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Unmanned Land & Aerial Vehicle

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Abstract: *In the past decade, unmanned vehicles have become a topic of interest in many research organizations. Unmanned Aerial & Land vehicle is helpful in many applications ranging from military applications to commercial purposes for surveillance. Recently, there has been a great interest to design collaborative systems of UAV & UGV. This paper is a survey of both collaborative system.*
In this paper we focus on the interaction between UGV & UAV to extend the endurance of UAV. It is difficult for UAV in some operations involving precise coordination both system tend to focus on surveillance problems where somewhere aerial can prove to be invaluable where UGV can play a better role of target inspection.
Keywords: *Unmanned Aerial Vehicle(UAV), Unmanned Ground Vehicle(UGV), UAV/UGV collaborations.*

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I. Introduction

The goal of the ''UNAMNNED LAND AND AERIAL VEHICLE'' project done by fabricate, implement and test a stable robot and flying quadcopter. Our plan was to choose an existing ULAV kit and add the required components to give the ULAV the capabilities to gather and log data autonomously. Remote control vehicle without any pilot. If this goal is accomplished, our team would also like to design and implement some autonomous commands that may help aid a user in collecting the data. These commands include the auto-landing command, auto-move command, auto-homing command, and hold position command. Along with the fabrication of vehicle, we have the responsibility of presenting the vehicle workshops at institutions. Both unmanned air vehicles (UAVs) and unmanned ground vehicles (UGVs)continue to find new applications through the relentless advances of sensing, computation, and algorithmic capabilities. Wherever tasks exist that are either dangerous, boring, or both, the development of robotic alternatives to human labor has been both swift and valuable. Both classes of vehicles provide different advantages and shortcomings when attempting to automate particular tasks, and the complementarities of their differing skill sets make UAV/UGV team a promising area for future development.

This vehicle, also known as quad rotor helicopter or robot on two wheels, is a multi rotor helicopter that is lifted and propelled by four rotors. Vehicles are classified as rotorcraft, as opposed to fixed-wing aircraft, because their lift is generated by a set of rotors. In a quad copter, two of the propellers spin in one direction (clockwise) and the other two spin the opposite direction (counter clockwise) and this enables the machine to hover in a stable formation. Also there is two servo motor in land vehicle with one caster wheel which moved the different directions. And this controlled by the Bluetooth.

Firstly the motors which we used have an obvious purpose: to spin the propellers. Motors are rated by kilovolts, the higher the kV rating, the faster the motor spins at a constant voltage. Next the Electric Speed controller or ESC, is what tells the motors how fast to spin at any given time. We need four ESCs for a quad copter, one connected to each motor. The ESCs are then connected directly to the battery through either a wiring harness or power distribution board. Many ESC1s come with a built in battery eliminator circuit (BEC), which allows you to power things like your flight control board and radio receiver without connecting them directly to the battery. Because the motors on a quad copter must all spin at precise speeds to achieve accurate flight, the ESC is very important. And the flight control connects with the motor driver for the giving supply to Arduino nano and Bluetooth module. Arduino nano also connect with the 9/10 volt battery which are the same battery to the flight controller. In this the arduino nano isvery important to control the all the direction of the vehicle. Taking the arduino nano because of weight. This weight is very cheap from arduino nano. There are uses of many jumper wires female to female which are connect the all module with each other. Our Quadcopter uses four propellers, each controlled by its own motor and electronic speed controller. Using accelerometers we are able to measure the angle of the Quadcopter and accordingly adjust the RPM of each motor in order to self-stabilize itself. The Quadcopter platform provides stability as a result of the counter rotating motors. For Hovering over the skies the flight controller which is used is the 'brain' of the quadcopter. It houses the sensors such as gyroscopes and accelerometers that determine how fast each of the quadcopter's motors spin. Its purpose is to stabilize the aircraft during flight and to do this, it takes signals from on-board gyroscopes (roll, pitch and yaw) and passes these signalswhich in-turn processes signals according the users selected firmware (e.g. Quadcopter) and passes the control signals to the installed Electronic Speed Controllers (ESCs) and the combination of these signals instructs the ESCs to make fine adjustments to the motors rotational speeds which in-turn stabilizes the craft.

II. Components Used

Aluminum frame	**1**
Brushless motor 920kv	**4**
Woodenframes 10*10	**2**
Servomotors	**2**
Casterwheel	**1**
Flightcontroller	**1**
Motor driver L293D	**1**
Bluetooth module	**1**
Arduino Nano	**1**
Electronic speed controller(ESC)	**4**
Receiver system	**1**
Propeller	**4**
Battery Li-po 12V	**1**
Remote control FS-CT6B	**1**
Wheel	**2**
Jumper wire	**As Required**
Chassis	**1**
Wireless Camera	**1**

III. Methodology

WORKING PROCESS OF UNMANNED AERIAL VEHICLE:

Firstly we had made the quadcopter.

