Ganesh Venkatraman

From: onbehalfof+pesavento+nt.tu-darmstadt.de@manuscriptcentral.com on behalf of pesavento@nt.tu-darmstadt.de
Sent: Tuesday, December 23, 2014 2:05 AM
To: gvenkatr@ee.oulu.fi
Cc: pesavento@nt.tu-darmstadt.de; gvenkatr@ee.oulu.fi; antti.tolli@ee.oulu.fi; ltran@eeng.nuim.ie; tranlnam@yahoo.com; markku.juntti@ee.oulu.fi
Subject: ((R)) (Reject and Resubmit as Regular paper) - T-SP-18051-2014 - IEEE Transactions on Signal Processing - "Traffic Aware Resource Allocation Schemes for Multi-Cell MIMO-OFDM Systems"
Attachments: TSP2014_MIMOprecoding_review.pdf

22-Dec-2014

Mr. Ganesh Venkatraman
University of Oulu
Erkki Koiso Kanttilan Katu 3
Oulu
Oulu
Finland
90014

Manuscript: T-SP-18051-2014 "Traffic Aware Resource Allocation Schemes for Multi-Cell MIMO-OFDM Systems"

Dear Mr. Ganesh Venkatraman,

Your manuscript, T-SP-18051-2014 "Traffic Aware Resource Allocation Schemes for Multi-Cell MIMO-OFDM Systems", which you submitted to the Transactions on Signal Processing has been reviewed. The comments from the reviewers are included at the bottom of this letter (**See note below about attachments). As you will see I have received reviews from 4 reviewers that were returned as RQ, R, RQ, RQ. All reviewers state that the topic of buffer/traffic aware resource allocation is a challenging and timely problem that is of great importance and requires further research. In this aspect the reviewers expressed their interest in the algorithms proposed in the paper. However the reviewers have also provided a large number of substantial comments and requests concerning the technical aspects and the organization of the paper among which the request to carry out a rigorous convergence analysis has been mentioned most prominently. In view of the criticisms and the concerns regarding the technical rigor and correctness that have been raised by all the reviews I unfortunately have to reject the paper from publication in its current form. I however want to strongly encourage you to resubmit the manuscript if you can address all the reviewers' comments and revise your manuscript accordingly.

Your new manuscript may be submitted back to Manuscript Central https://mc.manuscriptcentral.com/tsp-ieee together with a point-by-point reply that explains how you addressed the reviewers' comments.

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If you have any questions, please contact the Admin for this journal Rebecca Wollman at r.wollman@ieee.org.

Sincerely,

Prof. Marius Pesavento
Associate Editor
IEEE Transactions on Signal Processing
pesavento@nt.tu-darmstadt.de

Rebecca Wollman
Coordinator Society Publications
IEEE Signal Processing Society
r.wollman@ieee.org

** {This applies to SUBMITTING AUTHOR Accounts ONLY: You can find any possible ATTACHMENTS FROM THE REVIEWERS by going to the "Manuscript with Decisions" status link in your Author Center and clicking on "view decision letter". They are located at the bottom of decision letter under "Files attached" heading}

Reviewer Comments:

Reviewer: 1

Recommendation: RQ - Review Again After Major Changes

Comments:
Please refer to the attachment for detailed comments.

Additional Questions:
1. Is the topic appropriate for publication in these transactions?: Yes

2. Is the topic important to colleagues working in the field?: Moderately So

Explain:

1. Is the paper technically sound?: Yes

why not?:

2. Is the coverage of the topic sufficiently comprehensive and balanced?: Important Information is missing or superficially treated.

3. How would you describe technical depth of paper?: Suitable only for an expert

4. How would you rate the technical novelty of the paper?:

1. How would you rate the overall organization of the paper?: Could be improved

2. Are the title and abstract satisfactory?: Yes

Explain:

3. Is the length of the paper appropriate? If not, recommend how the length of the paper should be amended, including a possible target length for the final manuscript.: Yes

4. Are symbols, terms, and concepts adequately defined?: Not always

5. How do you rate the English usage? : Satisfactory

6. Rate the Bibliography: Satisfactory

null:

1. How would you rate the technical contents of the paper?: Fair

2. How would you rate the novelty of the paper?: Slightly Novel

3. How would you rate the "literary" presentation of the paper?: Totally Accessible

4. How would you rate the appropriateness of this paper for publication in this IEEE Transactions?: Good Match

Reviewer: 2

Recommendation: R - Reject (Paper Is Seriously Flawed; Do Not Encourage Resubmission.)

