Optimal Control Distribution in Multi-Relay MIMO Support Networks

K.Swathi[1], Dr.R.V.Krishnaiah[2]

[1]M.Tech Student, [2] PG Coordinator

[1]Dept of CS, [2]Dept of CSE

[1]DRK College of Engineering & Technology, Hyderabad, Andhra Pradesh, India

[2]DRK Institute of Science and Technology, Hyderabad, Andhra Pradesh, India

ABSTRACT:

Cooperative networking in latest years has established a considerable interest from the wireless networking research community. Many interesting problems for cooperative networks have been energetically researched. Due to inadequate incredible understanding of the optimal authority provision structures in multiple-input multiple output (MIMO) supportive networks, these two constraints are interrelated. In this paper, we study the structural properties of the optimal authority provision in MIMO-CN with per-node power constraints. In particular, the optimal control distributions at the supply and each transmit follow a matching structure in multiple-input multiple output Cooperative networks (MIMO-CN) is shown in this paper. To the multi-relay setting, the power provision result is comprehensive under the basic three-node setting, for which the optimal authority provision structure has been heretofore unknown. Due to cooperative relay and set up a connection between accommodating relay and pure relay by specifying the performance. Finally, we decrease the MIMO-CN rate maximization problem to a comparable scalar formulation based on these structural imminent. Further a global optimization method is proposed to solve this simplified and corresponding problem.

Keywords: ***Optimal Control Distribution, multiple-input multiple output (MIMO), Multi Relay, and Mid-Hop.***

1. INTRODUCTION:

Cooperative networking in recent years has received significant attention from the wireless networking research community [1] [2]. Many interesting problems for cooperative networks have been vigorously researched [3] [4]. On optimizing the performance of cooperative networks the majority of the works are limited by the first fundamental three-node relay scheme. The basic three-node relay scheme is where the message transmitted from source X to destination Y is relayed by a node N, which can overhear the message is shown in Fig 1. However, the message from the source is likely to be overheard by multiple neighboring nodes in an ad hoc network environment [5]. Relay assignment is a common cooperative approach in this situation i.e., we choose only one of the neighboring nodes as a relay for which the three-node relay scheme can be applied. To further improve the system performance, this relay assignment scheme is clearly despite its simplicity, suboptimal since all such neighboring nodes can potentially serve as relays single-antenna systems. Research on cooperative networks with multiple-input multiple output (MIMO) enabled nodes remains limited in the current literature [6] [8].

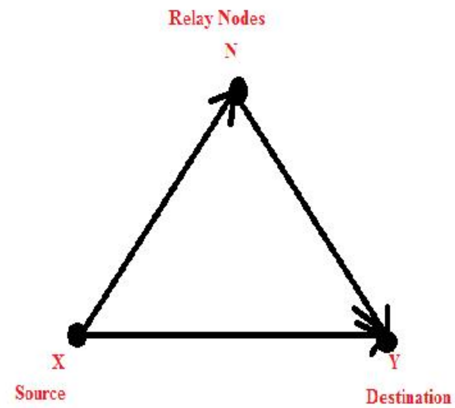

Fig 1: The Three Node Method

2. CONCEPT OF COOPERATIVE NETWORKS:

It is interesting to explore the idea of deploying multiple antennas at each node in cooperative networks. By exploiting the inherent independent spatial channels with multiple antennas, the source and the relays can multiplex independent data streams. As the above two limitations are apparently unrelated, they are in fact both associated with the partial theoretical understanding of multiple-input multiple output cooperative networks (MIMO-CN) [7]. The single-antenna multi-relay network is considered so that we can treat all single-antenna relays N1….. NV as a single virtual relay node with V antennas is shown in Fig 2. In this sense, to analyzing a three-node cooperative network with a MIMO enabled relay is analyzed by this multi-relay network which is closely related. The optimal power allocation at the source and each relay to maximize the end-to-end achievable rate of multi-relay MIMO-CN is considered in this paper. Our focus is on the amplify-and-forward (AF) relay strategy. Since no decoding/encoding is needed so an obvious reason is that AF has low complexity. Where decoding multiple data streams could be computationally intensive as the benefits are even more attractive in MIMO- CN. In terms of network capacity scaling a more important reason in addition to simplicity is that AF outperforms decode-and-forward (DF): in general, the effective signal-to-noise ratio (SNR) under AF scales linearly increases with the number of relays in MIMO-CN, and as opposed to being a constant under DF. The outcome of this work are : First, at each relay follows a matching structure based on the optimal power allocation is shown here: To the multi-relay setting the matching structure is generalized under the basic three-node setting, for which the optimal power allocation structure has been heretofore unknown. Due to the more complex per-node power constraint, we remark that our finding is not a straightforward extension of the "matching structure" in the three-node relay setting. As a result, the identical organization in our case requires a new proof. Second is, we establish the relationship between MIMO-CN and multi hop MIMO networks with pure relay links by analyzing the channel structures in MIMO-CN.