CONSTRUCTION:

- FRAME

Firstly we had made an aluminium frame for the quadcopter arms. There are 4 arms each arms are of 50 cm. Each arms are fixed at 90 degree. Also we had made a wooden frame of dimension 10*10cm and the wooden frame is mounted on the middle of the each aluminium frame.

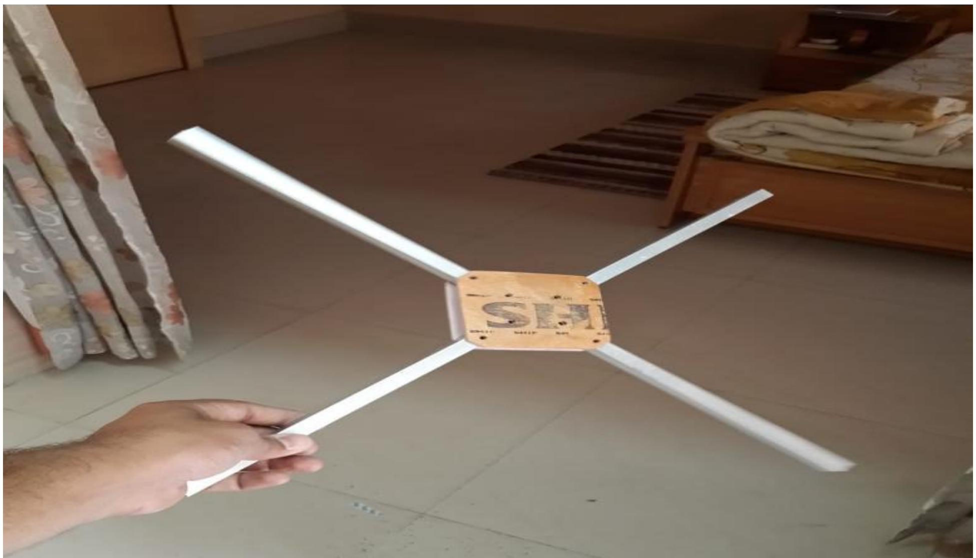


FIG. FRAME

- BRUSHLESS DC MOTOR AND ESC

We are using brushless motor which has three wires. This is the 3 phase connection motor. So that 3 wires are connect with the output of electronic speed controllers. And the input ESC has 3 wires which has positive, negative and signal wire.

FIG. BRUSHLESS MOTOR AND ESC

- ESC CONNECT WITH EACH OTHER

After connection of esc and brushless motor, connect the each esc and each connection has only two wires where one is negative and second one is positive. All the esc signal wire connects with the flight controller. And then this mounts on the frame.

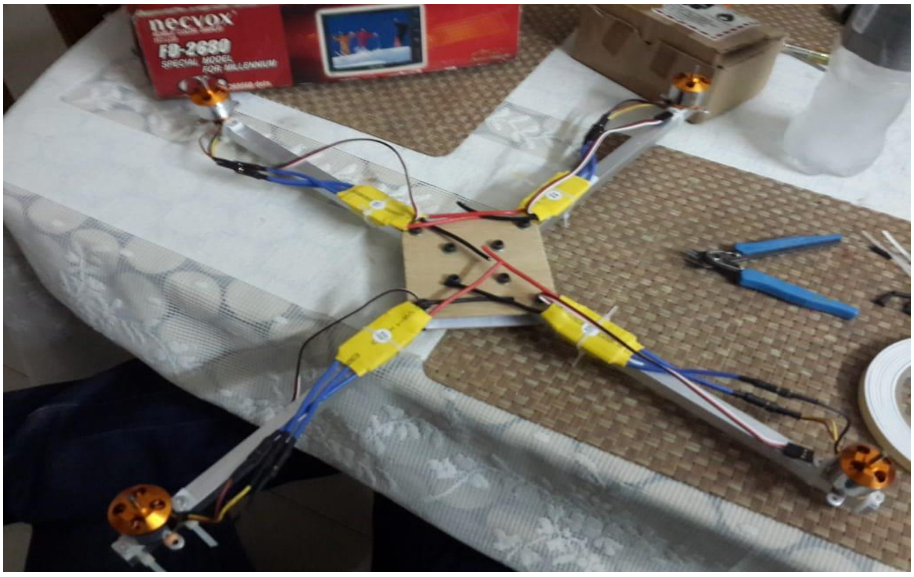


FIG. ESC CONNECT WITH EACH OTHER

- ESC CONNECT WITH FLIGHT CONTROLER

After the connection of each esc with each other then the all esc had one wire which had signal wire which is connected to the flight controller. All the esc connects with the 5v flight controller pins. That pins supply the current to esc for controlling the speed.