Comments:
Comments on the Recommendation:

The logic from (6) to (16) is not clear. The only difference is the two newly introduced NON-CONVEX constraints (16b) and (16c), while the objective function (16a) and the constraint (16d) is the same as (6). The equivalence between (6) and (16) is not straightforward and it is confusing why the reformulation in (16) is beneficial.

The authors use the successive convex approximation framework, but the approximate problem proposed by the authors is actually not convex. Inspecting (19), its objective function is the same as in (6), and the non-convexity of (6) comes exactly from the objective function, so (19) is not a convex problem. The same flaw is repeated several times in the approximate problems proposed by the authors.

The authors proposed to use block coordinate descent method to solve (16). But as the authors have already pointed out, to apply block coordinate descent method, the constraint sets for different variables should be disjoint (uncoupled), which is however not the case in (16), because receive and transmit precoders (i.e w and m) are coupled in the constraints. It is confusing on its own why the authors made a statement that contradicts the proposed methodology, and the convergence followed is in question.

Regarding the convergence of the SCA, the authors cited [27] for the convergence conditions, but the reference is wrong, because the conditions after the three bullets on page 6 are not mentioned in [27]. In case the authors disagree, please make the citation more specific, for example, specify the theorem/statement/proposition in [27] where those conditions are specified.

The authors also cited [28] to establish the convergence of SCA. But the techniques of [27] and [28] are different, and the convergence conditions are different too. It is not clear why the authors need two set of convergence conditions for a single problem, and the resulting convergence analysis itself is not solid enough.

Another comment on reference: to the reviewer's knowledge, the term SCA is never explicitly used in [2]. So please either correct the reference or be more specific (section, theorem, etc.).

The authors propose primal decomposition method, ADMM approach to the non-convex problem (19), while their convergence analysis is based on literature that proved convergence for convex problems only, e.g., [13]. So the convergence analysis is not trustworthy.

Given the above comments, the reviewer is very skeptical on the technical correctness and the paper should be rejected.

Additional comment on content:

The length of the paper is too extensive. Some of the reformulations as mentioned in the previous comment can be skipped. Also, Section III.D. is not deeply explained and does not bring additional value to the paper. The implications of ordering the sub-channels for the iterative approach should be carefully studied and extensively explained in a different publication.

Information regarding the value of q used to obtain the simulation results is missing (with exception of Fig. 3).

In Fig. 1 and Fig. 2, the labels for the system model do not fit with the written description. Additionally, the reference scheme Q-WSRM is not optimal, since it over allocates resources if there are few queued packets. Therefore, it is not interesting for comparison purposes.

Assuming that Fig. 2 and Fig. 3 where obtained based on the same simulation setup, i.e. user queues, number of transmit and receive antennas and number of base stations, it is not clear why results in Fig. 3 are worse than Fig. 2 when comparing JSFRA. Even more, since the number of sub-channels is larger in Fig. 3, the result seems contradictory.

Additional Questions:
1. Is the topic appropriate for publication in these transactions?: Yes

2. Is the topic important to colleagues working in the field?: Yes

Explain:

1. Is the paper technically sound?: Yes

why not?:

2. Is the coverage of the topic sufficiently comprehensive and balanced?: Important Information is missing or superficially treated.

3. How would you describe technical depth of paper?: Appropriate for the Generally Knowledgeable Individual Working in the Field or a Related Field

4. How would you rate the technical novelty of the paper?: Somewhat Novel

1. How would you rate the overall organization of the paper?: Satisfactory

2. Are the title and abstract satisfactory?: Yes

Explain:

3. Is the length of the paper appropriate? If not, recommend how the length of the paper should be amended, including a possible target length for the final manuscript.: No

4. Are symbols, terms, and concepts adequately defined?: Not always

5. How do you rate the English usage? : Needs improvement

6. Rate the Bibliography: Unsatisfactory (explain):

null: See Comments to the Author, below

1. How would you rate the technical contents of the paper?: Fair

2. How would you rate the novelty of the paper?: Sufficiently Novel

3. How would you rate the "literary" presentation of the paper?: Partially Accessible

4. How would you rate the appropriateness of this paper for publication in this IEEE Transactions?: Poor Match

Reviewer: 3

Recommendation: RQ - Review Again After Major Changes

Comments:
This manuscript focuses on the beamforming and scheduling optimization for IBC MIMO-OFDM system, including the centralized and decentralized optimization methods. This is an interesting and important topic.

However there are some problems in technical details.

1. The number of transmitted packets t_k's are optimization variables, which should be explicitly stated in the problem formulation of (6), (16), (19), (20) and (26) to avoid confusing.

2. The manuscript states that the inequalities (16b) and (16c) achieve equality at optimality(line 23, page 5). This is not obvious. An easy case to check this statement is that assuming the system has two BS and each BS serves one user. When Q_1=0 and 2nd BS has sufficienlty large power, (16b) and (16c) donot hold equality. Rigorous proof is needed if authors stick to this statement.

