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# LARGE-SCALE MIMO IS CAPABLE OF ELIMINATING POWER-THIRSTY CHANNEL CODING FOR WIRELESS TRANSMISSION OF HEVC/H.265 VIDEO

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## ABSTRACT

A wireless video transmission architecture relying on the emerging large-scale multiple-input–multiple-output (LSMIMO) technique is proposed. Upon using the most advanced High Efficiency Video Coding (HEVC) (also known as H.265), we demonstrate that the proposed architecture invoking the lowcomplexity linear zero-forcing (ZF) detector and dispensing with any channel coding is capable of significantly outperforming the conventional small-scale MIMO based architecture, even if the latter employs the high-complexity optimal maximum likelihood (ML) detector and a rate-1/3 recursive systematic convolutional (RSC) channel codec. Specifically, compared to the conventional small-scale MIMO system, the effective system throughput of the proposed LS-MIMO based scheme is increased by a factor of up to three and the quality of reconstructed video quantified in terms of the peak signal-to-noise ratio (PSNR) is improved by about 22.5 dB at a channel-SNR of Eb/N0 _ 6 dB for delay-tolerant video-file delivery applications, and about 20 dB for lip-synchronized real-time interactive video applications. Alternatively, viewing the attainable improvement from a power-saving perspective, a channel-SNR gain as high as _Eb/N0 _ 5 dB is observed at a PSNR of 36 dB for the scenario of delay-tolerant video applications and again, an even higher gain is achieved in the real-time video application scenario. Therefore, we envisage that LS-MIMO aided wireless multimedia communications is capable of dispensing with power-thirsty channel codec altogether!

## INTRODUCTION

## WIRELESS SENSOR NETWORKS

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to *monitor* physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling *control* of sensor activity.

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The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding. [5] discussed about Vision based Path Planning and Tracking control using Mobile Robot. This paper proposes a novel methodology for autonomous mobile robot navigation utilizing the concept of tracking control. Vision-based path planning and subsequent tracking are performed by utilizing proposed stable adaptive state feedback fuzzy tracking controllers designed using the Lyapunov theory and particle-swarm-optimization (PSO)-based hybrid approaches.

## EXISTING SYSTEM

The systems are assumed to be synchronous and may be characterized by the classic MIMO system model of y = Hs + n, where $y \in CNr\times1$ is the signal vector received at the BS in each time instance; $H \in CNr\times Nt$ denotes the random wireless channel matrix between Nt single-antenna users and the BS equipped with Nr antennas; and $s \in CNt\times1$ represents the symbol vector transmitted in each time instance, whose elements si, i = 1, 2, · · · ,Nt, are randomly taken from a modulation constellation A and satisfy the total transmit power constraint of E(ksk2) = 1. In other words, the total transmit power of all users at each time instance is assumed to be constant and the transmit power of each single-antenna user in our LS-MIMO system is proportional to 1/Nt. Additionally, $n \in CNr\times1$ denotes the complex-valued additive white Gaussian noise vector (AWGN), whose elements obey the independent identically distributed (i.i.d) CN(0, 2_2). We assume an uncorrelated flat Rayleigh fading channel, which implies that each entry of H, i.e. hji, is a complex-valued Gaussian variable. In order to ensure that the site-specific received-SNR biases caused by large-scale fading such as pathloss and shadowing are removed, the channel coefficients hji are normalized as CN(0, 1).

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**PROPOSED SYSTEM**

Based on the above numerical evaluation of the BER performance as well as the discussions concerning the energy efficiency of the two MIMO configurations, in this section we propose a low-complexity M2P video transmission architecture relying on the uplink LS-MIMO system.

At the transmit side, a standard video encoder, such as H.264 [5, 6] or H.265 [2–4], may first be invoked at each user for video compression. Then the output video streams of the video encoders are segmented into packets of different size for transport over IP networks. In a common M2P wireless video transmission scenario, such as mobile video capture or multipoint wireless video monitoring, the users typically have a similar transmit power and rate. Therefore, with only a marginal loss of throughput, at the transmit side of the proposed architecture of Fig. 2 we use a zero-padding-aided packet synchronization mechanism, where a variable number of zeros are appended to the shorter packets, after completing the video encoding and packet segmentation. Explicitly, for packets of different size, the number of zeros appended by the zero-padding operation is different so that after completing the zero-padding operation, all the packets would have the same size. This mechanism is capable of aligning video packets and synchronizing the transmissions of multiple users. The bits in these aligned packets are then transmitted as QAM signals.

