Referee report for the manuscript "Robust Feasibility of Systems of Quadratic Equations Using Topological Degree Theory"

1. **Uncertainty set modeling**

1) The authors adopt an interval uncertainty set shown in (3) to describe the uncertainty of parameters in $\mathbf{u}$, where u_i is restricted over an given interval $\left[u_i^{\min}, u_i^{\max}\right]$. Under such an interval uncertainty set, the worst-case realization leading to the maximum constraint violation will be straightforward, since u_i will either takes its minimum or maximum value. Additionally, it is noteworthy that it is unlikely that all the uncertain parameters will be imposed their maximum possible fluctuations. To overcome this issue, previous study has developed some other more practical uncertainty sets, like polyhedral set with uncertainty budget constraint and ellipsoidal set. The authors are thus invited to explain whether their proposed method can be extended to other types of uncertainty sets which are more general. If not, I suggest the authors briefly discuss the major challenges restricting the generality of their method, as well as pointing out that this could be a possible research direction in the future.

2) The authors only consider the uncertainty in quadratic equation constraints. What if the quadratic terms also appear in an inequality constraint? What if the uncertainty also exists in linear constraints (2) (b_i is also subject to uncertainty)? Whether your method is still applicable in these cases?

2. **Robustness margin**

1) The description of robust margin is confusing for me. It is clear that the larger fluctuation on u_i is imposed (higher value of e_i), the more difficult it that the equality constraint (1) can be satisfied. From the reviewer's perspective, robust margin should be defined as the maximum fluctuation on u_i to maintain the feasibility of the optimization problem. However, the author mentions $e_i \geq r$ in Definition 2.1, that is, the maximum allowable fluctuation from the nominal value u_i^* is greater than or equal to r. Why not $\leq$?

2) It can be observed from Definition 2 that r is the only parameter defining the robustness margin. Additionally, the value of i-th constraint violation must be monotonously related to e_i restricted by r. It seems that the problem of finding the value of a single parameter is trivial and straightforward. To be more specific, we can iteratively change the value of r, check whether the feasible region is empty, and adjust the value of r accordingly to progressively approach the true value of r. Therefore, my concern is why we do not adopt a simpler method to determine the value

of r, but instead resort to a more complex one which even can only provide lower and upper bounds, not an exact value.

3. **Computational experiments**

There exist some other alternatives to determine the robustness margin, like the aforementioned iterative method or formulating it as a bi-level optimization problem, where the upper level determines the value for r and the lower level minimizes the value of constraint violation. It seems that the authors only present the results obtained by their proposed method, while the comparison with other alternative options is lacking. The authors are thus invited to add more case studies against previous methods to demonstrate the superiority of their method.

In summary, the reviewer is convinced that the authors indeed provide a novel perspective to study this problem, and their proposed method is potentially useful to provide their readers with a deeper insight on the related topic. However, my major concern is that the objective of this paper can be realized following some other simpler and more straightforward manners. I suggest the author clearly justify the necessity of their proposed method. Another option is to simply focus on developing a new method to judge whether a nonlinear system restricted by a set of quadratic equality constraints and linear inequality constraints has at least one feasible region.