Wideband Millimeter Wave OFDM Uplink with Hybrid Receiving

[1] R.S.Pratap singh, [2]Sajja Venkatesh, [3]Golla Vamsi Yadav , [4]Tangiralla Lokesh , [5]MK Teja Reddy , [6]Malepati Tarun Kuamar

[1]ASSOCIATE PROFFESOR,[2,3,4,5,6] UG STUDENTS PBR VITS, KAVALI, AP, INDIA, 524201

Abstract - The uplink transmission of millimeter-wave orthogonal frequency division multiplexing with a broad bandwidth and hybrid receiving is investigated in this research. The spectral efficiency of the system is examined by taking into account the spatial- and frequency-wideband effects in the channel model. The beam squint effect generated by wideband effects is visible in the analysis and simulation findings. Furthermore, the effects of bandwidth and subcarrier count on the beam squint effect are highlighted.

Index Terms - Millimeter-wave (mm-wave), wideband, beamsquint, orthogonal frequency division multiplexing (OFDM), hybrid.

I. I NTRODUCTION

A large antenna array and a wide bandwidth can be employed inmillimeter-wave (mm-wave) communication to increase the data transmission rate. In such systems, the delay for each path at the base station (BS) antennas not only causes the phase differences between antennas, but also causes a non-negligible delay in the channel impulse response for the widebandwidths. This is known as the spatial-wideband effect. As a result, the beam formed by the BS points to different direction for different frequencies. This is known as the beam squint effect.However, the spectral efficiency of the wideband mm-wave systems with hybrid receiving has not been analyzed in these papers. In the signal-to-interference-plus-noise ratio (SINR) in wideband mm-wave systems is analyzed and shows the impacts of the array dimension and the bandwidth on the beam squint effect, but the dual-wideband effects, i.e., the spatial- and frequency-wideband effects, have not been considered in the analysis. On the other hand, the spectral efficiency of mm-wave systems is analyzed . However, these analyses have not addressed the beam squint effect in wideband mm-wave systems

In [1]- [3] , channel estimation approaches are proposed to address the beam squint effect in wideband mm-wave systems. In [4] , the transmission issues related to the beam squint effect is discussed. However, the spectral efficiency of the wideband mm-wave systems with hybrid receiving has not been analyzed in these papers. In [5], the signal-to-interference-plus-noise ratio (SINR) in wideband mm-wave systems is analyzed and shows the impacts of the array dimension and the bandwidth on the beam squint effect, but the dual-wideband effects, i.e., the spatial- and frequency-wideband effects, have not been considered in the analysis. On the other hand, the spectral efficiency of mm-wave systems is analyzed in [6]- [9]. However, these analyses have not addressed the beam squint effect in wideband mm-wave systems.

II. EXISTING METHOD

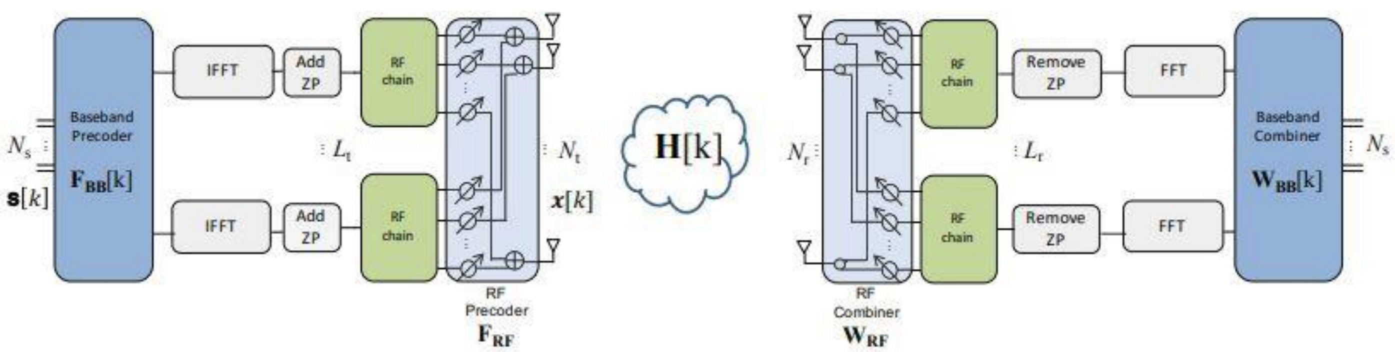

Fig.1 Illustration of the structure of a hybrid MIMO architecture, which include analog and digital precoders and combiners

Existing method deals with the problem of channel estimation in the presence of beam-squint effect. although the ML criterion suggests that coupling among different AoA/AoD must be exploited, the modification of the suboptimal strategy proposed achieves the same performance results as the proposed SW-OLS algorithm.

