TITLE:

Multi UAV collision free path planning and coordination for multiple targets

Group No:-36

Group Members:

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BACKGROUND:

Unmanned Aerial Vehicles (UAVs) is an area of interest for a lot of research works because of their probable use and applications in a broad area of militia and scientific fields. A widely researched territory is the use of Artificial Intelligence algorithms to design a path plan for the automated vehicles in a various simulated environments.

An interesting sphere of this field of research is the coordination between multiple Unmanned Aerial Vehicles. This thesis aims to compare the performance of various algorithms for finding collision free paths for a number of Unmanned Aerial Vehicles such that they have to reach multiple target spots avoiding collision.

It will be simulated in a 3- Dimensional environment that has a number of obstacles. The aim is to deduce paths for each UAV that will successfully avoid the obstacles (if any) as well as successfully avoid collisions with any other UAVs. Multiple inter-UAV collision avoidance techniques will be explored.

Naturally Inspired Algorithms (NIAs) has self-organizing action; concurrent, asynchronous and decentralized are most appropriate for soft processing applications. Many Nature Inspired algorithms have been applied in problems of the real world successfully, where solutions that are nearly optimal are more important and relevant in comparison to time-consuming optimal solutions.

Two different Nature Inspired Algorithms will be applied to solve this problem and the performance of these algorithms over time will be measured and compared. Attempts will also be made to modify these existing algorithms to improve performance.

Motivation:

Why is this problem important?

.Coordination of multiple UAVs is important for targeting multiple goals during war and rescue operations.

.Use of Artificial Intelligence algorithms reduces the effort needed to control and coordinate the different UAV operations.

.Path planning tasks are very complex and highly time consuming. Therefore optimization is needed. Nature Inspired Algorithms are better at finding optimal solutions when compared to traditional deterministic algorithms which have high complexity.

Why did you choose this problem?

.Not much work has been done to compare the performance of algorithms which can help us determine which algorithm will work better in which situation.

.Not much work has been done on the task of coordination between different UAVs to achieve multiple goals.

Why should others be interested in this problem?

.There is significant risk to life involved in the flying of aerial vehicles by humans. Human life is much more costly when compared to technology.

.UAVs can provide timely and effective resolution of many problems related to military and surveillance applications.

.Nature has already solved many problems and hence we can utilize those methods to develop solutions to this problem.

>RESEARCH GAPs:

There has been a significant amount of research in the field of Unmanned Aerial Vehicles in environments with different properties. However to date there has not been a lot of work in the area of coordination between multiple Unmanned Aerial Vehicles.

There is a need for more extensive research in this area to determine the situations that benefit from the use of a particular class of algorithms. Performance of these algorithms taking into account factors like learning time, time and space complexity and accuracy must be considered.

Comparing different algorithms for a given environment setup will help in determining the best algorithm for that particular use case.

Problem/Objectives:

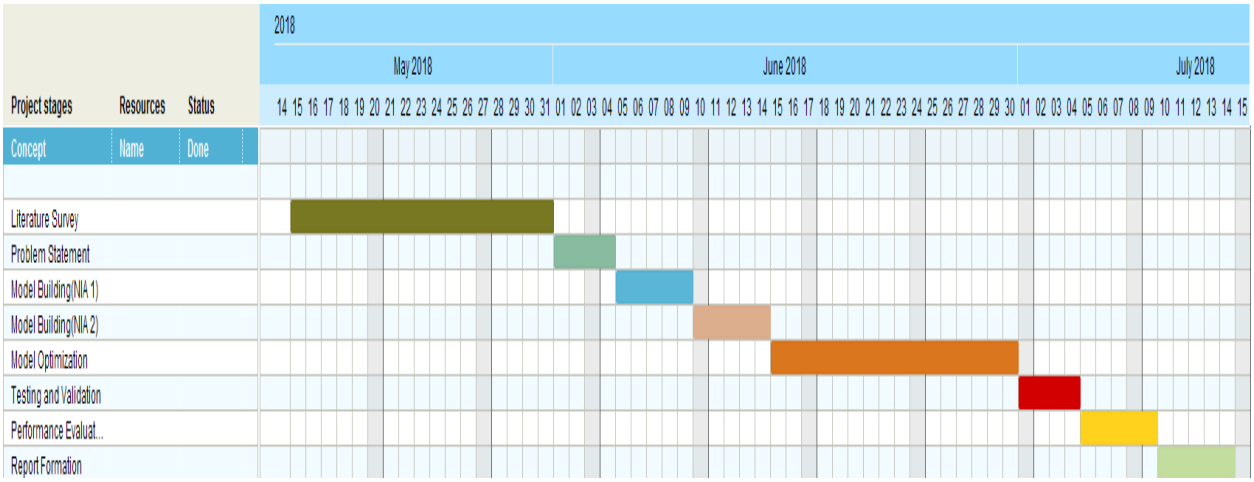
- ➔ Comparing NIA path finding algorithms for finding a path for UAV from its location to goal.
- ➔ Proposing a novel method to accomplish goals. In our case, the goal will be to coordinate UAVs to goals by avoiding the obstacles present in the environment as well as the inter-UAV collision during the motion of UAVs.
- ➔ Simulation, verification and validation of the proposed algorithms.

Literature Reviewed:

Sno	Paper	About
1	Yongquan Zhou, Guo Zhou, and Junli Zhang. A hybrid glowworm swarm optimization algorithm to solve constrained multimodal functions optimization. Optimization, 64(4):1057–1080, 2015	The outcomes of the simulation suggest that HGSO is better in terms of the performance, complexity and accuracy than other algorithms.
2	Xin Zhao, Shanshan Chen, and Yu Sheng. Research on the problem of the shortest path based onthe glowworm swarm optimization algorithm. In CICTP 2015, pages 538–547.	GSO algorithm gives the solution for route calculation problem in a graph .The technique used for improving result was roulette.
3	Bo Zhang and Haibin Duan. Predator-prey pigeon-inspired optimization for uav three dimensional path planning. In International Conference in Swarm Intelligence, pages 96–105. Springer, 2014.	In three dimensional complex surrounding environment paths finding algorithm was applied. Its outcomes were better in path planning in complex environment on both 2D and 3D simulation.
4	Si-Yao Fu, Li-Wei Han, Yu Tian, and Guo-Sheng Yang. Path planning for unmanned aerial vehicle based on genetic algorithm. In Cognitive Informatics & Cognitive Computing (ICCI* CC), 2012 IEEE 11th International Conference on, pages 140–144. IEEE, 2012.	New approach based on GA. Its performance indicates GA to be useful for UAV path planning. Same approach can be applied in 3D as it was applied in 2D.
5	V. Roberge, M. Tarbouchi, and G. Labonte. Comparison of parallel genetic algorithm and particle swarm optimization for real-time uav path planning. IEEE Transactions on Industrial Informatics, 9(1):132–141, Feb 2013.	The Genetic Algorithm and the Particle Swarm Optimization were used to deal with the environmental complexity and calculate possible and quasi-optimal paths for UAVs

Timeline

Gantt Chart



Task Description	Start Date	Duration
Literature Survey	15/5/18	17
Problem Statement Formation	1/6/18	4
Model Building for first NIA	5/6/18	5
Model Building for second NIA	10/6/18	5
Model Optimization	15/6/18	16
Testing and Validation	1/7/18	4
Performance Evaluation	5/7/18	5
Report Formation	10/7/18	5