

Rebuttal Letter for DRONES

Answers to Reviewer #4:

“This paper makes a decent contribution to the UAV field. However, I have a few concerns:”

Answer: Dear Reviewer, thank you for all your comments. Besides answering all your comments (highlighted in blue in the new version of the manuscript), we have thoroughly revised the entire manuscript to improve it in clarity. As follows, we have addressed each one of your comments.

1. “How do you guarantee that inner loops objectives are always satisfied as instructed by outer loop? Are there any constraints on actuators that can violate this? What happens to time-scale separation in that case? “

Answer: Thank you for this comment. In case the outer loop instructs the inner loop with commands that require more force and torque that the actuators can provide, the tracking performance (and robustness) will be degraded. However, by considering the actuator constraints into our outer-loop (guidance) method, we avoid this violation to occur and guarantee that the robustness objective of the inner loop is always preserved. Moreover, in case the actuator constraints are violated, an undesirable consequence may emerge in the form of a decrease in the time-scale separation between the position and attitude closed-loop dynamics, which would degrade the tracking performance of the control system.

2. “How do you account for size and shape of the obstacles? As per my understanding, the obstacles are considered as point mass, so collision is never going to happen? Please have a read at the paper to have a better understanding of my concern:”

1. Dhal, Kashish, Abhishek Kashyap, and Animesh Chakravarthy. "Collision avoidance and rendezvous of quadric surfaces moving on planar environments." 2021 60th IEEE Conference on Decision and Control (CDC). IEEE, 2021.

2. Sunkara, Vishwamithra, Animesh Chakravarthy, and Debasish Ghose. "Collision avoidance of arbitrarily shaped deforming objects using collision cones." IEEE Robotics and Automation Letters 4.2 (2019): 2156-2163.

3. Quinlan, Sean. "Efficient distance computation between non-convex objects." Proceedings of the 1994 IEEE International Conference on Robotics and Automation. IEEE, 1994.

Answer: Thank you for this comment. In fact, we consider that the obstacles can be circumscribed by spheres of known radii. Then, the proposed method considers these spheres in order to avoid collisions. By successfully evading contact with these spheres, we can ensure the prevention of any potential collisions between the vehicle and actual obstacles. While this isn't a significant limitation, as more complex shapes can be approximated using a collection of spheres, there are

situations where employing this approach might lead to an increased level of complexity to represent the obstacles.

3. “What is the time complexity of your algorithm and how do you compare it with other approaches? What are the main advantages of your approach. “

Answer: Thank you for this constructive comment. First of all, we have removed the optimization algorithm from the list of the main contributions to provide better clarity regarding the manuscript’s key contribution to the state of the art, which are the proposed control and guidance methods. Nevertheless, for completeness and providing the reader with the possibility of implementing the proposed method, the optimization algorithm adopted in this paper for realizing the formulated optimization-based guidance method is still detailed in Section 4.

Based on your comment, we have added a paragraph (highlighted in blue), right after Algorithm 1, explaining the proposed algorithm in more details. It is worth mentioning that, as future works, we pretend to improve the proposed algorithm, aiming at its implementation in embedded systems. This information (highlighted in blue) is present in the new conclusion section of the manuscript.