In existing method, an algorithm that approximates the optimal solution to the dictionary-constrained Maximum-Likelihood (ML) estimator for frequency-selective mm Wave channels considering frequency-dependent array responses. Further, a suboptimal channel estimation strategy to consider the beam squint effect as well. Channel estimation approaches are proposed to address the beam squint effect in wideband mm-wave systems

III. PROPOSED METHOD

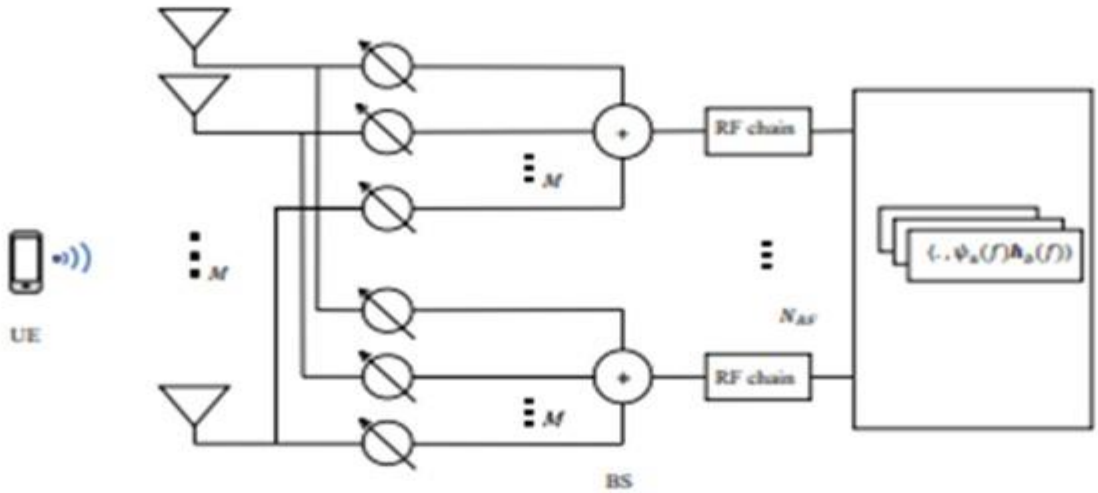

Fig.2 A mm-wave uplink system

In proposed method, the spectral efficiency of wideband mm-wave orthogonal frequency division multiplexing (OFDM) uplink transmission with hybrid receiving is analysed. The base station (BS) is equipped with a large array and employs a hybrid receiving structure. The dual-wideband effects are considered in the channel model. By analyzing the norm of the beamspace channel, the spectral efficiency of the system is derived, which shows the deterioration caused by the beam squint effect. Moreover, the impacts of the bandwidth and the number of subcarriers on the beam squint effect are revealed by analyzing the spectral efficiency, which provide guidance for designing the system.

A mm-wave uplink system where one single-antenna UE transmits OFDM signals to the BS with M antennas. The BS antennas are connected to a phase shift network and N_RF RF chains. In the digital processing unit, the signals are processed with matched filters

Lower-case (upper-case) boldface symbols denote vectors (matrices); AH is the conjugate transpose of A; [a]m is the m-th element in a; [A]m is the m-th column in A; kxk denotes the Euclidean 2-norm of a complex vector x; Efg is the expectation; () is the Dirichlet delta function; IM is an identity matrix with dimension M; a(t)b(t) is the convolution of a(t) and b(t); ha(f); b(f)i = R f2 f1 bH(f)a(f)df is the inner product, where [f1; f2] is the range of the frequency