3. The solution in (21) is obtianed for MMSE, i.e. for 2-norm(q=2). If q=1 or q=\infty, it is actually an equivalent linear programming problem. Details for this solution should be provided.

4. The convergencde proof need to be rigorous. The inequality of (23a) is opposite to the referrence [28]. Also the statement on uniqueness of the transmit and the receive beamformers are not correct. Although we can choose one antenna to be real value, this does not mean the problem has unique solution!

5. (25) is generally wrong. (25) only holds when the MSE is minimized(by MMSE receiver) and the snr is the optimized(which is obtained by general eignvalue decompostion). This is clearly stated in the reference [5] and [6]. This can also be easily checked by comparing (25) and (2). Consequently the alternative formulation (26) based on this conclusion is questionable.

6. For ADMM aproach, the determination of the value of \rho in equation (35a) should be discussed. 1. The numbers of transmitted packets for users t_k's are optimization variables. So they should be explicitly stated in the problem formulation (6), (16), (20) and (26) to avoid confusing.

Additional Questions:
1. Is the topic appropriate for publication in these transactions?: Yes

2. Is the topic important to colleagues working in the field?: Yes

Explain:

1. Is the paper technically sound?: No (why not?)

why not?: rigorous convergence proof are missing; there exist errorneous statement

2. Is the coverage of the topic sufficiently comprehensive and balanced?: Yes

3. How would you describe technical depth of paper?: Appropriate for the Generally Knowledgeable Individual Working in the Field or a Related Field

4. How would you rate the technical novelty of the paper?: Somewhat Novel

1. How would you rate the overall organization of the paper?: Satisfactory

2. Are the title and abstract satisfactory?: Yes

Explain:

3. Is the length of the paper appropriate? If not, recommend how the length of the paper should be amended, including a possible target length for the final manuscript.: Yes

4. Are symbols, terms, and concepts adequately defined?: Yes

5. How do you rate the English usage? : Satisfactory

6. Rate the Bibliography: Satisfactory

null:

1. How would you rate the technical contents of the paper?: Fair

2. How would you rate the novelty of the paper?: Slightly Novel

3. How would you rate the "literary" presentation of the paper?: Totally Accessible

4. How would you rate the appropriateness of this paper for publication in this IEEE Transactions?: Weak Match

Reviewer: 4

Recommendation: RQ - Review Again After Major Changes

Comments:
Venkatraman, Tolli, Tran, Juntti, "Traffic Aware Resource allocation Schemes for Multi-Cell MIMO-OFDM Systems", IEEE TSP == This paper proposes a practical method for minimizing the number of currently backlogged packets in a wireless multicell MIMO-OFDM network. Resource allocation is performed over space (beamformers) and frequency (subcarriers), and a norm of the queue deviations is minimized. The problem studied is very relevant, but still most work in the literature has so far focussed on the infinite queue model which clearly does not reflect reality particularly well. The proposed methods seem practical, due to their possibility to be implemented as distributed methods coupled with distributed CSI acquisition. The paper has a multitude of approaches to the problem, but there are several areas which must be improved before a possible publication.

First, this reviewer is not convinced by the arguments for showing the convergence of the JSFRA method. "The SCA method" is often referred to, but never really defined or referenced. The three required conditions (as stated on p. 6, col. 1, rows 38-40) do not, as far as I can tell, appear in [27]. Indeed, [27] is concerned with optimization problems where the objective function is non-convex, but the constraint set is convex and separable over the blocks of variables. Perhaps you meant to cite [A], wherein non-convex constraints are handled in a similar way? Numerically, the algorithms do converge, and the argument put forward makes sense, but the treatment must be improved to be more rigorous.

Second, the optimization problems formulated only depend on Q_k, the current levels of backlogged packets, and not on the arrival rates. This is due to how the conditional Lyapunov drift is minimized. This approach completely removes the queue dynamics from the optimization problem, essentially leading to greedy one-shot optimization in

every time instant. The framework would be more interesting if some sort of optimization (or tracking) is performed over several time instants, rather than the one-shot approach that is currently used for the JSFRA algorithms. Possibly, some expectation over the queues would be optimized then. Even if no analytical treatment of the tracking over several time-steps is added, I would at least highly recommend adding some simulation results where the proposed one-shot algorithms are performed sequentially over several time instants.

Third, the distributed methods (at least the primal decomposition and ADMM) seem to be fairly straight-forward applications of existing results. This reviewer recommends spending more space on the convergence, than on the description of the distributed techniques. Still, it would be nice with a direct description of what local CSI is required, and how it is acquired, to perform the local computations for the primal decomposition and ADMM methods. For the description of the signaling of the CSI in Sec. IV-B, are you envisioning a TDD system?

