CHAPTER 2

LITERATURE REVIEW
In [1], the channels are considered as slow time-varying and, moreover, the fraction of time dedicated to the transmission of training data has to be small in order to maintain the overall system spectral efficiency. Their policy can be adopted when no channel state information is available at the transmitter. This is advisable to find a suitable suboptimal setting for the LMMSE channel estimator, such that the estimator itself would be capable of providing pretty good performance, regardless of the unknown real channel correlation conditions. However, this appears to be a very stringent requirement for mobile communication systems, and at the beginning of any wireless transmission.

In [2], the metric of the inter-leaver is derived from the union bound of the bit error rate (BER) of linearly pre-coded orthogonal frequency division multiplexing (OFDM) systems, assuming that the power-delay profile of the channel is known at the transmitter. To avoid the exhaustive search, a novel cyclic shift inter-leaver is introduced and its design parameter is optimized according to the proposed design criterion to improve the performance of the OFDM system. A local minimum search is used to find cyclic shifts which can minimize the proposed design complexity.

In [3], the reported scheme is capable of dynamically sensing unused spectrum segments in a target spectrum pool, and communicating via the unused spectrum segments without causing harmful interference to the primary users. Their goal is to
keep the primary user’s rate unchanged while maximizing the CR user’s rate. It is reasonably assumed that the CR can obtain these request information in the beginning of a service session, and apply the proposed method in the remainder of that session. The work verified the asymptotic correctness of the proposed sub-optimal methods. Their asymptotic analysis showed that the relaying ratios and the pre-coding coefficients obtained by the proposed methods converge to those with full CSIT as the K-factor approaches infinity.

In [4], they provided analytical framework for calculating the large-system throughput of a MIMO cellular network with channel estimation errors. The aforementioned studies assumed that each AP only decodes the users in its service region without AP cooperation. In [4], if the average path gain of one link is relatively low, ignoring its contribution is worth consideration while slightly sacrificing system performances but greatly reducing system complexity. In addition to the optimal MMSE detector, this study also utilizes the suboptimal but simple linear MMSE (LMMSE) detector. In [4], finally, they have reported that the weak path hardly contains useful information, and the additional training segment seems to be wasted and decrease the available data transmission period.

In [5], they proposed a codebook switching scheme exploiting the cross-polar discrimination (XPD) statistics. One solution to decreasing the necessary physical space needed is to employ dual-polarized antennas, where the antennas are grouped in pairs of polarized collocated antennas. In [5], a framework for limited feedback beam forming
and combining in MIMO dual-polarized channels is proposed, that assumes the transmitter and receiver both know the XPD variable. They derive a tractable upper bound on the average SNR distortion. The average SNR distortion metric is employed to measure the performance loss due to the quantization. They proposed a framework for performing limited feedback beam forming over dual-polarized MIMO channels using a codebook known to both the transmitter and receiver.

In [6], the bit error rate performance of popular space time codes for two and four transmit antennas is evaluated under zero-forcing, minimum mean squared error and maximum likelihood detection rules. In the channel estimation stage, full-pilot OFDM symbols are transmitted from different transmit antennas. Although the PHN processes at the Local oscillator (LO) output are correlated, considering their joint probability density function would increase the complexity of the estimation algorithm significantly and, therefore, they are estimated separately. In addition, they generalized the estimator to the MIMO scenario and investigated its un-coded and coded BER performance for different MIMO transmission schemes.

In [7], they studied the impact of nonlinear devices on OFDMA signals. Therefore, they combine an OFDM modulation with an FDMA (Frequency Division Multiple Access) scheme. Their results allow an analytical spectral characterization of the transmitted signals, as well as the computation of the nonlinear interference levels on the received signals. They considered the nonlinear signal processing schemes which operate on a sampled version of the OFDM signal. They will take advantage of the Gaussian nature
of OFDMA signals with a large number of subcarriers for the analytical characterization of the transmitted signals. In [7], they presented an analytical tool to evaluate nonlinear distortion effects on systems employing OFDMA signals.

In [8], they proposed the novel transceiver schemes for the MIMO interference channel based on the mean square error (MSE) criterion. Their goal is to optimize the system performance under a given feasible degree of freedom. They also proposed the robust MSE based transceiver schemes that take channel estimation error into account. In specific, two types of MSE were studied. One is the total MSE among all users without considering user fairness, and the other is the maximum per-user MSE when user fairness is concerned. In [8], the channel model used in the simulations is a quasi-static flat Rayleigh fading channel. They also proposed robust Sum-MSE Minimization and Min-Max algorithm in the presence of channel estimation errors.

