"Multi Robot Systems for Surveillance Application" by Dr. Aseem Borkar

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Online lecture held on October 2020, 7.30 p.m

*During the webinar **Dr.Aseem Borkar** ,shared his thoughts and Experiences on two projects done at PG level extended to Doctorate and Post Doctorate level In this talk Dr. Aseem Borkar explained the design and implementation of path planning and guidance strategies for aerial surveillance using **Unmanned aerial vehicles (UAVs)** .The focus of this talk featured two applications**: Target monitoring and Area surveillance.** He also spoke about the ROS (Robot Operating System) and finally the application of these Aerial vehicles to mankind.*

Introduction

Robotics is an evergreen field where a new possibility and application is always coming up. Collaborative robots are built to work together for many applications ranging from Surveillance to Medical applications   Our expert speaker shared his research in the area of collaborative robots and insight about the various control strategies adopted for controlling them.

The informative talk covered the design and implementation of path planning and guidance strategies for aerial surveillance using unmanned aerial vehicles (UAVs).
The focus of this talk featured two applications:

- Target monitoring
- Area surveillance.

Target monitoring

Target monitoring is when a team of UAVs follow and observe a particular target or group of targets. The main task is to carry out area surveillance using Lissajous curves.
The objectives were:

- Repeated collision free surveillance of rectangular area with a multi agent (ground robots) on Lissajous curves.
- Online reconfiguration strategies for this formation for agent addition, removal and replacement.

Area surveillance

Area surveillance is when the team of UAVs continuously patrols a given area and tries to make sure the entire area is repeatedly observed over time.
The objectives was to track stationary and moving Targets .

Key Strategy

The strategies used in these projects were:

- Target Centric Cyclic Pursuits: For single target.
- Vector field based Guidance: For single Target or Convoy of Targets.

As the motive behind these projects he gave insights on:

- Complete and periodic area coverage
- Collision free patrolling with agents (Drones or Aircrafts) having non zero size.
- Finite time detection for rogue element

Emphasis on knowing fundamentals

About the project which he worked on, he made special mention of how the knowledge of fundamental concepts and tools helped him build successful projects

1. Basic Mathematics behind Lissajous curves generalization of circle.
2. Benefits of Lissajous curves for multistage coverage.
    - Trailing agents on the Lissajous curves.
    - Elliptical formation of surveilling agents
3. Summary of theoretical results with analysis
4. Algorithm for implementation
5. Simulation results

Knowledge of relevant tools for building the project

1. ROS (Robot Operating System) the open source system was used for for multi robot experiments. It has numerous advantages for such projects.
2. ROS-Gazebo software In-the-Loop simulator which supports scaling and we can also simulate sensors.

Real life Applications

He gave examples of where these drones are used:

- Military surveillance
- Animal tracking
- Special species tracking
- Search and Rescue
- Geo tracking

It was an informative session and a true example of how passion can be converted into a profession.

Report prepared by Prof. Uma Jaishankar & Prof. Avinash Shrivas