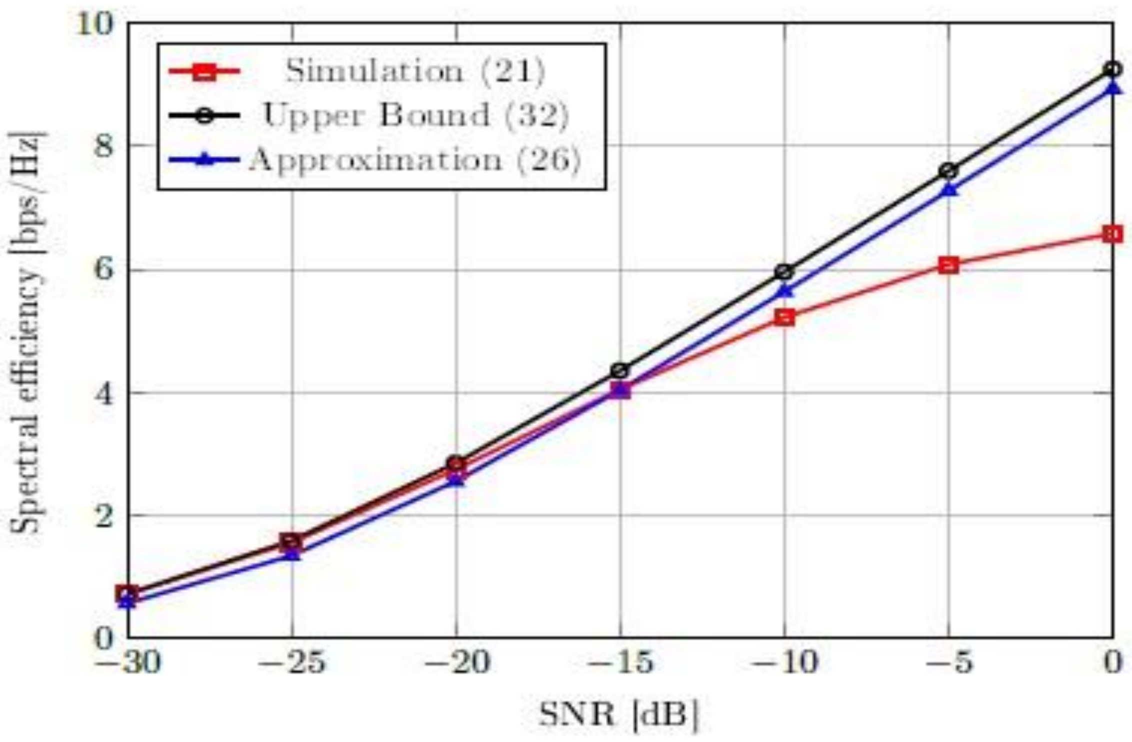

Fig.3.The spectral efficiency versus the SNR

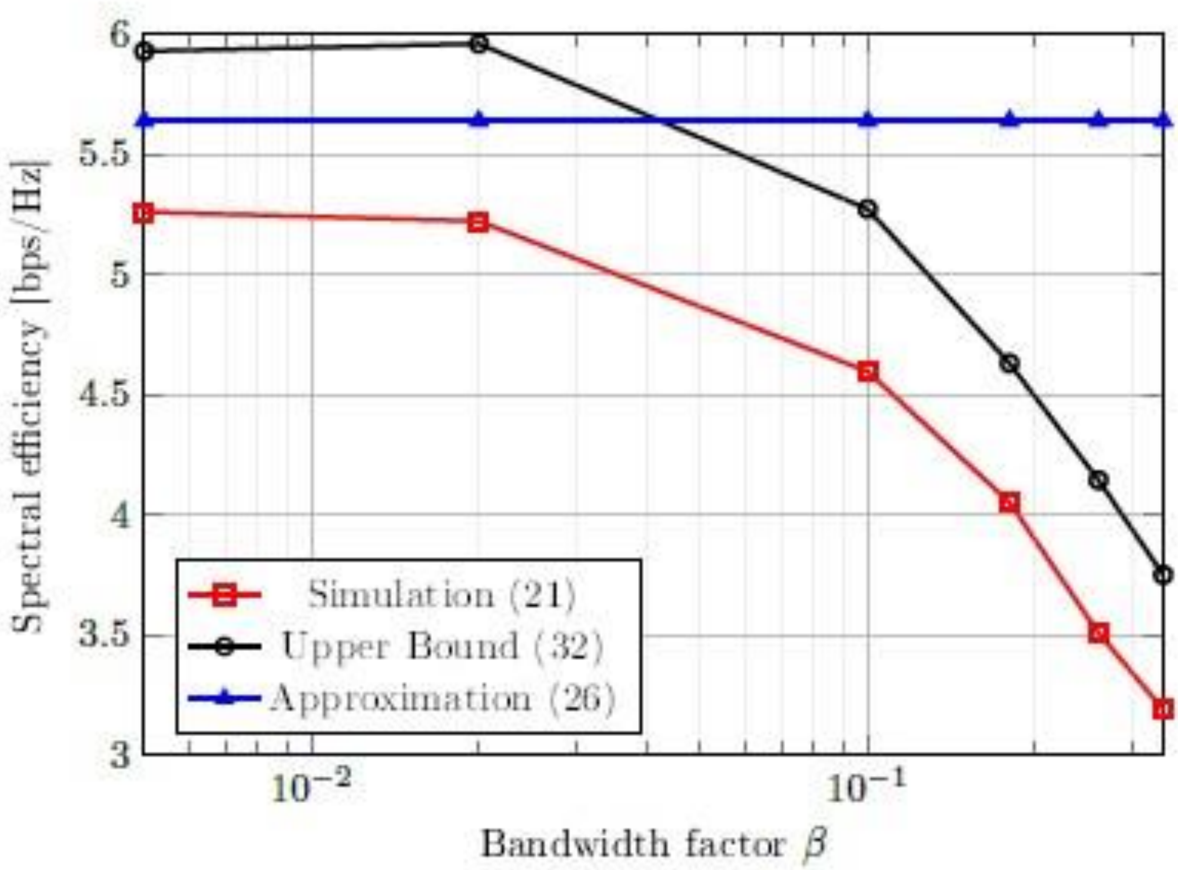

Fig.4.The spectral efficiency versus the bandwidth

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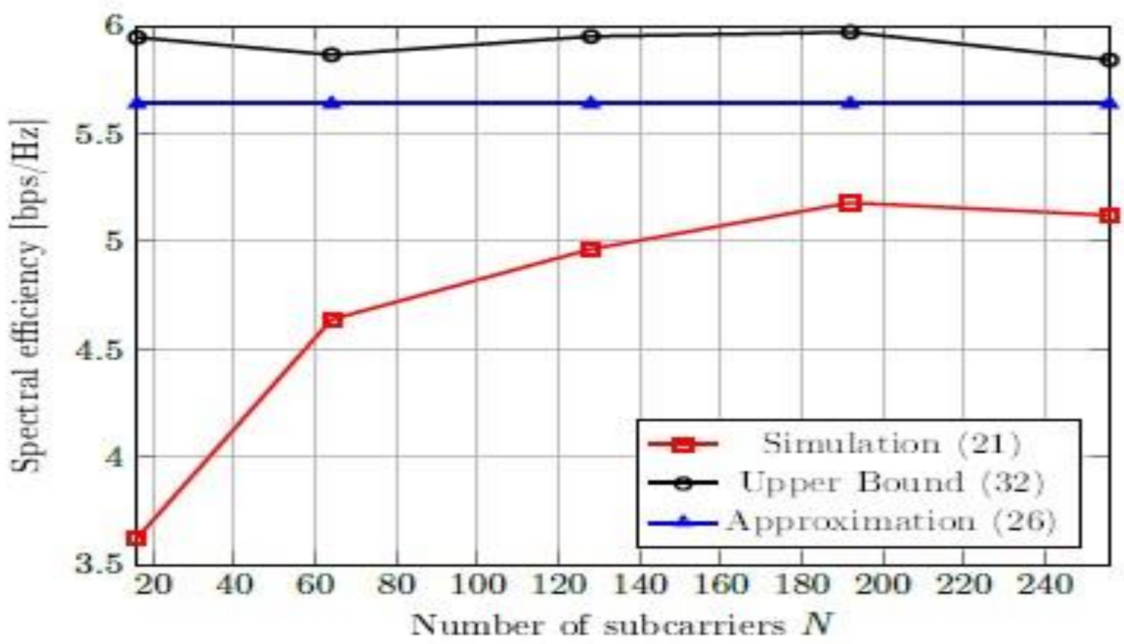

Fig.5.The spectral efficiency versus the number of subcarries

IV. CONCLUSION

In this paper, we analyzed the spectral efficiency of wideband mm-wave OFDM systems with a large antenna array at the BS.The analysis and the simulation show that the wide bandwidth makes the beam points to a direction away from the path, i.e., causes the beam squint effect. We show that by increasing the number of subcarriers the beam squint effect can be alleviated

IV. REFERENCES

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