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Real-time Autonomous UAV Formation Flight with Collision and Obstacle Avoidance in Unknown Environment

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Abstract In this paper autonomous formation control for Unmanned Aerial Vehicles (UAVs) has been discussed and a real time solution has been put forward by benefiting General Purpose Graphical Processing Units (GPGPU) accelerated potential field approach while ensuring obstacle and collision avoidance in unknown environment by using real-time sensors. GPGPU accelerated real time formation control for UAVs was designed and the basic model of the approach has been explained in our previous work (Cetin and Yilmaz 2014). As the deficiencies of the previous approach, autonomous real time collision and coordinated obstacle avoidance features in unknown environments are also handled while maintaining formation flight conditions in this work. With these features, improved autonomous formation control approach is discussed as a real time solution. The computation is performed by using Graphical Processing Units (GPUs) as parallel computation architectures by benefiting from Single Instruction Multiple Data (SIMD) type parallel algorithms. Classic binary map conversation, connected component labeling and minimum bounding box algorithms which are commonly used for image processing applications, has been evaluated for real time obstacle detection and avoidance features by developing GPGPU suitable parallel algorithms. Real-time solution has been developed by integrated these parallel algorithms with parallel Artificial Potential Field (APF) computation algorithm. Simulation results are proved that this novel autonomous improved formation control approach is successful and it would be used in real time applications like UAV formation flight missions.

1 Introduction

Formation flight is a kind of flight technique that is implemented by more than one aircrafts. Aircrafts keep their positions against a leader and maintain the formation shape during the formation flight. Especially military aircrafts use formation flight to perform

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