In [9], their goal is to improve the overall system performance by exploring the full potential of the network in various dimensions including user, subcarrier, relay, and bidirectional traffic. This is essentially a problem of opportunistic relaying with or without network coding. In [9], they established the equivalence between the original joint optimization problem and a maximum weighted clique problem (MWCP) in classical graph theory. Moreover, the traffic session on each subcarrier can only operate in one of the five transmission modes. In [9], after establishing its equivalence to a maximum weighted clique problem in graph theory, they employed an ACO based heuristic algorithm to find the solution in polynomial time.
In [10], the receiver has perfect channel state information (CSI), while the transmitter has either statistical or no CSI. In practice, this fundamental gain is difficult to obtain. They however, show that having statistical CSI can greatly improve the performance in certain environments. Explicit asymptotic solutions will be derived at low and high SNRs and for large symbol constellations. The maximum relative performance loss is around 5 percent, which can be seen as validation of the heuristic strategy. In [10], the considered system was Rayleigh fading with orthogonal space time block codes (OSTBC) transmission, perfect CSI at the receiver side, and the Symbol rate error (SER) was used as performance measure.

In [11], the main contribution showed how the routing routes are decided on route stability based on mobility of mobile nodes to increase the operational lifetime of routes as well as how the stability of routing routes can be measured quantitatively in mobile ad-hoc wireless sensor networks. In [11], they assumed all nodes have sufficient power and store node ID, sequence number, the mobility information of the downstream node ID (to destination node) in REPLY TABLE (REPT). However, in general in MAWSN the route between a source and a destination may traverse multiple intermediate nodes (hops). The pause at the end of each epoch is zero second. In [11], the ERPM will work very well in group mobility environments according to the basic concepts of the ERPM.

In [12], using experiment results they verify that energy efficiency of wireless sensor network is enhanced by parallel particle swarm optimization, dynamic awakening approach and sensor node selection. In [12], the dynamic energy management
mechanism is particularly exploited for target tracking applications. Stationary sensor nodes are clustered first, and each cluster is related to a specified coverage task for part of the sensing field. These mobile sensor nodes are regarded as stationary sensor nodes. They obtained the cluster centroids and boundary curves. In [12], the PPSO is implemented by cluster heads to maximize coverage area and minimize communication energy in each cluster.

In [13], they proposed a scheme to obtain an aggregate form of sensor data with precision guarantees. The precision constraint is partitioned and allocated to individual sensor nodes in a coordinated fashion. They develop a candidate-based method for precision allocation and prove its optimality for single-hop networks. The key idea is to let each sensor node estimate and report to the base station the normalized energy consumption rates for a number of candidate error bounds based on historical sensor readings. The purpose of precision allocation is to differentiate the quality of data collected from different sensor nodes, thereby balancing their energy consumption.

In [14], the computer simulation results are reported to obtain optimal encoding rate and network size for different operating conditions (SNR, spatial variability of the random field) and reconstruction distortion vs. network size. Such encoding rate has an impact on (i) the number of quantization bits used at the encoders and (ii) the actual number of observations reliably received at the FC, as a consequence of the outage probability experienced in the sensor-to-fusion centre fading channels. With the absence of instantaneous CSI at the sensor nodes, the encoding rate cannot be dynamically
adjusted to match the channel rate. In [14], their aim is for a proposed constant-rate encoding strategy which unavoidably entails some outage probability in Rayleigh fading scenarios.

In [15], the multi objective optimal design of space based reconfigurable sensor networks with novel adaptive MEMS antennas is investigated by using multi objective evolutionary algorithms. Their idea of wireless sensor network has significant impact on the traditional sensing systems due to its reliability, robustness, flexibility and redundancy. In [15], their choice of materials, like silicon used in the substrate gives us an advantage of having physically smaller antennas. This actuation voltage is predetermined by the frequency of operation and the desired signal phase. When they designed and operated a wireless sensor network there are often multiple objectives to be dealt with concurrently at different levels and under different constraints or requirements.

