Constellation Rearrangement in Cooperative Relay-HARQ Network

Abstract—We study the constellation rearrangement (CoRe) problem in a relay-HARQ network to achieve symbol mapping diversity for reliable communication. Specifically, we formulate the bit error rate (BER) maximization into a quadratic three-dimensional assignment problem (Q3AP) and make use of the recent development of numerical method to find the optimal CoRe solution. Performance gains on various channel settings are demonstrated with simulations.

I. INTRODUCTION

In modern wireless communication systems, Automatic Repeat reQuest (ARQ) or Hybrid ARQ (HARQ) are recognized as key technologies for reliable transmission. HARQ comined with relay networks has attracted great research interest in recent years []. Since in practice the transmitted symbols are modulated from a finite-size constellation (e.g., PSK, QAM), the performance of cooperative relay-HARQ system can be further enhanced with Constellation Rearrangement (CoRe) [].

There are a wide variety of works on CoRe for cooperative relay-HARQ systems with different channel settings and design criteria.

Nevertheless, since the CoRe problem is usually formulated into a binary linear programming (BIP) problem, which is known to be one of Karp's 21 NP-complete problems [], the abovementioned problems are usually solved with very heuristic approaches [], or by impractically dropping the binary constellation mapping constraints [].

Historically, various CoRe problem for HARQ system fall within the realm of Quadratic Assignment Problem (QAP) or its extensions like Quadratic 3-dimensional Assignment Problem (Q3AP) []. Recent development in the numerical approaches to QAP/Q3AP [] has enbaled us to efficiently derive CoRe schemes with high quality.

In this work, we

II. SYSTEM MODEL AND PROBLEM FORMULATION

III. OPTIMAL CONSTELLATION REARRANGEMENT

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A. BER Maximization via Q3AP solution

B. Computation of the Pair-wise Symbol Rate

C. Q3AP Solution

IV. NUMERICAL RESULTS

V. CONCLUSION

REFERENCES

[1] H. L. Koch, "Some personality correlates of sex, sibling position, and sex of sibling among five-and six-year-old children." *Genetic Psychology Monographs*, 1955.