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Super-ellipsoidal Potential Function for Autonomous Collision Avoidance of a Teleoperated UAV

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Abstract : In this paper, we present the design of the super-ellipsoidal potential function (SEPF), that can be used for autonomous collision avoidance of an unmanned aerial vehicle (UAV) in a 3-dimensional space. In the design of SEPF, we have the full control over the shape and size of the potential function. In particular, we can adjust the length, width, height, and the amount of flattening at the tips of the potential function so that the collision avoidance motion vector generated from the potential function can be adjusted accordingly. Based on the idea of the SEPF, we also propose an approach for the local autonomy of a UAV for its collision avoidance when the UAV is teleoperated by a human operator. In our proposed approach, a teleoperated UAV can not only avoid collision autonomously with other surrounding objects but also track the operator’s control input as closely as possible. As a result, an operator can always be in control of the UAV for his/her high-level guidance and navigation task without worrying too much about the UAVs collision avoidance while it is being teleoperated. The effectiveness of the proposed approach is demonstrated through a human-in-the-loop simulation of quadrotor UAV teleoperation using virtual robot experimentation platform (v-rep) and Matlab programs.

Keywords : artificial potential function, autonomous collision avoidance, teleoperation, quadrotor
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