

AWARE Year II Newsletter

Platform for Autonomous self-deploying and operation of Wireless sensor-actuator networks cooperating with AeRial vEHicles

Introduction

The AWARE project is committed to the development of a platform that will enable the co-operation of autonomous aerial vehicles with ground wireless sensor-actuator networks comprising static and mobile nodes. The platform offers self-deployment, self-configuration and self-repairing features by means of co-operating autonomous helicopters. These features are highly relevant in natural and urban environments without pre-existing infrastructure or in situations where the infrastructure has been damaged or destroyed. Two validation scenarios are being considered: Disaster Management/Civil Security and Filming applications.



Disaster management and Civil Security Scenario

Objectives

The general objective of the project is the design of, development of, and experimentation with a platform providing a middleware and functionalities required for the co-operation of unmanned aerial vehicles (i.e. autonomous helicopters) with a ground wireless sensor-actuator network, including ground mobile nodes carried by people and vehicles. The platform

permits operation in sites with difficult access and without a communication infrastructure. Additionally, the project also considers the self-deployment of the network using autonomous helicopters that have the ability to transport and deploy loads (communication equipment and nodes of the ground network).

Partners and Their Roles

The consortium, coordinated by AICIA/University of Seville, consists of eight partners, with five institutions that are currently playing an important role in several EU initiatives in the field and three companies with significant industrial capabilities that will exploit the results in different sectors, such as Disaster Management/Civil Security and Filming.

The company SELEX Sensors and Airborne Systems leads the specifications. AICIA, Technische Universität Berlin and Flying-Cam collaborate in the co-operation of autonomous systems and UAVs. Universität Stuttgart and Universität Bonn are in charge of the middleware. The University of Twente is responsible for the ground wireless sensor network. Iturri is in charge of the preparation of the experiments. SELEX and Iturri evaluate the system for Civil Security/Disaster Management applications, while Flying-Cam is in charge of the evaluation for Filming.

The AWARE Second Year

The AWARE project achieved in the second year all the scheduled objectives. The components and subsystems of AWARE have been developed, including the middleware, the ground wireless sensor network, the load transportation, and the functionalities required for the operation. These components and subsystems have been tested in the general experiments carried out on April 12th-18th at the Iturri premises in Utrera, near Seville. The experiments were a success in spite of the bad weather conditions that did not allow to show all the planned demonstrations to the reviewers and end-users on April 18th.

the AWARE application scenarios e.g. sensors that monitor fire fighters. Work on data link layer for wireless sensor networks has been verified using formal methods. Attention has been paid to the validation of MAC protocol for self-organization.

Co-operation Between Static & Mobile Sensor Nodes

Event Detection: Business rules and fuzzy logic have been used to express simple logic in a compact and efficient way and to fuse multi-sensor, multi-node unreliable information. The approach has shown better detection rates and false-rejection rates.

Implementation and Evaluation: Selection of sensors and implementation of drivers. A new enclosure has been developed in such a way that the antennas remain perpendicular to the ground when deployed from the helicopter. Wireless camera nodes have been also integrated in the network and used in tracking experiments.

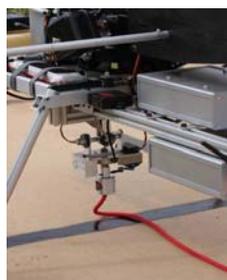


New node enclosure and deployment from helicopters

Self-Deployment with Co-operative UAVs

The objective is to develop an embedded system for the control and coordination of several autonomous helicopters for self-deploying, self-configuration and self-repairing of the sensor network as well as for using autonomous helicopters equipped with sensors as intelligent sensor nodes. This software should be connected to the AWARE middleware.

Design of the Control System for load transportation and environment sensing. The control system, capable of compensating the influence from the load and/or the other helicopters coupled to the load, has been designed and tested in simulation environment and on the helicopter.



