

Analysis of Electronic Engineering Technology in Intelligent Communication Systems

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Abstract: With the rapid development of modern industrial control fields, the application of electronic engineering technology in intelligent control systems has become increasingly important. These technologies are widely used in key industries such as manufacturing, energy, and transportation, where the optimization of control precision and response speed directly impacts the production efficiency and safety of the entire industry. Based on this, this paper primarily analyzes electronic engineering technology in intelligent communication systems for reference.

Keywords: intelligent communication system; electronic engineering; technology

Introduction

With the rapid development of information technology, intelligent communication systems have become the core infrastructure for information transmission and interaction in modern society, continuously meeting the demands of homo sapiens for high-speed, stable, and intelligent communication. Electronic engineering technology, as the technical cornerstone of intelligent communication systems, encompasses multiple critical domains ranging from signal processing and radio frequency transmission to chip design. It plays a decisive role in enhancing the performance, expanding the functionality, and driving the innovation of intelligent communication systems. Conducting an in-depth analysis of the application and development of electronic engineering technology in intelligent communication systems helps to grasp the direction of technological evolution and promote the continuous advancement of the intelligent communication industry.

1 Overview of Electronic Engineering Technology

Electronic engineering technology encompasses a broad spectrum ranging from microelectronics, signal processing, algorithm optimization to embedded system design. The core of this discipline lies in the development and application of electronic systems to solve complex engineering problems. Electronic engineers utilize various semiconductor devices such as transistors, diodes, and integrated circuits to design electronic circuits, equipment, and systems that perform precise functions like amplification, computation, data conversion, and signal modulation. With technological advancements, the application scope of electronic engineering has expanded from simple appliance design to sophisticated automation and intelligent control systems.

2 Analysis of Electronic Engineering Technology in Intelligent Communication Systems

2.1 Signal processing technology

In intelligent communication systems, signal processing technology is the key to ensuring communication quality. With the explosive growth of communication data volume and the increasing complexity of communication environments, higher demands are placed on the speed, accuracy, and adaptability of signal processing. Advanced digital signal processing algorithms enable efficient encoding, decoding, modulation, and demodulation of communication signals. For example, the Orthogonal Frequency Division Multiplexing (OFDM) technology widely used in 5G communication divides high-speed data streams into multiple low-speed sub-data streams and transmits them in parallel on multiple orthogonal subcarriers, effectively improving spectrum utilization while mitigating the impact of multipath fading. Additionally, channel coding technologies such as Low-Density Parity-Check (LDPC) codes and polar codes can detect and correct errors during signal transmission, enhancing the reliability of signal transmission. The integration of artificial intelligence technology and signal processing has brought new breakthroughs to intelligent communication systems. By leveraging machine learning

algorithms, such as Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) in deep learning, intelligent analysis and processing of communication signals can be achieved. For instance, training neural network models enables real-time prediction of communication channel states, thereby dynamically adjusting signal transmission parameters to optimize communication quality. In terms of anti-interference, artificial intelligence algorithms can automatically identify the characteristics of interference signals and implement corresponding suppression measures, improving the anti-interference capability of communication systems.

2.2 Radio Frequency (RF) Technology

Radio frequency (RF) technology is the core technology enabling wireless communication, determining the signal transmission distance, speed, and coverage of intelligent communication systems. The RF front-end primarily consists of components such as power amplifiers, low-noise amplifiers, filters, and switches, whose performance directly impacts the signal quality and power consumption of communication systems. In mobile terminals like smartphones, to meet the demands of multi-band and multi-mode communication, RF front-ends are increasingly moving toward integration and miniaturization. For example, system-in-package (SiP) technology integrates multiple RF components into a single package, reducing chip size and power consumption while enhancing system reliability.

Additionally, with the application of 5G millimeter-wave bands, the performance requirements for RF front-end components have become more stringent, necessitating the development of RF devices with high gain, low loss, and wide bandwidth. Phased array antennas achieve rapid beam scanning and shaping by controlling the phase of individual elements in the antenna array, making them widely applicable in 5G base stations and satellite communications.

In 5G networks, Massive MIMO (Multiple-Input Multiple-Output) technology, combined with phased array antennas, significantly improves system capacity and spectral efficiency. By adjusting the phase and amplitude of the antenna array, phased array antennas can concentrate signals toward the target direction, reducing interference and enhancing communication quality. Moreover, phased array antennas offer advantages such as strong resistance to fading and interference, making them suitable for complex communication environments.