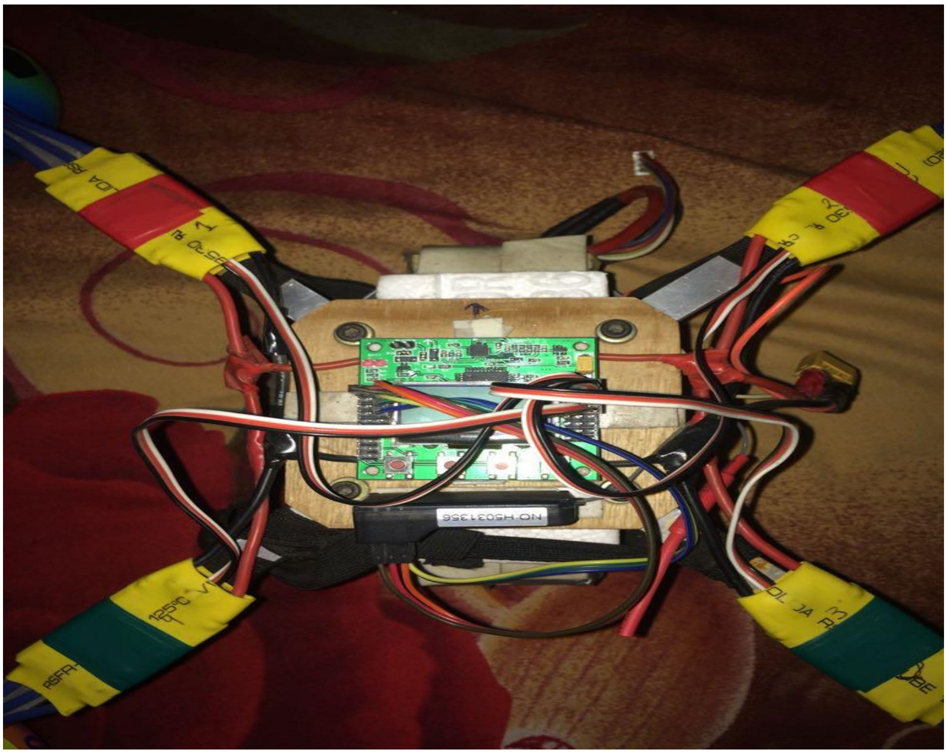


FIG ESC CONNECT WITH FLIGHT CONTROLLER

FLIGHT CONTROLLER WITH RECEIVERCONNECTIONS ARE AS GIVEN BELOW:

CH 1	AILERON	ROLL
CH 2	ELEVATOR	PITCH
CH 3	THROTTLE	THROTTLE
CH 3	RUDDER	YAW

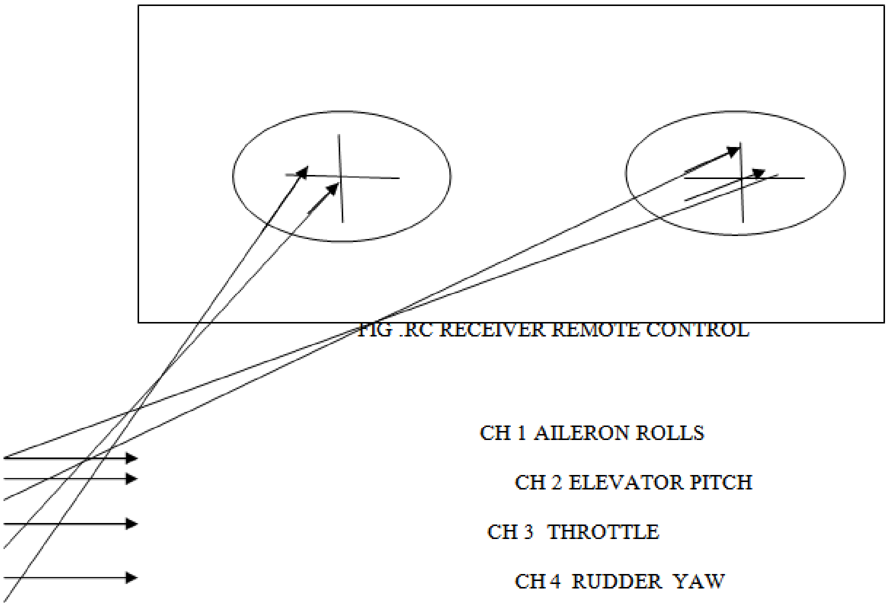


FIG .RC RECEIVER REMOTE CONTROL

FIG FLIGHT CONTROLLER WITH RECEIVER

After completing all the connection burn the program in flight controller ic.