In [16], they employed a broadband orthogonal frequency division multiplexing (OFDM) signal to increase the frequency diversity of the system as different scattering centres of a target resonate variably at different frequencies. They have resolved and exploited the multipath components with short pulse, multi-carrier wideband radar signals. Therefore, for both OFDM and CE-OFDM measurement models, they assumed that the clutter and noise are temporally white and circularly symmetric zero mean complex Gaussian process with unknown covariance’s. In this paper, the problem of detecting a moving target by exploiting multipath reflections is addressed. In [16], they
have developed the measurement model accounting for only a finite number of specular multipath reflections.

In [17], they derived the optimal source and relay matrices of a multihop MIMO relay system that guarantee the predetermined QoS criteria be attained with the minimal total transmission power. They showed that the solution to the original optimization problems can be upper-bounded by using a successive geometric programming (GP) approach and lower-bounded by utilizing a dual decomposition technique. However, a rigorous analysis of the convergence of the successive GP algorithm is not available.

All simulation results are averaged over 1000 independent channel realizations. In [17], finally the successive GP approach and the dual decomposition technique were used to solve the optimization problem.

In [18], they derived a distributive two-stage two-winner auction-based control policy which is a function of the local CSI and local QSI only. One potential issue of cooperative communication is the half-duplex penalty in the relay nodes. There have been some recent works to address the half-duplex issue in cooperative relay systems. When the source node is to deliver information bits to one Relay Station (RS), selecting different RS's with different buffer lengths may have different effects on the average packet delay of the system. Brute-force solution could not lead to any useful implementations. In [18], they showed that by exploiting buffering in each MIMO relay, they could substantially reduce the intrinsic half-duplex loss in cooperative systems.
In [19], it addresses the design problem of DFE transceiver without zero-forcing constraint. They assumed that both instantaneous channel state information (CSI) at the transmitter (CSIT) and the receiver (CSIR) are available. Here, they considered the design of ST-GTD transceiver based on perfect channel prediction and use it as a theoretical foundation for the development of the ST-GTD transceivers with imperfect channel prediction or even without channel prediction in the later section. They showed the class of ST-GTD MMSE transceivers has smaller total MSE per ST-block than the conventional GMD-based MMSE system. In [19], the three MIMO-MMSE decision feedback transceivers for narrowband MIMO time-varying channels are proposed.

In [20], the two related optimization problems, maximizing the minimum of weighted rates under a sum-power constraint and minimizing the sum-power under rate constraints, are considered. They assumed that the Gaussian input and that each signal is decoded at no more than one receiver. The complexity is high because the steepest ascent algorithm for the weighted sum-rate maximization needs to be solved repeatedly for each weight vector searched by the ellipsoid algorithm. Then the solution does not satisfy the single-user water-filling structure. They can be used in admission control and in guaranteeing the quality of service. In [20], finally the mappings were used for many other optimization problems.

In [21], the Numerical results show that the downlink throughput with a limited feedback of CSI can be close to that with perfect CSI by exploiting correlation properties of downlink CSI for quantization. As a result, the performance of resource allocation
schemes is degraded due to imperfect CSI. Analyzing the effect of finite feedback rate in OFDMA systems turns to be a crucial problem. However, as they shown, the feedback of the channel gains allows the information-theoretic approach to relate the actual channel gain to the feedback channel gain for a given fixed CSI-feedback rate. In [21], they have investigated the downlink throughput maximization for an OFDMA system with finite feedback rate. They have also derived the test channel that achieves this RDF.

In [22], specifically, they focused on the problem of maximizing the amount of power available to broadcast a jamming signal intended to hide the desired signal from a potential eavesdropper, while maintaining a pre-specified SINR at the desired receiver. Ultimately, for a wiretap channel without feedback, they had shown that a nonzero secrecy capacity can only be obtained if the eavesdropper’s channel is of lower quality than that of the intended recipient. If perfect CSI of the eavesdropper’s channel is available, then it is known that the use of artificial interference is suboptimal. In [22], they had presented beam-forming-based approaches for improving the secrecy of the wireless communications between two multi-antenna nodes.

In [23], their goal is to maximize the weighted sum rate of the system by jointly optimizing subcarrier pairing and power allocation on each subcarrier in each hop. In view of the lack of joint optimization of power allocation and subcarrier pairing for OFDM systems with DF? Relaying in the literature, the goal of [23], is to solve this problem with the presence of the SD? link and destination combining of signals from
the source and the relay. This corresponds to the situation where more than one source
subcarriers select the same relay subcarrier. In both cases, the obtained subcarrier
pairing scheme is near optimal. In [23], they solved the optimization problems by using
some special properties of the systems, as well the continuous relaxation and the dual
method.

