Teaching reform

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## 1. Introduction

As a core course for automation majors, “Motion Control System” covers core technologies such as DC speed control systems, AC speed control systems, and servo systems. Its technical requirements of “high precision, high dynamic response, and high reliability” inherently contain rigorous scientific spirit, striving-for-excellence craftsman philosophy, and systematic engineering philosophy<sup>[1]</sup>.

However, influenced by traditional engineering education thinking, some teachers focus on explaining textbook content, emphasizing whether students can understand and master knowledge principles while ignoring the educational elements contained in the course<sup>[2]</sup>. This makes it difficult for professional courses to give full play to the role of ideological education and value guidance, and to truly implement curriculum ideological and political construction and talent training projects. Against the backdrop of increasingly fierce international manufacturing competition, China is committed to promoting a series of strategies, such as becoming a

manufacturing power, quality power, and digital power, leading the modernization and transformation and upgrading of industries, and advancing the new round of technological revolution. At the same time, national strategies and industrial transformation have put forward higher requirements for talents' engineering capabilities and comprehensive quality. This requires teachers to target the practical needs of cultivating outstanding engineering talents, attach importance to knowledge education and engineering skill training, and regard curriculum ideological and political education as an important teaching task. They should make good use of the teaching position of professional courses to infiltrate ideological and political education elements comprehensively and in-depth throughout the whole process<sup>[3]</sup>.

Therefore, based on the teaching position of the "Motion Control System" course, focusing on the integration of curriculum ideological and political education, adding the goal of value guidance and shaping on the basis of knowledge impartment and ability training, systematically reconstructing the teaching content and implementation system, and cultivating engineering talents with family and country feelings, social responsibility, and innovative spirit are imperative.

## **2. Implementation paths of curriculum ideological and political education in "motion control system"**

The key to integrating curriculum, ideological and political education is to regard professional courses as a "dish" and curriculum, ideological and political education as a "condiment". It is necessary to identify the appropriate integration methods, opportunities, and integration points to ensure that the ideological and political "condiment" matches the professional "dish", achieving the collaborative resonance of ideological and political education and professional education. The following four-in-one path is constructed<sup>[4]</sup>.

### **2.1. Improve teachers' ideological and political literacy and integration capabilities**

Teachers are the key to curriculum ideological and political education. Establish a long-term special learning and improvement mechanism to provide teacher support for the implementation of curriculum ideological and political education<sup>[5]</sup>. Strengthen beliefs through special research and learning: regularly carry out collective lesson preparation and ideological and political special teaching and research activities, study curriculum, ideological and political policy documents, and study the deeds of academicians such as Pan Jiluan and Jiang Xinsong. Draw strength from their choices and scientific research spirit of "responding to the country's needs", and internalize it into teaching appeal. Keep up with the frontier to make up for shortcomings: track the "Made in China 2025", "industrial mother machine" special projects and field frontiers, update the case database every quarter, and select domestic technological breakthrough cases such as lithography machine workbench control and industrial robot core controllers to ensure that teaching is aligned with national strategies<sup>[6]</sup>. Improve capabilities through cross-border cooperation: establish a joint teaching and research mechanism with the School of Marxism, invite ideological and political teachers to interpret the "craftsman spirit"; participate in curriculum ideological and political workshops and competitions, learn the "seamless integration" skills of excellent teachers, and improve the ability to integrate value guidance<sup>[7]</sup>.

### **2.2. Systematically excavate and sort out ideological and political elements in the course**

Excavating ideological and political elements in the professional curriculum system is a prerequisite for effective integration. It is necessary to set anchor points in professional concepts, collect ideological and political themes

with high relevance and close connection, and targetedly excavate ideological and political elements <sup>[8]</sup>.