Finally, some readers might be confused by the "joint space-frequency" terminology, believing that the beamforming is performed over a joint space-frequency channel space, where the space-frequency channels are formed by block-diagonal matrices, each block belonging to one subcarrier. This could easily be clarified.

The paper is studying a relevant problem, and the proposed methods have merits. The aspects above need improvement however, and thus I recommend that a major revision is returned.

Minor comments
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- p. 1, col. 1, row 42: "userss"
- p. 1, col. 2, row 18: the precoders are used _implicitly_ as decision variables. This is the whole point, to avoid explicitly modeling the hard decisions in the optimization, and instead do soft decisions during the iterations, and then finally hard decisions after convergence.
- p. 1, col. 2, row 33: Which chapter in [2] is referred to? With a quick look-through of the table of contents, I can't find and chapter or section treating the SCA method?
- p. 2, col. 2, row 36: Write $\text{rank}(.)$ and $\min$ instead
- p. 3, col. 1, row 26: It would be more clear to explicitly write out the dependence of $\mathbf{M}$ and $\mathbf{W}$ in $\tilde{v}$ here
- p. 3, col. 2, row 26: Which general MIMO-OFDM problem are you talking about here, and what is combinatorial about it? Is it the problem of selecting users to be served on orthogonal subcarriers? There is nothing inherently combinatorial over the problem in (6) as far as I can tell, as the beamformers are used as soft decision variables.
- p. 4, col. 2, row 40: "In fact, (5) provides similar expression of ..." This sentence is very hard to understand.
- (16d): suggest your write out the power constraints here, in order to be faster be able to interpret the optimization problem. There is hardly any spaced saved by referring back to (6b).
- p. 5, col. 1, rows 27-30: Here you might want to quickly mentioned how one could show the NP-hardness of (16).
- p. 5, col. 1, row 50: "According to the SCA method...". I am not sure exactly how you define "_the_ SCA method"? Clarify or cite the definition.
- p. 5, col. 2, row 31: Here is a case where it makes sense to reference earlier optimization constraints. However, are (19d) and (18) not the same??
- p. 5, col. 2, row 51: Slightly confusing with the notation between the iterates in (21b) and the MMSE filter in (22b).
- p. 6, col. 1, row 9: You might want to add somewhere that (22b) can be used instead of the fixed-point of (21b), since the scaling of the receive filters do not matter in the SINRs. However, does it affect the convergence of the algorithm?
- p. 6, col. 1, row 37: Are you sure that you should cite [27], and not [A]? In [27], a non-convex objective function over a convex constraint set is treated. In [A], a non-convex objective function over a non-convex constraint set is treated.
- p. 6, col. 2, rows 8-10: I don't fully understand the reasoning on the relation between the constraint sets in the different iterations. Why is this the case?
- p. 7, col. 1, row 35: Just because a problem is convex does not mean that it has a unique solution. (Although it seems to me that (26) should have a unique solution.) Is the problem in (26) strictly convex?
- Table 1: "backpreassure"
- p. 11, col. 1, row 56: "performances". I'm not sure this is a countable noun.

References

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[A] Scutari, Facchinei, Lampariello, Song, "Distributed Methods for Constrained Nonconvex Multi-Agent Optimization -- Part I: Theory", arXiv:1410.4754v1

Additional Questions:
1. Is the topic appropriate for publication in these transactions?: Yes

2. Is the topic important to colleagues working in the field?: Yes

Explain:

1. Is the paper technically sound?: Yes

why not?:

2. Is the coverage of the topic sufficiently comprehensive and balanced?: Treatment somewhat unbalanced, but not seriously so.

3. How would you describe technical depth of paper?: Appropriate for the Generally Knowledgeable Individual Working in the Field or a Related Field

4. How would you rate the technical novelty of the paper?: Somewhat Novel

1. How would you rate the overall organization of the paper?: Satisfactory

2. Are the title and abstract satisfactory?: Yes

Explain:

3. Is the length of the paper appropriate? If not, recommend how the length of the paper should be amended, including a possible target length for the final manuscript.: Yes

4. Are symbols, terms, and concepts adequately defined?: Yes

5. How do you rate the English usage? : Satisfactory

6. Rate the Bibliography: Satisfactory

null:

1. How would you rate the technical contents of the paper?: Fair

2. How would you rate the novelty of the paper?: Slightly Novel

3. How would you rate the "literary" presentation of the paper?: Mostly Accessible

4. How would you rate the appropriateness of this paper for publication in this IEEE Transactions?: Good Match