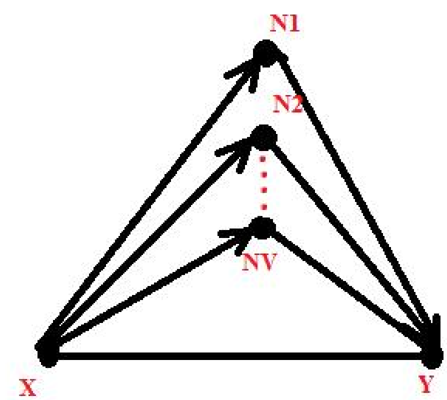

Fig2. A Supportive Network with Multiple Relays

The performance gain due to cooperative relay is specifically enumerated [9]. This result is novel because it simplifies the proof of the optimal control distribution structure under Cooperative relay and it is the first result that connects cooperative relay and pure relay in a multi-relay setting, which further advances our understanding of the benefits of cooperative communications. Third is, we reduce the MIMO-CN rate maximization problem to an equivalent scalar formulation which is based on the above structural insights. We propose a global optimization algorithm based on a branch-and-bound framework coupled with a custom-designed convex programming relaxation and we analyze the structure and convexity properties of the equivalent problem, which guarantees finding a global optimal solution for this non convex problem.

3. OPTIMAL RELAY AMPLIFICATION MATRIX:

Several initial attempts on extending cooperative networking to MIMO have been reported and recognized by the benefits of cooperative networking. The optimal relay amplification matrix for the basic three-node MIMO-CN is considered under the assumption that the source-relay channel state information (CSI) is unknown [10]. Their main conclusion is that the optimal amplification matrix adopts a “matching” structure as the direct link between the source and the destination is not present. The matching result to the three-node MIMO-CN network where the source has full CSI is generalized here in this paper. Recent works on MIMO-CN started to consider more complex relay settings. The MIMO-CN with amplify and forward (AF) relays is similar to our setting. However, each relay has its own power budget and their work differs from ours in that they assumed a sum power constraint across all relay nodes which are usually not realistic. Thus, a per-node power constraint on each relay is more appropriate and imposing a per-node power constraint results in a more demanding control distribution problem. It is worth pointing out that the three nodes multi-carrier MIMO-CN considered can also be viewed as a MIMO-CN with multiple relays. The major difference is that each source-relay destination path operates under orthogonal channels that do not cooperate with each other compared to our network setting. This yields a more obedient problem, which can be thought of as a special case of the model we consider in this paper.

4. CONSEQUENCES AND CONTRIBUTION:

The optimal power distribution at each relay follows an identical structure: the diagonalization of each relay’s extension matrix matches with certain Eigen directions of the joint source-relay and relay-destination channels. By simplifying the matching structure under the basic three-node setting to the multi-relay setting, for which the optimal power distribution structure has been heretofore unknown. A relationship between MIMO-CN and multi hop MIMO networks was analyzed by the channel structures in MIMO-CN and establish the with pure relay links. Due to cooperative relay we specifically quantify the performance gain because it simplifies the proof of the optimal power distribution structure under CR and it is the first result that connects cooperative relay and pure relay in a multi-relay setting. We investigate the structure and convexity properties of the corresponding problem, and then propose a global optimization algorithm based on a branch-and-bound framework coupled with a custom-designed convex programming relaxation, which finds a global optimal solution for this non convex problem.

5. RESULTS:

The number of Branch and Bound framework iterations depends on the number of variables, which is in turn determined by the number of per-node antennas. Hence, we imagine that the number of per-node antennas has a more direct impact than the number of relays does. The number of Branch and Bound framework iterations depends on the number of per-node antennas. We note that the Branch and Bound framework process converges reasonably fast for practical numbers of antennas. On the other hand, we also evaluate the scaling of the number of Branch and Bound framework iterations with respect to the number of relays.

6. CONCLUSION:

In this paper, to solve the optimal control distribution problem we have investigated the structural properties of optimal power allocation in multi-relay MIMO-CN and designed algorithms. With per-node power constraints, the matching results are generalized under the basic three-node setting to the multi-relay setting, for which the optimal power allocation has been heretofore unknown. The connection between cooperative relay and pure relay is enumerated by the performance gain due to cooperative relay. To equivalent scalar form based on the derived structural insights, we have reduced the MIMO-CN rate maximization problem, 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. With multiple relays, our results in this paper offer an important systematic tools and insights to fully utilize the potential of AF based MIMO-CN. More importantly, the fundamental non convex difficulties encountered in large-scale MIMO cooperative networks are overcome by our proposed global optimization approach.

REFERENCES:

[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," *Advanced 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.

BIOGRAPHY:

K.Swathi has completed MCA from Nava Bharathi College of PG studies and pursuing M.Tech(C.S) in DRK Institute of Science and Technology, JNTU, Hyderabad, Andhra Pradesh, India. Her main research interest includes Mobile Communications & Computer Networks.

Dr.R.V.Krishnaiah, MTech(EIE), MTech(CSE), Ph.D,MIE,MIETE, MISTE Principal & DRK Institute of Science and Technology, Hyderabad, Andhra Pradesh, India. His main research interests include computer networks, Data mining, Network Protection and Security Control. She has various publications and presentations in various national and international journals.