Nonlinear constrained optimal trajectory control is an important and fundamental area of research that continues to advance in numerous fields. Many attempts have been made to present new methods that can solve for optimal trajectories more efficiently or to improve the overall performance of existing techniques. This research presents a recently developed bio-inspired method called the Virtual Motion Camouflage (VMC) method that offers a means of quickly finding, within a defined search space, the optimal trajectory that is equal or close to the optimal solution.

The research starts with the polynomial-based VMC method, which works within a search space that is defined by a selected and fixed polynomial type virtual prey motion. Next will be presented a means of improving the solution’s optimality by using a sequential based form of VMC, where the search space is adjusted by adjusting the polynomial prey trajectory after a solution is obtained. After the search space is adjusted, an optimization is performed in the new search space to find a solution closer to the global space optimal solution, and further adjustments are made as desired. Finally, a B-spline augmented VMC method is presented, in which a B-spline curve represents the prey motion and will allow the search space to be optimized in addition to the solution trajectory.

It is shown that (1) the polynomial based VMC method will significantly reduce the overall problem dimension, which in practice will significantly reduce the computational cost associated with solving nonlinear constrained optimal trajectory problems; (2) the sequential VMC method will improve the solution optimality by sequentially refining certain parameters, such as the prey motion; and (3) the B-spline augmented VMC method will improve the solution optimality without sacrificing the CPU time much as compared with the polynomial based approach. Several simulation scenarios, including the Breakwell problem, the phantom track problem, the minimum-time mobile robot obstacle avoidance problem, and the Snell’s river problem are simulated to demonstrate the capabilities of the various forms of the VMC algorithm. The capabilities of the B-spline augmented VMC method are also shown in a hardware demonstration using a mobile robot obstacle avoidance testbed.

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The public is welcome to attend.