The comments about the manuscript "**Minimal variance-based outlier detection method using forward search model error in a leveling network**"

Outlier detection problem is one of important issues in geodesy discipline. Conventional and Robust methods have been used for the outlier detection problem. Especially the studies about the efficiencies of the methods are worthy for the interpretations of the results of the analysis. In this manuscript, Author has applied a new method for the detection of the outliers in geodetic networks. A leveling network has been simulated and different types of outliers' detection problems have been examined. In my opinion, the paper has been accepted after the comments given below are considered:

1) The title should be changed. In the paper, the proposed method has been applied to the only leveling network; but the functional and stochastic models can be applied to all type of geodetic networks. Also, this method has been applied to the regression problem before. That's why, the title can be changed as "Minimum variance based outlier detection method using forward search model error".
2) In the Abstract, at the line 10, "…removes dependency" is not clear. Is the dependency between observations? Maybe it can be "…removes dependency between observations".
3) In the Abstract, at the line 10, "…to seek the novel outlier detection approach efficiency in…" should be "to seek the efficient outlier detection approach in…".
4) In the Abstract, at the line 14, "(i.e., 1<m<4)" should be deleted.
5) In the Abstract, at the line 14, "Besides, the Forward Search of Model Error (FSME) is…" should be changed as "Besides, proposed model is…".
6) Author has used "model" or "approach", in my opinion only the "model" can be used. Please, check the manuscript.
7) In the introduction, at the line 19, "gross errors" should be "outliers". Not only the gross errors, but also outliers have contaminated effects on the results of LSE.
8) In the introduction, at the line 20, "estimation" should be "estimated".
9) In the introduction, at the line 25, "Batilovic et al., 2020 or 2021?
10) In the introduction, at the line 26, "low efficiency" can be used instead of "unreliability".
11) In the introduction, at the line 28, "…these novel methods…" should be "these mothods".
12) In the introduction, at the line 29, "the reliability…" should be "the reliabilities…".
13) In the introduction, at the line 32, "IF" should be "influence function (IF)".
14) In the introduction, at the line 32, "Maronna et al., 2006 or 2019?
15) In the introduction, at the line 35, the sentence "Multiple outliers can be identified at most the number of possible outliers by repetitive test procedures" is not clear. Please, rewrite the sentence clearly.
16) In the introduction, at the line 44, "conventional method" should be "robust methods". Please check the reference.
17) In the introduction, at the line 45, "…observation(s) is included as an additional unknown parameter in the…" should be ""…observation(s) is(are) included as an additional unknown parameter(s) in the…"
18) In the introduction, at the line 53, "…value were flagged…" should be "…value are flagged…".
19) In the introduction, at the line 54, "combination pace…" should be "combination step…".

20) In the introduction, at the line 56, the sentence “The primary purpose of this study is to apply seek the proposed outlier detection method efficiency in geodetic networks.” should be changed as sentence “The primary purpose of this study is to apply the proposed outlier detection method to geodetic networks and to seek its efficiency.”
21) In the section 2, at the line 63, “…**P** a positive definite weight…” should be “…**P** be weight…”.
22) In the section 2, at the line 64 “…$\mathbf{x}_{ux1}$ a vector…” should be “…$\mathbf{x}_{ux1}$ be a vector…”; “…$\mathbf{l}_{ux1}$ an observation…” should be “…$\mathbf{l}_{ux1}$ be an observation…”; “…$\boldsymbol{C}_{ll_{nxn}}$ an a priori…” should be “…$\boldsymbol{C}_{ll_{nxn}}$ be a priori…”.
23) In the section 2, at the line 65, “…$\boldsymbol{Q}_{ll_{nxn}}$ a weighted…” should be “…$\boldsymbol{Q}_{ll_{nxn}}$ be a weighted…”; “…σ_o^2 an a priori…” should be “…σ_o^2 be a priori…”; “…where n and u a number…” should be “…where n and u are the number…”.
24) At the line 76, “…the following hypothesis” should be “…the null hypothesis.”
25) At the line 79, in the Eq.(6) and at the line 80, “τ” should be “w”; also, τ_i and w_i should be explained after related equations.
26) At the line 84, “are used iteratively…” should be “is used iteratively…”.
27) At the line 90, the reference “Huber 1964” should be added to the reference list.
28) At the line 100, “$\hat{\mathbf{x}}^k$” should be “$\hat{\mathbf{x}}^r$”.
29) At the line 103, is “3σ” a priori or a posteriori?
30) At the line 128, in the Eq.(22), is it (+) inverse or (-1) inverse?
31) At the line 155, the expression square root should be removed. Because, variance is calculated with the Eq.(30), not standard deviation.
32) In the section 3, Author uses “σ” and “s” for variance. Please, select one of them and use in the text.
33) I think the sentence at the line 178 “whether the model……or not.” should be move to the line 175 (after $\alpha = 0.05$; before the sentence “if both…”.
34) At the line 189, “Hekimoglu and Koch (2000) have…” should be “Hekimoglu and Koch (2000) has…”.
35) At the line 196, “Erdogan et al. (2019) have…” should be “Erdogan et al. (2019) has…”
36) At the line 199, “…biased…” should be changed as “…contaminated…”.
37) At the line 205,”…novel methods…” should be “proposed methods…”.
38) At the line 221, “…for Robust methods…” should be “…for robust methods…”.
39) At the line 223, “…the A priori variance…” should be “…the a priori variance…”.
40) At the line 225, “Pope's test had a lower MSR than Baarda's did. However, the MSRs of the FSME (Forward Search of Model Error) are…” should be “Pope's test had a lower MSR than Baarda's test. However, the MSRs of the FSME are…”
41) At the line 231, maybe “affect” can be used instead of “impact”.
42) At the line 241, the reference “Durdag 2020” should be added to the reference list.
43) At the line 259, the reference “Durdag 2021” should be added to the reference list.
44) In the text, Author uses different types of outliers. How did Author define influential outliers? Please add some explanations.
45) At the line 292, the sentence “When the redundancy of the observations decreases…” should be “When the redundancies of the observations decrease…”.
46) In the conclusion, the first and second sentences may be changed as “This study was designed to determine the usability of the FSME method in geodetic networks. For this aim, FSME methods have been applied to the leveling network. The design of the FSME method is based on identifying the minimum variance from all possible combinations that assume observations as model errors in the Gauss-Markov model. Although, only leveling network has been simulated, the functional and stochastic models of FSME methods can be applied to all type of geodetic networks. This method gives….”.

47) Although Hekimoglu and Erdogan (2013) has been added to the reference list, it has not been cited in the text.