In [24], a multiuser network using the uplink-downlink duality is approached for
solving the downlink optimization problems. The duality is examined by analyzing the
Karush-Kuhn-Tucker conditions for the uplink and downlink channel problems. The
latter duality is limited to sum MSE minimization problem. They first solved the power
allocation part of each problem ensuring global optimum. They believe that if the CSI is
imperfect both at the BS and MS, the derivation of rate expression is much involved.
Moreover, the performance gap between these designs increases as the SNR increases in
[24], is considered, two MSE-based transceiver design problems where imperfect CSI is
available both at the BS and MS’s.

In [25], specifically, they studied the problem of soft demodulation for the case where
all antennas transmit independent symbols. Their focus is on systems that use capacity-
achieving codes, i.e., turbo and low-density parity-check (LDPC) codes. In the first step,
a carefully chosen set of marginalization sums is approximated by their largest terms. In
the second step, a low-complexity method (ZF-DF preferably) is used to find these
largest terms. Their approach does not appreciably affect the performance, but it
simplifies the description of the PM algorithm. In [25], their correspondence offers a
new soft-input extension, for arbitrary separable constellations, to the PM method. Also, the computational complexity is not significantly increased.

In [26], the benefits of MIMO systems with respect to reliability increase of channel capacity and spectrum efficiency is presented. Its basic advantages are a simple detector and the possibility of channel decoupling, which enable decomposition of complex systems to a number of simpler ones. [26] reverses the biggest problem of a conventional wireless model (multipath propagation due to scatter environment), into the most important advantage. [26] discusses that the signal suffers from a severe degradation in some points, which could lead to a link breakdown if the signal is under the receiver threshold level.

In [27], has solved the trade-off between estimating the channel more accurately and increasing the achievable data rate. Since the total block length, and therefore the total training duration is limited, each user can only train a fraction of its available channel dimensions, which might result in shorter individual training signal durations compared to the single-user case. Their goal is to find the optimum values of these training and the data transmission parameters. Each group is correlated within them, but among groups are uncorrelated, which results in a block diagonal channel covariance matrix. During the training phase, they have reported that the users send time-orthogonal training signals.
In [28], the problem in MIMO systems owing to the co-antenna interference (CAI) caused by simultaneous transmissions from different transmit antennas is discussed. They proposed a novel soft-IC (SIC) scheme for the MIMO-MC-CDM system under study using Fourier transform (IFFT) and cyclic extension of an OFDM symbol as guard interval or cyclic prefix (CP). This is followed by Q detectors operating in a parallel fashion, one for each subcarrier. Only the autocorrelation matrix is used in the conventional scheme. The performance gain gap becomes bigger as the SNR increases. The gain is smaller at low SNRs owing to the dominance of the circular channel noise. A novel interference cancellation scheme for MIMO-MCCDM systems are proposed.

[29] One of the principal techniques for efficient spectral usage is to implement dense spatial reuse of available spectrum as proposed in [29]. All the discussions and analysis are done considering the fact that both the interfering and desired link use the same MIMO scheme. In [29], their proposed treatment can be generalized to the case where the interferers use different STBC lengths. So, for multiple-symbol receiver, the receiver now needs to estimate the correlation of received signals across multiple-symbol durations and use this knowledge to null out the interferers. The channel is taken as time-invariant. Thus, they conclude that multiple-symbol processing based linear MMSE receiver provides robustness against all single-stream interferers, such as STBC, SIMO etc.

[30] Proposed and compared the novel interpolation algorithms for MIMO-OFDM with cancellation. Two optimal MMSE solutions are computed with a different data
detection order. Therefore, in the worst case, the number of optimal solutions that needs to be computed is doubled. Also, after the Fourier transform, the channel matrix for each sub-channels are correlated. Therefore, interpolation of the channel matrix should be performed. Different interpolation algorithms for a MIMO OFDM receiver with interference cancellation is proposed & analyzed.