When explaining the knowledge of “double closed-loop speed control system”, guide students to think about the conditions under which DC motors achieve optimal performance from a professional perspective, and analyze the importance of the synchronous operation of the current loop and speed loop in the entire motor system; let students regard the motor as a system from a philosophical perspective, analyze the role of each component in the operation of the overall system, and realize that only when each component keeps up with the overall development can the optimal overall operation be achieved, cultivating students’ overall concept, systematic thinking, and collaborative spirit. In the process of professional knowledge discussion and philosophical analysis, students learn to analyze problems from an overall perspective and establish a positive concept of actively improving themselves and united cooperation according to the system needs of the entire country, enterprise, or team <sup>[9]</sup>.

From “control precision and robustness” to “striving for excellence, craftsman spirit and calmness in the face of changes”: the extreme pursuit of positioning accuracy and tracking accuracy in motion control is a vivid portrayal of the “craftsman spirit” in the field of engineering and technology. By explaining the harsh requirements for micron-level and nanometer-level precision in “national heavyweight equipment” such as lithography machine workbenches and high-precision missile actuators, cultivate students’ professional belief in being meticulous about technical details and striving for excellence in product quality <sup>[10]</sup>. At the same time, the “robustness” of the system requires it to maintain stable operation and complete tasks in the face of “uncertain disturbances” such as load disturbances and parameter perturbations. We extend this to the level of personal cultivation, guiding students to recognize that they will inevitably encounter challenges from various external environments and interference from wrong ideological trends on the road of growth. They must rely on firm ideals and beliefs (set points) and strengthen the “Four Matters of Confidence” (control algorithms) to maintain political stability and the stability of life direction, achieving “remaining unyielding despite thousands of trials and tribulations, no matter which direction the wind blows.”

From “trade-off between dynamic response and stability” to “grasping the dialectics of things’ development and the art of ‘degree’”: in controller design, the rapid response and stability of the system are an eternal contradiction. Excessively pursuing rapidity will lead to overshoot or even oscillation instability, while excessive conservatism will make the system response slow. This profoundly reveals the philosophical wisdom of “going too far is as bad as not going far enough”, as well as the dialectical thinking of overall consideration and coordinated balance. We inspire students that when solving engineering problems and even dealing with personal and social relationships, they should be good at grasping the “degree”, not only dare to forge ahead and pursue efficiency, but also respect objective laws, pay attention to stability and harmony, and seek the optimal balance point in dynamics <sup>[11]</sup>.

### **3. Develop a comprehensive ideological and political case of “high-precision permanent magnet synchronous motor servo control”**

To realize the transformation of ideological and political elements from “concept” to “classroom”, we designed a comprehensive teaching case that runs through multiple knowledge points.

#### **3.1. Knowledge objectives**

Deeply understand the field-oriented control (FOC) architecture of permanent magnet synchronous motors,

master the three-loop design methods of position loop, speed loop, and current loop, and be able to analyze the impact of PID parameters on the dynamic performance (response speed, tracking accuracy) and stability of the system through simulation. Cultivate students' system-level design, debugging, and optimization capabilities, as well as the ability to solve complex engineering problems through modeling and simulation.

### **3.2. Integration and implementation of ideological and political education**

Taking how the workbench achieves nanometer-level positioning accuracy under high-speed motion as an introduction, expound the extreme importance of “a miss is as good as a mile” in high-end manufacturing and national defense security. In the parameter tuning experiment, require students to repeatedly debug until strict performance indicators are met, personally experiencing what it means to be “striving for excellence” in technology <sup>[12]</sup>.

In the simulation experiment, the integral gain was intentionally set too large to allow students to intuitively observe the dynamic process of the system from stability to oscillation instability. The teacher then guides the discussion: if personal growth is eager for quick success and instant benefits (similar to excessive integration), it will instead lead to imbalance in mentality and irregular behavior, resulting in system collapse. Thus, it is emphasized that we must take correct values as the “control law” and a profound academic foundation as the “system model” to maintain the “asymptotic stability” of life direction under various disturbances.

## **4. Construct an integrated hybrid teaching model of “online-offline, in-class and after-class”**

To overcome the contradiction between limited class hours and rich content, and adapt to the learning habits of the new generation of students, we constructed a diversified teaching model.

