Low-Complexity Near-Optimal Detector for Multiple-Input Multiple-Output OFDM with Index Modulation

Lavanya.M
PG Scholar, Bharathiyar Institute of Engineering For Women, Salem
Mail ID:avanya20@gmail.com
Ms K.Vaishnavi M.E., Assistant Professor
Electronics and Communication Engineering, Bharathiyar Institute of Engineering for Women , Salem

***Abstract*— Cooperative networking is famous to have significant impending in increase network aptitude and program dependability. Although there have been extensive studies on applying cooperative networking in multi-hop ad hoc networks, most works are limited to the basic three-node impart scheme and single-antenna systems. These two limitations are consistent and both are due to a limited academic considerate of the optimal power allowance structure in MIMO cooperative networks (MIMO-CN). In this paper, we study the structural properties of the best power allocation in MIMO-CN with per-node power constraints. More specifically, we show that the optimal power allocations at the basis and both relay follow a same structure in MIMO-CN. This result *generalizes* the power allocation result in the basic three-node setting to the multi-relay setting, for which the optimal power allocation structure has been heretofore unknown. We further quantify the performance gain due to cooperative relay and establish a connection between cooperative inform and pure relay. Finally, base on these structural insights, we compress the MIMO-CN rate maximization problem to an equal scalar formulation. We then plan a global optimization method to solve this easy and the same problem.**

***KEYWORDS*- Cooperative networks, multiple-input multiple-output (MIMO), relay, amplify and forward, power allocation, nonconvex optimization, algorithms.**

I. INTRODUCTION

The Concept of cooperative networking traces its roots back to the 1970s, when information-theoretic studies were first conducted in under the theme of "relay channels." In recent years, cooperative networking has received substantial interest from the wireless networking and communications research communities. Many interesting problems for cooperative networks have been actively researched, such as throughput-optimal scheduling network lifetime maximization distributed routing and MAC layer protocol design just to name a few.Although there have been extensive studies concerning cooperative networks, most works on optimizing the performance of cooperative networks.

THE BASIC THREE-NODE RELAY SCHEME

The basic three-node relay scheme is where the message transmitted from source S to destination D is relayed by a node R, which can overhear the message. In an ad hoc network environment, however, the message from the source is likely to be overheard by multiple neighboring nodes. A common cooperative approach in this situation is *relay assignment*, i.e., we choose only one of the neighboring nodes as a relay for which the three-node relay scheme can be applied Despite its simplicity, this relay assignment scheme is clearly suboptimal since all such neighboring nodes can potentially serve as relays to further improve the system performance.

SINGLE-ANTENNA SYSTEMS

In the current literature, research on cooperative networks with MIMO-enabled nodes remains limited. In cooperative networks, it is interesting to explore the idea of deploying multiple antennas at each node. With multiple antennas, the source and the relays can multiplex independent data streams by exploiting the inherent independent spatial channels. While the above two limitations are seemingly unrelated, they are in fact both associated with the limited theoretical understanding of MIMO cooperative networks (MIMO-CN). To see this, let us consider the single-antenna multi-relay network. Here, we can treat all single-antenna relays $R1, \ldots, RM$ as a single virtual relay node with M antennas. In this sense, analyzing this multi-relay network is closely related to analyzing a three-node cooperative network with a MIMO enabled relay. Thus, besides the attractive capacity benefits, research results of MIMO-CN can also generalize previous studies on single-antenna-based cooperative communication, which can be viewed as special cases of MIMO-CN.

In this paper, we consider the optimal power allocation at the source and each relay to maximize the end-to-end achievable rate of multi-relay MIMO-CN. Our focus is on the amplify-and-forward (AF) relay strategy. An obvious reason is that AF has low complexity since no decoding/encoding is needed. This benefit is even more attractive in MIMO- CN, where decoding multiple data streams could be computationally intensive. In addition to simplicity, a more important reason is that AF outperforms decode-and forward (DF) in terms of network capacity scaling: in general, as the number of relays increases in MIMO-CN, the effective signal-to-noise ratio (SNR) under AF scales linearly, as opposed to being a constant under DF.