In [31], by using their experimental test bed and indoor field measurements, they present a representative profile of received power versus distance, as well as comparative studies of SISO, MISO, and MIMO bit error probability performance. In [31], they presented the use of infrared (IR) diffuse optical signaling to overcome the inherent limitations of RF communications. The transmitted signals utilize unique, but correlated, paths to each of the spatially separated receiver elements.

In [31], they have developed a flexible experimental diffuse optical MIMO test bed with which they can test the performance of the MIMO STC. Diffuse optical links provide a more secure alternative to traditional RF systems by providing a tightly contained wireless coverage area.

In [32], they first discuss the tradeoffs between diversity, interference cancellation and spatial multiplexing in MIMO systems, and they compared optimum combining (OC), maximum-ratio combining (MRC) and interference cancellation (IC) for different numbers of receive antennas. Another way of increasing spectral efficiency is to use multiple antennas at the transmitter and at the receiver. In [32], they also declared that IC does worse than MRC except at low SIR, where interference dominates performance
degradation and hence cancelling interference is the correct strategy. The simulations were made using uncoded signal constellations and uncorrelated Rayleigh fading channels. In [32], they have first discussed the diversity, interference cancellation and multiplexing gain tradeoffs in MIMO systems.

In [33], they analyzed a wideband non-coherent multi-antenna fading channel model in which the fading process exhibits both spatial and temporal correlation. By contrast, their scheme uses non-coherent on-off signaling, without explicit training. In [33], they sacrificed the goal of achieving capacity, and instead investigate the sub-capacity channel behavior. They consider a MIMO channel with 'm' transmits and n receive antennas. They also (analytically and numerically) evaluate L for general Toeplitz correlation structures. This holds for the SIMO case also.

In [34], they presented a study on the influence of channel estimation errors and noise on the probability of error of the system when no error correction mechanisms are provided. They consider that the number of receive antennas is at least the number of transmit antennas, so that, in the case where the channel matrix is full rank, all the Eigen modes can be decoded. In [34], the matrix M is introduced to account for the fact that, although they assume that the channel matrix elements have zero mean, in a short-term analysis they would have nonzero mean and would be conditioned by the previous temporal evolution. A study of the impact of channel estimation errors on the performance of SVD-based systems is also done.
In [35], they proved a new outer bound to the capacity region of a certain class of interference channels, and quantify the gap between it and the Han-Kobayashi (Theorem 1) inner bound. They noted that none of the outer bounds discussed there imply the bound of Theorem 1, for the Gaussian interference channel. The gap implied by the bound is less than 1 bit per complex dimension for any value of the channel parameters. In [35], furthermore, the entropy of the output of memory less channel conditioned on the input is already in a single letter form. In [35], the case of an additive Gaussian noise channel, the 'two looks' at the channel output is equivalent to a single channel with twice the signal-to-noise ratio (SNR).

In [36], the use of more receiver antennas not only results in an increase in hardware cost but also aggravate signal processing complexity at the base station. In [36], multi-user MIMO uplink transmission system exploiting complex OSTBC schemes is investigated for complex OSTBC with 3 or 4 antennas. Based on the analysis a solution utilizing the special property of OSTBC equivalent channel to solve multi-user interference is derived. However, when applying their method to complex OSTBC cases with 3 or 4 antennas, some modifications should be made. An iteration interference cancellation detector for multi-user MIMO uplink transmission system is also proposed with a focus on alleviating the burden in signal processing at the base station.

In [37], it is proposed that the OFDM systems possess a diversity gain over single carrier systems since the orthogonality of the subcarriers prohibits multipath from being combined across the channel at the symbol level. They assume that the channel is
frequency selective and time-invariant during the transmission of one OFDM symbol. Consequently, the simulation results derived in [37], just aim at giving the lower bound of the performance of the considered system. The work has expanded the idea of using block spreading to improve the bit error performance of OFDM systems over frequency selective multipath Rayleigh fading channels to apply to STC-MIMO-OFDM systems, resulting in so-called STC-MIMO-BOFDM systems.

In [38], the wireless networks, node cooperation have been proposed as a strategy to improve communication reliability and system capacity. They show that up to an SNR threshold, which depends on the network geometry and the number of antennas, a cooperative system performs at least as well as a MIMO system with isotropic inputs. In [38], the relay is assumed to be close to the source, and together they form the transmit cluster. In [38], the cooperative capacity in different SNR regions, based on the given geometry and the number of cooperating antennas in each cluster is explored.