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BALD EAGLE SEARCH OPTIMIZATION BASED BIOINSPIRED SPACECRAFT RENDEZVOUS-DOCKING AND SPACE DEBRIS MITIGATION

Abstract

The rapid expansion of space technology in military missions, human spaceflight and space exploration has presented new challenges and opportunities for close-proximity maneuver. With this, the need for performing these operations without a human operator has increased and has led to a considerable interest in the development of autonomous control for spacecrafts that are reliable and robust. Recently, Artificial Intelligence (AI) has been finding acceptance in the space community as AI can make autonomous decisions and navigate on their own without human assistance. Traditional AI algorithms have had various limitations owing to their reliance on high precision sensors and high computing power. Bioinspired Intelligent Algorithm is a class of efficient computing methods that attempt to incorporate biological mechanisms witnessed in nature to solve complex problems and does away with the shortcomings of traditional AI techniques. The Bald Eagle Search (BES) algorithm is one such novel method that has been developed based on the hunting tactics employed by the bald eagle while hunting its prey. This is a meta-heuristic optimization algorithm that works in three phases involving the selection of the space, searching in the space and finally swooping in on the target. A center point is critical in every phase of this algorithm. The search space is selected around this point and the search is performed around this point. The final swoop is also initiated from this point. This research proposes to employ the BES algorithm towards optimizing the autonomous rendezvous and docking problem. The center point in this application would be the target and the optimized path to reach this point would be selected based on several other control points. These control points would form the basis of the Bezier curves that would model the optimal trajectory ensuring obstacle avoidance. The feasibility of this technique in real-time spacecraft operations would form an integral part of this study. Its application in the Autonomous Rendezvous and Docking problem would have far reaching impacts in missions involving on-orbit servicing operations like refueling and repair, space systems assembly and several other missions.