II. EXISTING TECHONOLOGIES

` In Existing System, the multi-hop ad hoc networks most works are limited to the basic three-node relay scheme and single –antenna systems. These two limitations are interconnected and both are due to a limited theoretical understanding of the optimal power allocation structure in MIMO cooperative networks (MIMO-CN). So, capacity level is very low. Indeed, most of current works on wireless networks attempt to create, adapt, and manage a network on a maze of point-to-point non-cooperative wireless links. Such architectures can be seen as complex networks of simple links.

DISADVANTAGES:

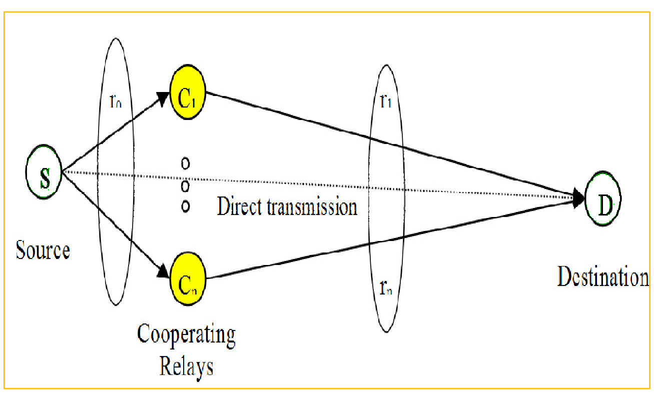
Low Network Capacity.

Communications are focused on physical layer issues, such as decreasing outage probability and increasing outage capacity, which are only link-wide metrics.

III. PROPOSED SYSTEM

In Proposed system we use Cooperative diversity. It is a cooperative multiple antenna technique for improving or maximizing total network channel capacities for any given set of bandwidths which exploits user diversity by decoding the combined signal of the relayed signal and the direct signal in wireless multi hop networks. A conventional single hop system uses direct transmission where a receiver decodes the information only based on the direct signal while regarding the relayed signal as interference, whereas the cooperative diversity considers the other signal as contribution.

PROPOSED ARCHITECTURE



ADVANTAGE

To make larger or more powerful; increase.

To add to, as by illustrations; make complete.

To exaggerate.

To produce amplification of: amplify an electrical signal.

IV.IMPLEMENTATION

Implementation is the stage of the project when the theoretical design is turned out into a working system. Thus it can be considered to be the most critical stage in achieving a successful new system and in giving the user, confidence that the new system will work and be effective.

The implementation stage involves careful planning, investigation of the existing system and it's constraints on implementation, designing of methods to achieve changeover and evaluation of changeover methods.

THREE-NODE RELAY TRANSMISSION

With physical layer cooperative communications, there are three transmission manners: direct transmissions, multi-hop transmissions and cooperative transmissions. Direct transmissions and multi-hop transmissions can be regarded as special types of cooperative transmissions. A direct transmission utilizes no relays while a multi-hop transmission does not combine signals at the destination. The cooperative channel is a virtual multiple-input Multiple-output (MIMO) channel, where spatially distributed nodes are coordinated to form a virtual antenna to emulate multi-antenna transceivers.

NETWORK CONSTRAINTS

Two constraint conditions need to be taken into consideration in the *network connectivity*, which is the basic requirement in topology control. The *end-to-end network connectivity* is guaranteed via a hop-by-hop manner in the objective function. Every node is in charge of the connections to all its neighbors. If all the neighbor connections are guaranteed, the end-to-end connectivity in the whole network can be preserved. The other aspect that determines network capacity is the path length. An end-to-end transmission that traverses more hops will import more data packets into the network. Although path length is mainly determined by routing, MIMO – CN limits dividing a long link into too many hops locally. The limitation is two hops due to the fact that only two-hop relaying are adopted.

