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A NOVEL MULTI-SATELLITE PURSUIT-EVASION STRATEGY BASED ON REACHABLE DOMAIN ANALYSIS UNDER TARGET MANEUVERING CONDITION

Abstract

To effectively intercept and even take over the maneuvering target, this paper investigates the multi-chaser one-target pursuit-evasion problem based on the reachable domain analysis. Different from the traditional pursuit-evasion problem, our proposed method can plan the pursuit strategy autonomously by observing the target to obtain its state of motion and reachable domain. Specifically, 1) in our studied problem, each chaser (pursuer) and target (evader) have its own motion equations with a small continuous low-thrust; 2) the target's reachable domain is within the control area of chasers is selected as the criterion for the success of the pursuit-evasion game, in which the reachable domain of the target is defined as the area that the target may reach in one impulse maneuver, and the control area of the chaser is defined as the collection of the area that each chaser may reach in one impulse maneuver; 3) the target will perform autonomous orbital maneuver based on the observed information of each chaser, and each chaser will also independently plan and adjust its pursuit scheme based on the target information accordingly; 4) the total fuel consumed by each satellite for maneuvering is defined as the cost function of game players; 5) the optimal strategy of intercepting the target by multiple chasers is solved by Nash equilibrium; 6) numerical simulations separately analyze the game situation with one chaser vs one target case and three chasers vs one target case, and they demonstrate the effectiveness and robustness of the game strategy proposed in this paper. The main innovations of this paper are: 1) proposing a pursuit-evasion strategy for the maneuverable target, and defining the criterion for the success of the game based on the reachable domain analysis; and 2) using multiple chasers to intercept the target and improving the robustness of the pursuit-evasion game.