2.3 Power management technology

Intelligent communication devices impose stringent requirements on power management, necessitating both long-term stable operation and reduced power consumption to extend battery life. The adoption of advanced power conversion technologies, such as switching power supply technology, can enhance power conversion efficiency and minimize energy loss. Switching power supplies convert input voltage to the desired output voltage through the high-frequency switching of conduction and cutoff states in power devices. Furthermore, techniques like synchronous rectification and soft-switching can further improve power conversion efficiency and reduce switching losses. Dynamically adjusting power output based on the device's operational state and load demands achieves energy-saving objectives. For instance, in smartphones, when the device is in standby mode, the supply voltage and frequency to components like the processor and display are reduced to lower power consumption; during data transmission or when running large applications, the power supply is increased to ensure performance. Dynamic power management technology effectively extends battery life without compromising device performance.

2.4 Chip design technology

Chips are the core components of intelligent communication systems, and their performance directly determines the functionality and performance of the system. Intelligent communication devices require powerful computing capabilities to handle complex communication protocols and run various applications. Therefore, high-performance processor chips become critical. For example, the application processors in smartphones integrate multiple cores such as CPU, GPU, and NPU, enabling high-speed data processing, graphics rendering, and Homo sapiens artificial intelligence computing. In 5G base stations, dedicated baseband processor chips are employed to achieve rapid processing and transmission of 5G signals.

To meet the specific functional requirements of intelligent communication systems, application-specific integrated circuits (ASICs) are widely used. For instance, in the field of signal processing, ASIC chips can implement efficient digital signal processing algorithms, improving processing speed and accuracy. In the radio frequency (RF) domain, ASIC chips can realize high-performance RF front-end circuits to meet the requirements of specific frequency bands and

communication standards. Compared to general-purpose chips, ASIC chips offer advantages such as low power consumption, high performance, and high integration, but their design costs and cycles are relatively longer.

3 Optimization strategies and methods

3.1 Optimization of electronic components and circuits

In intelligent control systems, the design of electronic components and circuits has a decisive impact on system performance. Optimizing these components and circuits can not only improve the system's response speed and processing capability but also enhance its stability and reliability in harsh environments. Selecting high-quality electronic components is the foundation of optimization. Utilizing high-speed, low-power microprocessors and high-precision sensors can significantly enhance the system's data processing capability and accuracy. For instance, adopting advanced metal-oxide-semiconductor field-effect transistors (MOSFETs) with lower threshold voltage and faster switching speed can reduce circuit power consumption and thermal loss, thereby improving overall efficiency.

In terms of circuit design, employing multilayer printed circuit board (PCB) technology can effectively reduce the physical size of the circuit, increase the number of wiring layers, optimize signal transmission paths, and minimize electromagnetic interference (EMI). Additionally, using differential signal transmission can further reduce noise and ensure signal integrity. Through these technical optimizations, the optimal design of the circuit can be achieved, ensuring the efficient and stable operation of the intelligent control system.

3.2 Optimization of algorithms and control strategies

In intelligent control systems, optimization algorithms and control strategies are key to ensuring system efficiency and accuracy. Analyzing the applicability of MPC is crucial in intelligent control systems. MPC is an advanced control method that adjusts current control inputs by optimizing predicted future behaviors. For multivariable control problems and various constraints, MPC can provide effective solution strategies. This study thoroughly investigates the mechanism of MPC algorithms and their optimization effects in practical engineering applications, with particular focus on how to enhance the precision and response speed of control strategies through algorithm improvements. The core idea of MPC is to solve a finite-time horizon optimization problem at each control step, calculating control actions based on current and predicted future information.

4 Closing Remarks

Electronic engineering technology, as the core supporting technology of intelligent communication systems, plays an indispensable role in fields such as signal processing, radio frequency transmission, power management, and chip design. With the deep integration of emerging technologies, continuous improvement in integration levels, and the development of green energy-saving technologies, electronic engineering technology will provide strong impetus for the sustained innovation and upgrading of intelligent communication systems. It will propel the intelligent communication industry to higher levels, bringing more convenience and transformation to the lives of homo sapiens and the development of society.

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