RELAYING STRATEGIES

Amplify-and-forward

Decode-and-forward

In amplify-and-forward, the relay nodes simply boost the energy of the signal received from the sender and retransmit it to the receiver. In decode-and-forward, the relay nodes will perform physical-layer decoding and then forward the decoding result to the destinations. If multiple nodes are available for cooperation, their antennas can employ a space-time code in transmitting the relay signals. It is shown that cooperation at the physical layer can achieve full levels of diversity similar to a MIMO system, and hence can reduce the interference and increase the connectivity of wireless networks.

COOPERATIVE COMMUNICATIONS & OPTIMAL POWER ALLOCATION

Cooperative transmissions via a cooperative diversity occupying two consecutive slots. The destination combines the two signals from the source and the relay to decode the information. Cooperative communications are due to the increased understanding of the benefits of multiple antenna systems. Although multiple-input multiple-output (MIMO) systems have been widely acknowledged, it is difficult for some wireless mobile devices to support multiple antennas due to the size and cost constraints. Recent studies show that cooperative communications allow single antenna devices to work together to exploit the spatial diversity and reap the benefits of MIMO systems such as resistance to fading, high throughput, low transmitted power, and resilient networks.

MULTI-HOP TRANSMISSION

Multi-hop transmission can be illustrated using two-hop transmission. When two-hop transmission is used, two time slots are consumed. In the first slot, messages are transmitted from the source to the relay, and the messages will be forwarded to the destination in the second slot. The outage capacity of this two-hop transmission can be derived considering the outage of each hop transmission.

V.CONCLUSIONS

In this paper, we have investigated the structural properties of optimal power allocation in multi-relay MIMO-CN and designed algorithms to solve the optimal power allocation problem. Our contributions include generalizing the matching result under the basic three-node setting to the multi-relay setting with per-node power constraints, for which the optimal power allocation has been heretofore unknown. We also quantified the performance gain due to cooperative relay and established the connection between cooperative relay and pure relay. Based on the derived structural insights, we reduced the MIMO-CN rate maximization problem to an equivalent scalar form, which allowed us to develop an efficient global optimization algorithm by using a branch-and-bound framework coupled with a custom-designed convex programming relaxation. Our results in this paper offer important analytical tools and insights to fully exploit the potential of AF based MIMO-CN with multiple relays. More importantly, our proposed global optimization approach overcomes the fundamental non convex difficulty encountered in large-scale MIMO cooperative networks, which we hope will benefit future research in this area.

REFERENCE

[1] J. N. Laneman, D. N. Tse, and G. W. Wornell, "Cooperative diversity in wireless networks: Efficient protocols and outage behavior," *IEEE Trans. Inf. Theory*, vol. 50, no. 12, pp. 3062–3080, Dec. 2004.

[2] A. Sendonaris, E. Erkip, and B. Aazhang, "User cooperation diversity – Part I and Part II," *IEEE Trans. Commun.*, vol. 51, no. 11, pp. 1927– 1948, Nov. 2003.

[3] E. C. van der Meulen, "Three-terminal communication channels," *Ad-vanced Applied Probability*, vol. 3, pp. 120–154, 1971.

[4] T. M. Cover and A. A. El Gamal, "Capacity theorems for the relay channel," *IEEE Trans. Inf. Theory*, vol. 25, no. 5, pp. 572–584, Sep. 1979.

[5] E. M. Yeh and R. A. Berry, "Throughput optimal control of cooperative relay networks," *IEEE Trans. Inf. Theory*, vol. 53, no. 10, pp. 3827– 3833, Oct. 2007.

[6] T. Himsoon, W. P. Siriwongpairat, Z. Han, and K. J. R. Liu, "Lifetime maximization via cooperative nodes and relay deployment in wireless networks," *IEEE J. Sel. Areas Commun.*, vol. 25, no. 2, pp. 306–317, Feb. 2007.

[7] S. Sharma, Y. Shi, Y. T. Hou, H. D. Sherali, and S. Kompella, "Cooperative communications in multi-hop wireless networks: Joint flow routing and relay node assignment," in *Proc. IEEE INFOCOM*, San Diego, CA, Mar. 15-19, 2010, pp. 1–9.