Force sensor for load transportation



Load transportation with one helicopter and three helicopters joint load transportation

Implementation and integration of the embedded control systems. The load transportation experiments using one helicopter were performed several times including the general experiments in Utrera 2008. The load transportation experiments using three helicopters were performed twice. The first successful experiment with three helicopters was performed on 21st December 2007, which has been the very first time in the world that the joint load transportation using multiple autonomous helicopters was demonstrated.

Functionalities for the operation

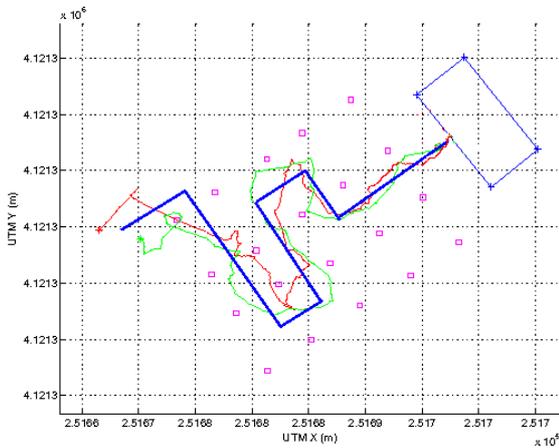
Development of network-centric functionalities for the operation: Perception for the self-deployment and operation, including surveillance, localisation and tracking; and Reliable co-operation strategies.

UAV Updating and Integration: The coupled load transportation with several helicopters significantly increased the demands on the TUB helicopter system and led to several problems that were solved by reducing the system complexity to allow easier maintenance and simpler safety checks. All these helicopters were equipped with load transportation devices designed for the transportation of loads using one or more UAVs. An emergency mechanic decoupling has been also implemented. The main element of the FC updating has been a wireless camera system with ultra low delay and high disturbance rejection digital COFDM transmission.

Tools for Co-operative Surveillance and Tracking: The techniques developed in the second year of the project included: localization of the static WSN nodes from a mobile node with known position (i.e. a robot with GPS); tracking of a mobile node by combining information of the processing of the UAV camera, ground camera nodes and wireless sensor network; and on-board computer vision techniques to improve the reliability of the UAV in case of GPS signal deterioration.



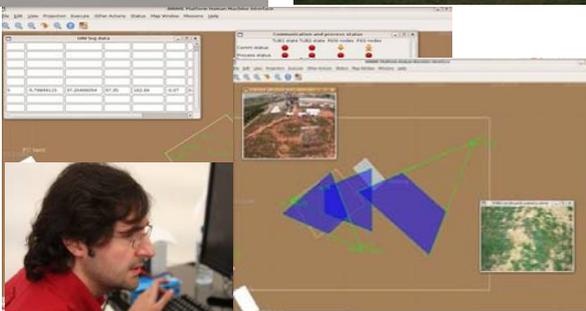
Fire extinguishing



Cooperative tracking

Furthermore, the design and implementation of tools for cooperative surveillance and tracking have been completed involving not only perception algorithms but also decision making techniques.

Cooperative missions involving multiples UAVs and the wireless ground sensor network have been performed. These missions included node deployment from the helicopter to repair the connectivity of the network.



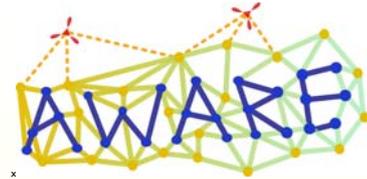
Cooperative missions involving node deployment

Preliminary fire extinguishing experiments were also carried out.

AWARE User Group

The User Group (UG) includes End Users (Agencies for Disaster Management/Civil Security, filming companies), ICT companies and researchers interested in AWARE technologies. New members of the UG are welcome.

Interested individuals can register in the Web site and/or contact the person below.



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TYPE: Specific Targeted Research Project

PROJECT PARTICIPANTS

- AICIA (Spain)
- Technische Universität Berlin (Germany)
- Flying-Cam (Belgium)
- University of Twente (Netherlands)
- Universität Stuttgart (Germany)
- SELEX sensors and airborne systems (UK)
- ITURRI (Spain)
- Universität Bonn (Germany)

CONTACT PERSON

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PROJECT WEBSITE

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