Use online course platforms to release shocking clips related to high-speed railways, precision assembly of industrial robots, etc., from documentaries such as “National Heavyweight Equipment” and “Innovative China” in advance, allowing students to intuitively feel the charm and value of motion control through visual impact, and stimulate national pride and learning motivation <sup>[13]</sup>.

Flexibly use and intersperse various teaching methods in offline classes, set exploratory questions, introduce cases with ideological depth, and trigger students' philosophical thinking on professional scenarios and problems <sup>[14]</sup>. When explaining PID controllers, use analogies to let students combine the characteristics of proportional (P), integral (I), and derivative (D), place them in professional scenarios, and analyze what good qualities and work styles the three possess, such as P: decisive execution; I: perseverance; D: preventing problems before they occur. This vivid analogy helps students deeply understand knowledge, triggers their thinking about the values behind professional principles, and subtly influences their values. In case teaching, design question chains based on case content, allowing students to explore and solve problems in groups, exercising their team cooperation learning ability and dialectical thinking ability <sup>[15]</sup>.

Assign comprehensive assignments, including system modeling, controller design, and simulation analysis, encouraging students to try different control strategies. In the experimental link, emphasize safety norms and team cooperation. At the same time, use the testing and questionnaire functions of the platform to timely check the degree of knowledge mastery, and collect students' feelings and suggestions on the integration methods of ideological and political education, forming an effective closed loop of “teaching-feedback-improvement” to continuously optimize the teaching process.

## 5. Teaching practice effects

After two years of teaching practice, the curriculum ideological and political reform has achieved remarkable results, which are reflected not only in quantitative achievements but also in students' spiritual and value changes.

### 5.1. Learning motivation: From “passive exam-oriented learning” to “active responsibility”

Ideological and political elements have injected warmth into professional knowledge. Students' questions have extended from “how to use formulas” to “how technology can serve national upgrading”; the number of after-class discussion groups has increased significantly, and the borrowing rate of related professional books has further improved. The learning state has changed from “learning for credits” to “learning to serve the country”.

### 5.2. Practical ability: From “completing tasks” to “pursuing excellence”

The craftsman spirit and innovative awareness have been transformed into practical action. Students take the initiative to optimize performance in experiments, and have won 3 national awards and more than 10 provincial and ministerial awards based on course knowledge. Works such as “intelligent car control experiments” reflect their understanding and innovative application of professional technology.

### 5.3. Value orientation: From “technology-oriented” to “responsibility-first”

Most students take the initiative to cooperate in teams and show perseverance in the face of technical difficulties; at the same time, the implementation of curriculum ideological and political education has guided students to integrate advanced values into current study and career development, establishing the struggle and development goal of “serving the country through science and technology and participating in the upgrading of the manufacturing industry”, laying the foundation for growing into engineering talents with both virtue and ability.

## 6. Conclusion

The practice of this curriculum's ideological and political reform shows that it is feasible and necessary to carry out ideological and political education in engineering courses. The key is to abandon rigid grafting and realize “seamless integration” of professionalism and ideological and political education through the four-in-one path of “improving teacher quality, excavating ideological and political elements, innovating teaching models, and closed-loop feedback”. Professional teaching provides a career for ideological and political education, and ideological and political education injects motivation into professional learning, ultimately achieving the coordination of the three goals of “knowledge, ability, and value”. While mastering the knowledge and principles of motion control, students have acquired the ability to apply knowledge to practice and solve complex engineering problems, and have integrated serving the country through science and technology into their own ideals, forming a steady and progressive, collaborative thinking concept, and a craftsman spirit of pursuing excellence.

Looking forward to the future, the construction of curriculum ideological and political education has a long way to go. This research is only an exploration and the beginning of a stage. In the next step, the teaching team will continue to deepen, reflect, and innovate, continuously deepen the integration and innovation of professional education and ideological and political education, and strive to build “Motion Control System” and other professional courses into a strong position for cultivating outstanding engineering talents of the new era who are

both virtuous and talented and can shoulder the responsibility of national rejuvenation.

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