[8] P. Liu, Z. Tao, S. Narayanan, T. Korakis, and S. S. Panwar, "CoopMAC: A cooperative MAC for wireless LANs," *IEEE J. Sel. Areas Commun.*, vol. 25, no. 2, pp. 340–354, Feb. 2007.

[9] Y. Shi, S. Sharma, Y. T. Hou, and S. Kompella, "Optimal relay assignment for cooperative communications," in *Proc. ACM MobiHoc*, Hong Kong SAR, China, May 2008, pp. 3–12.

[10] J. Cai, X. Shen, J. W. Mark, and A. S. Alfa, "Semi-distributed user relaying algorithm for amplify-and-forward wireless relay networks," *IEEE Trans. Wireless Commun.*, vol. 7, no. 4, pp. 1348–1357, Apr. 2008.

[11] J. Liu, N. B. Shroff, and H. D. Sherali, "Optimal power allocation in multi-relay MIMO cooperative networks: Theory and algorithms," *Technical Report, Deptment of ECE, Ohio State University*, Jul. 2010. [Online]. Available: http://www2.ece.ohio-state.edu/˜ liu/publications/ AF MIMO MRELAY TR.pdf

[12] X. Tang and Y. Hua, "Optimal design of non-regenerative MIMO wireless relays," *IEEE Trans. Wireless Commun.*, vol. 6, no. 4, pp. 1398– 1407, Apr. 2007.

[13] O. Mu˜noz-Medina, J. Vidal, and A. Agust´ın, "Linear transceiver design in nonregenerative relays with channel state information," *IEEE Trans. Signal Process.*, vol. 55, no. 6, pp. 2593–2604, Jun. 2007.

[14] W. Guan, H. Luo, and W. Chen, "Linear relaying scheme for MIMO relay system with QoS requirements," *IEEE Signal Process. Lett.*, vol. 15, pp. 697–700, 2008.

[15] A. Behbahani, R. Merched, and A. M. Eltawil, "Optimizations of a MIMO relay network," *IEEE Trans. Signal Process.*, vol. 56, no. 10, pp. 5062–5073, Oct. 2008.

[16] Y. Rong, X. Tang, and Y. Hua, "A unified framework for optimizing lin-ear nonregenerative multicarrier MIMO relay communication systems," *IEEE Trans. Signal Process.*, vol. 57, no. 12, pp. 4837–4851, Dec. 2009.

[17] B. Khoshnevis, W. Yu, and R. Adve, "Grassmannian beamforming for MIMO amplify-and-forward relaying," *IEEE J. Sel. Areas Commun.*, vol. 26, no. 8, pp. 1397–1407, Oct. 2008.

[18] Z. Fang, Y. Hua, and J. D. Koshy, "Joint source and relay optimization for non-regenerative MIMO relay," in *Proc. IEEE Workshop Sensor Array Multi-Channel Signal Processing*, Waltham, WA, Jul. 12-14, 2006, pp. 239–243.

[19] Y. Fu, L. Yang, W.-P. Zhu, and Z. Yang, "A convex optimization design of relay precoder for two-hop MIMO relay networks," in *Proc. IEEE ICC*, Cape Town, South Africa, May 23-27, 2010.

[20] Y. Rong, "Non-regenerative multicarrier MIMO relay communications based on minimization of mean-squared error," in *Proc. IEEE ICC*, Dresden, Germany, Jun. 14-18, 2009, pp. 1–5.

[21] T. M. Cover and J. A. Thomas, *Elements of Information Theory*. New York: John Wiley & Sons, Inc., 1991.

[22] D. J. Love, R. W. Heath, W. Santipach, and M. Honig, "What is the value of limited feedback for MIMO channels?" *IEEE Commun. Mag.*, vol. 42, no. 10, pp. 54–59, Oct. 2004.

[23] R. A. Horn and C. R. Johnson, *Matrix Analysis*. New York, NY: Cambridge University Press, 1990.

