Author responses to the reviewers' comments

Paper title: Designing and Implementing a Versatile Agricultural Robot: A Parallel Manipulator-Based Mobile Platform for Efficient Multitasking in Farming Operations

Dear Associate Editor and Reviewers,

Thank you very much for your valuable comments and suggestions. They have all been very helpful in improving the paper and are greatly appreciated.

The authors' responses to all the reviewers' comments are given here. In response to the reviewers' comments, the authors have thoroughly addressed each point raised. The manuscript has been revised accordingly to incorporate the reviewers' feedback. To facilitate easy reference, the modified and appended sections have been visually distinguished by highlighting them in blue color in the revised version.

Best regards,
Authors.

Responses to the comments of Reviewer #1:

General Comments: The article presents the design of a mobile skid-steering platform with four wheels, together with a serial Cartesian manipulator (PPP) mounted on it. The authors claim that the designed platform can perform several tasks in the agricultural process, since it can move heavy materials in the agricultural field. The conceptual mechanical design and dynamic properties were evaluated using specialized software. Simulation of the dynamic behavior of the platform was carried out, mathematical models and results are presented. Motion control analyzes are also shown in the results and, finally, experimental evaluations were performed to assess the dynamic behavior of the parallel mechanism in the end-effectors.

The authors sincerely appreciate the valuable suggestions and directions provided by the reviewer.

Comment 1: The text is very descriptive and tries to contextualize a project planning and its importance for agriculture. However, it does not make it clear why the constructed platform is as flexible as the authors propose, since it was designed to only support the harvesting of fruits and vegetables that can be grabbed by the designed grips.

We sincerely appreciate the reviewer for the wonderful observation and for pointing it out here. The authors have planned not only to harvest heavy fruits and have this platform to enhance agricultural tasks like weed removal, planting, spraying, pruning, and plowing operations. The current version of the end-effector is limited to gripping and is used to harvest heavy fruits. In response to this comment, the necessary descriptions are included in the revised manuscript.

Comment 2: As far as modeling and presentation of results is concerned, it is somewhat obscure. In this regard, the following can be mentioned:

- Lines 192-194: several variables are cited (B´, x-axis, wheel C) that cannot be seen in Figure 2 as referred.
- Thank you for pointing out these errors. We regret this and it was an unintentional one. the authors have corrected these errors.
- Lines 237-239: "Each limb consists of one prismatic joint and three revolute joints, and all the joint axes are parallel to each other", and that could be seen in Figure 6. However, it is not possible to see that in Figure 6. The three revolute joints cannot be located or imagined.
- We sincerely appreciate your kind observation and pointing out, that it was an unintentional mistake from our end. The description has been corrected and rewritten in the revised manuscript.

- In Section 6, Figures 7 and 8 and Tables 1 and 2 are supposed to describe the coordinate transformations between motion axes using the D-H notation. However, it is not possible to derive these transformations from the tables and figures, which refer to axes and movements that are not clearly specified.

- Thank you for raising this concern and suggestion. The corresponding section is rewritten with proper descriptions and other components in a better way to provide clarity to the readers.

- Figures 9, 10 and 11 show graphs of the dynamic behavior of the variables shown in the graph legend, but there is no reference in the text or in any figure to what these variables mean and why they are important.

- Thank you for your valuable comment. We really regret this connection and it was an unintentional one. As per the valuable suggestion, this part is rewritten appropriately to provide better readability and understanding of the proposed work.

- Figure 15 is a graph of the response to a force of 200N, but there is no reference to what this force is (direction) and where its point of application is.

- Thank you for your valuable comment and observation. We really regret this connection and the corresponding section/description is revised to provide a better understanding of the work.

- Figures 15 and 16 are difficult to understand.

- Thank you for bringing this to our attention, although it was an unintentional oversight. The description of the corresponding section has been modified to enhance clarity and ensure better readability for the readers.

Comment 3: The article concludes with the statement that the system was constructed to possibly move muskmelons and watermelons. Therefore, it obviously lacks the versatility that the article tries to demonstrate in its introductory part.

Thank you for the valuable comment. The introduction and conclusion sections have been revised to enhance their overall readability, as suggested by the reviewer. Further, the versatility part is described in the revised manuscript for providing clarity of the work.

Comment 4: In summary, the article is the description of a 4-wheel skid-steering mobile robot project that carries a Cartesian manipulator and a grip for grabbing fruits with a closed kinematic chain mechanism with actuation by parallel and symmetrical bars. The dynamic model is not clearly described and the graphics and information on how they were built need more clarity. The article's contribution as a novelty is quite questionable. For a publication it will be necessary to meet the criticism and improvements suggested.

Thank you for this valuable comment and important observation. The proposed research primarily concentrates on agricultural robots designed for intervention tasks like harvesting fruits, removing weeds, etc., and manageable by one or two individuals during the deployment/operation. The authors' group has already developed the prototype as per the proposed design, serving as the basis for this study. However, it is important to note that the research extends beyond this. The study has a broader scope and can be extended further. For better clarity, the contributions of the work are given in the revised manuscript.