



# Application of CSK Encryption Algorithm in Video Synergic Command Systems

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## ABSTRACT

Video command and dispatch systems have become essential communication safeguard measures in circumstances of emergency rescue, epidemic prevention, and control command as data security has become especially important. After meeting the requirements of voice and video dispatch, this paper proposes an end-to-end encryption method of multimedia information that introduces a multiple protection mechanism including selective encryption and selective integrity protection. The method has a network access authentication and service encryption workflow, which implants startup authentication and key distribution into the information control signaling procedure. This method constitutes a key pool with the three-dimensional Lorenz system, the four-dimensional cellular neural network (CNN) system, and the four-dimensional Chen system where the key source system and initial conditions are decided by the plaintext video frame itself. Then, this method optimizes the chaotic sequences to further enhance system security.

## KEYWORDS

Chaos Algorithm, Encryption and Decryption, Key Distribution, Synergic Commands, Video Conferencing, Video Encryption, Video Security, Video Synergic Command System, Video Systems

## 1. INTRODUCTION

As a kind of real-time communication system relying on image and voice communication, video systems enable geographically dispersed users to gather in one virtual conferencing space as the various information exchange modes through image and voice enable real and visualized exchange of cooperating members, and facilitate participant understanding of conference content (Yang et al., 2014). At present, video systems have been gradually developing in the directions of multi-network cooperation, high definition quality, development and intelligence. Video synergic command and dispatch systems can be deployed in public networks or private networks, and are broadly applied in cities' emergency responses, environmental protection, safety supervision, digital city management, public security, electric power and other industries. Particularly for public security and emergency management departments, video command and dispatch systems have become essential communication safeguard measures for large-scale security activities and emergency rescue. Especially in the prevention and control of COVID-19 outbreak in the beginning of 2020, video synergic command

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systems played a crucial role in areas of teleconference, rescue command, video monitoring command, telemedicine and enterprise work resumption. In the application of video systems, video content may concern state secrets, military intelligence, business secrets and private information. Any leakage of such sensitive information will lead to huge safety risks. Therefore, this paper extracts cryptographic demands from typical video conferencing systems and designs a video conferencing encryption scheme using research in combination with commercial cryptographic algorithm, and by taking full advantage of chaos algorithm. This is done to guarantee the information data security, ensure the sustainable development and secure application of video conferencing. This paper proposes an end-to-end encryption scheme for multimedia information in video synergic command systems which studies, combines and designs technologies such as user authentication, end-to-end information encryption protocol, and chaotic encryption algorithm. This implements the video synergic command system and meets various personalized user demands for multimedia information encryption.

### 1.1. Research Status

Video encryption technology appeared contemporarily with the rise of the Internet, both in the 1970s, and has undergone changes from analog signal to digital signal. At the beginning of the 1990s, with the establishment of video coding standards, new video encryption algorithms were continuously proposed, but only concerning the encryption of videos without considering the relation between coding and encryption. There were two encryption methods. In the first method, original videos were processed through traditional cryptographic encryption methods before coding, i.e. substituting and disturbing the pixels of videos. The other method was also called the complete encryption algorithm, which encrypted the code stream after coding and adopted a typical encryption algorithm for its high encryption efficiency. This was deemed as having low research value because of the abnormal decoding due to the change of video format after encryption. Then these two methods, were followed by entropy coding based encryption algorithm, which fused the encryption process into the entropy coding process resulting in preferable encryption results, and high encryption and decryption efficiency (Spanos et al., 1995; Shi et al., 2006). From the beginning of the 21st century, various video encryption algorithms began to attract the attention of researchers gradually and more and more technical proposals followed. Cao brought up the video encryption algorithm using discrete cosine transform coefficient, but it had unsatisfactory encryption results because it encrypted only one type of data (Cao et al., 2005). In 1963, Antonio presented a chaotic system and applied the system in video encryption (Antonio et al., 2015). He proposed a model using the three-dimensional Lorenz Chaos to avoid the complexity in solving high-dimensional chaos (He et al., 2013). However, it was inadequate for real-time transmission when combined with coding. Tian put forward a RC4 hyperchaotic video encryption algorithm that generated four pseudorandom sequences through four-dimensional hyper chaotic mapping to work respectively as the seed keys of RC4 algorithm (Tian et al., 2015). The purpose is to realize the joint encryption of Direct Coefficient (DC), Motion Vector Difference (MVD) symbol and non-zero Alternate Coefficient (AC) symbol. This algorithm featured big key space, strong key sensitivity and high security. The above literature all sought to achieve a sound balance between the efficiency and security of video encryption. Liu et al. came up with a puzzle algorithm that first separated the code stream into blocks, scrambled the blocks and then encrypted them respectively by key streams produced through AES-CTR (Liu et al., 2015). This algorithm was applicable in multimedia P2P video conferencing systems. Traditional encryption methods are primarily mathematical methods requiring costly equipment, and don't fit the document coding structure and mass data characteristic of video information. Chaotic encryption methods are mainly physical methods utilizing the chaotic features of chaotic systems and requiring low-cost equipment. Chen discovered the Chen System in 1999 and applied the four-dimensional hyper chaotic mathematical model (Guan et al., 2015). Chua and Yang were first to establish the Cellular Neural Network (CNN), in 1988, and utilized the four-dimensional CNN hyper chaotic system (Qi et al., 2013; Duan et al., 2014). An ideal chaotic random sequence should have certain characteristics

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