**MODULES:**

1. Video Coding Layer
2. High-Level Syntax Architecture
3. HEVC Video Coding Techniques

PERFORMANCE

**VIDEO CODING LAYER:**

The video coding layer of HEVC employs the same hybrid approach (inter-/intrapicture prediction and 2-D transform coding) used in all video compression standards since H.261. Fig. 1 depicts the block diagram of a hybrid video encoder, which could create a bitstream conforming to the HEVC standard.

An encoding algorithm producing an HEVC compliant bitstream would typically proceed as follows. Each picture is split into block-shaped regions, with the exact block partitioning being conveyed to the decoder. The first picture of a video sequence (and the first picture at each clean random access point into a video sequence) is coded using only intrapicture prediction (that uses some prediction of data spatially from region-to-region within the same picture, but has no dependence on other pictures). For all remaining pictures of a sequence or between random access points, inter picture temporally predictive coding modes are typically used for most blocks. The encoding process for interpicture prediction consists of choosing motion data comprising the selected reference picture and motion vector (MV) to be applied for predicting the samples of each block. The encoder and decoder generate identical interpicture prediction signals by

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applying motion compensation (MC) using the MV and mode decision data, which are transmitted as side information.

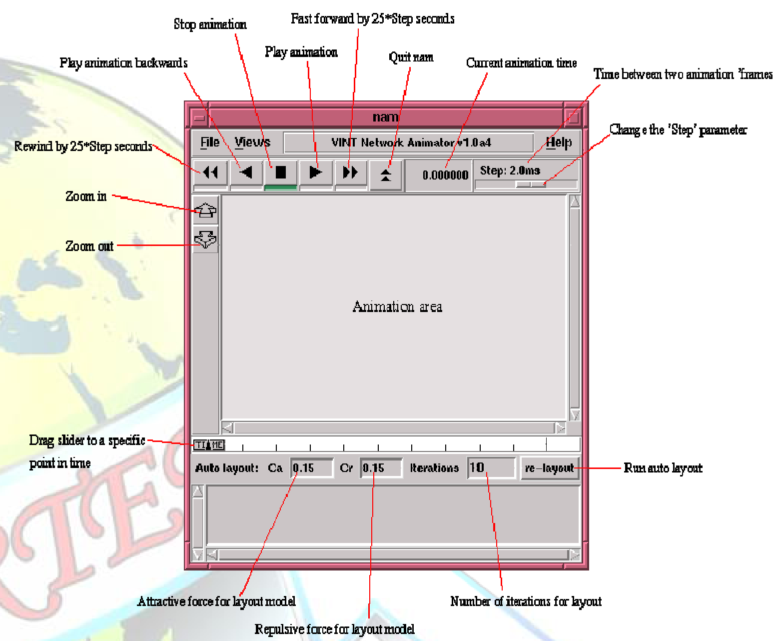
## HIGH-LEVEL SYNTAX ARCHITECTURE:

The high-level syntax of HEVC contains numerous elements that have been inherited from the NAL of H.264/MPEG-4 AVC. The NAL provides the ability to map the video coding layer (VCL) data that represent the content of the pictures onto various transport layers, including RTP/IP, ISO MP4, and H.222.0/MPEG-2 Systems, and provides a framework for packet loss resilience. For general concepts of the NAL design such as NAL units, parameter sets, access units, the byte stream format, and packetized formatting.

A number of design aspects new to the HEVC standard improve flexibility for operation over a variety of applications and network environments and improve robustness to data losses. However, the high-level syntax architecture used in the H.264/MPEG-4 AVC standard has generally been retained, including the following features.

## HEVC VIDEO CODING TECHNIQUES:

As in all prior ITU-T and ISO/IEC JTC 1 video coding standards since H.261 [2], the HEVC design follows the classic block-based hybrid video coding approach (as depicted in Fig. 1). The basic source-coding algorithm is a hybrid of interpicture prediction to exploit temporal statistical dependences, intrapicture prediction to exploit spatial statistical dependences, and transform coding of the prediction residual signals to further exploit spatial statistical dependences. There is no single coding element in the HEVC design that provides the majority of its significant improvement in compression efficiency in relation to prior video coding standards. It is, rather, a plurality of smaller improvements that add up to the significant gain.




## CONCLUSION

The emerging HEVC standard has been developed and standardized collaboratively by both the ITU-T VCEG and ISO/IEC MPEG organizations. HEVC represents a number of advances in video coding technology. Its video coding layer design is based on conventional block-based motion

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compensated hybrid video coding concepts, but with some important differences relative to prior standards.

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