Prof. Liang Xiao
Editor
IEEE Transactions on Communications

Re: Decision on TCOM-TPS-20-1501 (IRS-Aided SWIPT: Joint Waveform, Active and Passive Beamforming Design Under Nonlinear Harvester Model)

Dear Prof. Liang Xiao and Reviewers,

We would like to express our appreciation for the time and effort dedicated to the reviewing of our paper. The manuscript has been revised carefully based on your valuable comments and suggestions. In particular, we clarified the motivations and contributions of this work, proved the unit-rank property of the obtained IRS matrix, added two low-complexity designs with near-optimal rate-energy performance, and considered the cases of imperfect cascaded CSIT and finite IRS reflection states. To answer the questions and concerns, we also include a point-to-point response below, which also describes all modifications made to the manuscript. We hope that the revisions are to the satisfaction of the editor and reviewers.

Best Regards,

Yang Zhao, Bruno Clerckx and
Zhenyuan Feng

Reviewer 1

Comment 1.1 — *As this paper proposed a BCD-based algorithm and LC-BCD algorithm, it could be better if the authors can further discuss the complexity and provide some measurements or some simulation results.*

Response: TODO

Comment 1.2 — *Since this paper focused on IRS-aided SWIPT systems, it could be better if the authors can further enrich the survey part to make the paper more comprehensive. In particular, some papers have considered this kind of problem from a different aspect such as [R1]. It is kindly suggested to briefly discuss the main difference between [R1] and the problem considered in this paper.*

Response: TODO

Comment 1.3 — *It could be better if the authors can provide some references for the parameter values chosen in the simulation part.*

Response: TODO

Comment 1.4 — *The reviewer noticed that in Algorithm 5, there are two convergence criteria. It could be better if the authors can briefly interpret this issue.*

Response: TODO

Reviewer 2

Comment 2.1 — *Although this paper reveals many useful insights, most of them are obtained via simulation and then explained via text. The overall theoretical contributions can be greatly improved if the authors can analytically verify or prove some of them, especially those unique to this paper. The authors may conduct the analysis under some simplified or special cases. If some of the observations and findings have been verified in existing papers, the authors can cite and echo these papers wherever necessary.*

Response: TODO

Comment 2.2 — *The authors are suggested to study the impact of IRS passive beamforming on the waveform design without IRS. For example, they can show the optimized waveforms with versus without IRS to unveil the interplay between them. Or even better, analytically compare the two waveforms.*

Response: TODO

Comment 2.3 — *In the introduction, it is suggested to also discuss the new design challenges posed by the nonlinear model compared to the existing designs under the linear model.*

Response: TODO

Comment 2.4 — *In (14), the authors integrated the waveform design and active beamforming design into w_I and w_P. However, they separately optimized them later. Is it possible to directly optimize w_I and w_P as a whole?*

Response: TODO

Comment 2.5 — *In the low-complexity BCD, it is unclear how the authors dealt with the optimization of ρ and δ. In Algorithm 5, both of them are input. Did the authors perform a two-dimensional search here? Besides, they were assumed to be identical in the simulation. How will this assumption influence the performance loss?*

Response: TODO

Comment 2.6 — *If possible, in Fig.11, the authors can show the performance of the design under the conventional linear harvester model, so as to show how much performance loss it would incur.*

Response: TODO

Comment 2.7 — *It was shown via simulation that PS is not always superior to TS, unlike the linear model. Is it possible to develop some analytical preconditions to determine which one is better?*

Response: TODO

Comment 2.8 — *Is it possible to give the complexity order of the algorithms presented in this paper?*

Response: TODO

Comment 2.9 — *The expressions of signals in (1), (2), and (5) are not conventional. It may be better to give a per-band signal instead of their superposition. Besides, it is better to first introduce the functionalities of the modulated and multisine waveforms before giving (1).*

Response: TODO

Comment 2.10 — *In Remark 2, the meaning of the sentence, "there exists a tradeoff for auxiliary link control in the frequency domain", is not clear to me.*

Response: TODO

Comment 2.11 — *Some editorial comments: 1) "a (–>an) M-antenna"; 2) "through a (–>an) L-element IRS"; 3) "the CSIT of direct and cascaded channels are (–>is) known"; 4) "It demonstrated (–>demonstrates) that"; 5) In Figs. 9(b) and 10(b), the text in the y-axis is too long. Please divide it into two rows. Besides, the text in the x-axis of the upper figure is covered by the lower one.*

Response: TODO

Reviewer 3

Comment 3.1 — *Proposition 5 is questionable. The algorithm may not converge to a local optimal due to the coupling constraint 14b.*

Response: TODO

Comment 3.2 — *The figures are too small. For example, Fig 10, the axis legend is not fully shown.*

Response: TODO

Comment 3.3 — *It is said that the reference path loss is -35 dB at 1m, while for the center frequency at 5.18 GHz, even adopting the free space path loss model also will lead a much sever path loss at 1 m. It is not clear how the authors calculate this.*

Response: TODO

Comment 3.4 — *The authors considered the practical reflection coefficient beamforming in the simulkation results. It is not cleaer how the authors obtain the discrte phase shift results. Direct quantization method and some other customized optimization technqiues for discrete phase shifts may have significant performance gap, see [R2]. Also, this work adopts the same uniform quantization as the above work, which thus needs to be clarified in the paper.*

Response: TODO

Comment 3.5 — *There are also some other practical phase shift models and nonlinear energy harvesting models such as saturation model for IRS-aided SWIPT in existing works, which may be discussed as related works such as amplitude-dependent phase shift model.*

Response: TODO

Comment 3.6 — *Some early magazine papers and recent tutorial papers related to IRS-aided WPT/WIT may be further discussed.*

Response: TODO

Reviewer 4

Comment 4.1 — *What is the computational complexity of the proposed algorithm?*

Response: TODO

Comment 4.2 — *Some related works are worth citing, such as [R3].*

Response: TODO

References

[R1] D. Xu, V. Jamali, X. Yu, D. W. K. Ng, and R. Schober, "Optimal resource allocation design for large irs-assisted swipt systems: A scalable optimization framework," *arXiv preprint arXiv:2104.03346*, pp. 1–30, 2021.

[R2] Q. Wu and R. Zhang, "Beamforming optimization for wireless network aided by intelligent reflecting surface with discrete phase shifts," *IEEE Transactions on Communications*, vol. 68, no. 3, pp. 1838–1851, Mar. 2020.

[R3] H. Yang, Z. Xiong, J. Zhao, D. Niyato, L. Xiao, and Q. Wu, "Deep reinforcement learning-based intelligent reflecting surface for secure wireless communications," *IEEE Transactions on Wireless Communications*, vol. 20, no. 1, pp. 375–388, 2021.