WORKING PROCESS OF UNMANNEDLAND VEHICLE :

- CONNECT THE MOTOR WITH CHASSIS

Firstly we connect the motor with the chassis and connection of motor with the motor driver.

Connection of motor driver, Arduino nano and Bluetooth module connect the Arduino nano to the Bluetooth module. That's the point is given below;

BLUETOOTH MODULE	ARDUINO NANO
RX	TX
Tx	RX
GND	GND
5V	5V

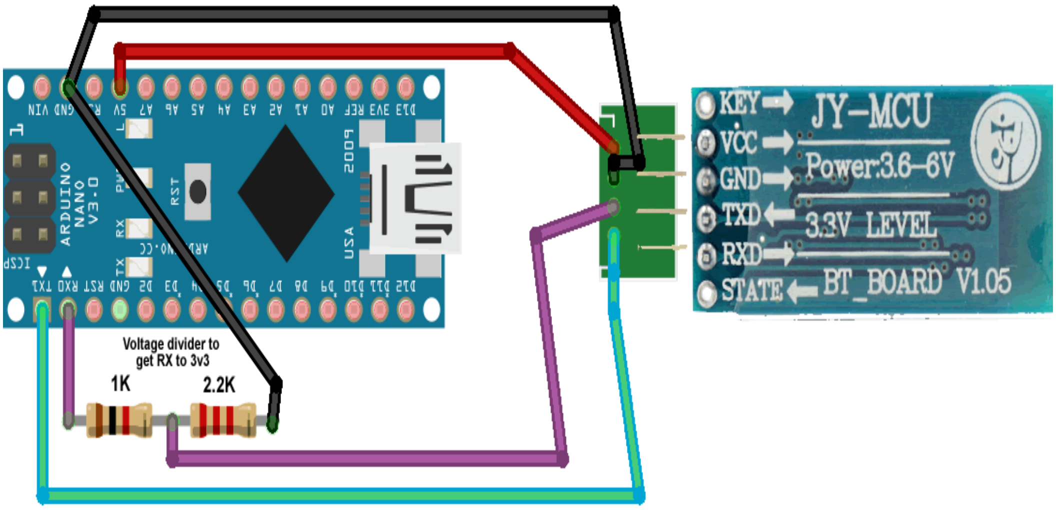


FIG. ARDUINO TO BLUETOOTH

- ARDUINO TO MOTOR DRIVER

In this motor driver had 2 motor output pins that connects with the 2 motors. Also there are 2 motor inputs that connects to the battery. And their 5v pin connect to the Arduino nano 5v, GND to the arduinonano GND and also their 12v connect with the main 12v battery.

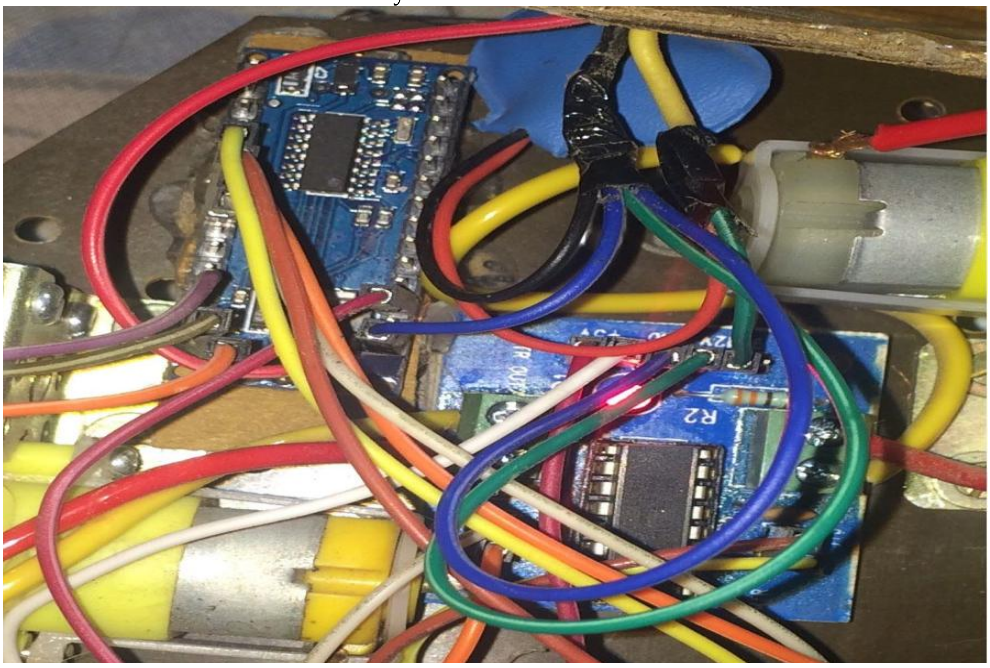
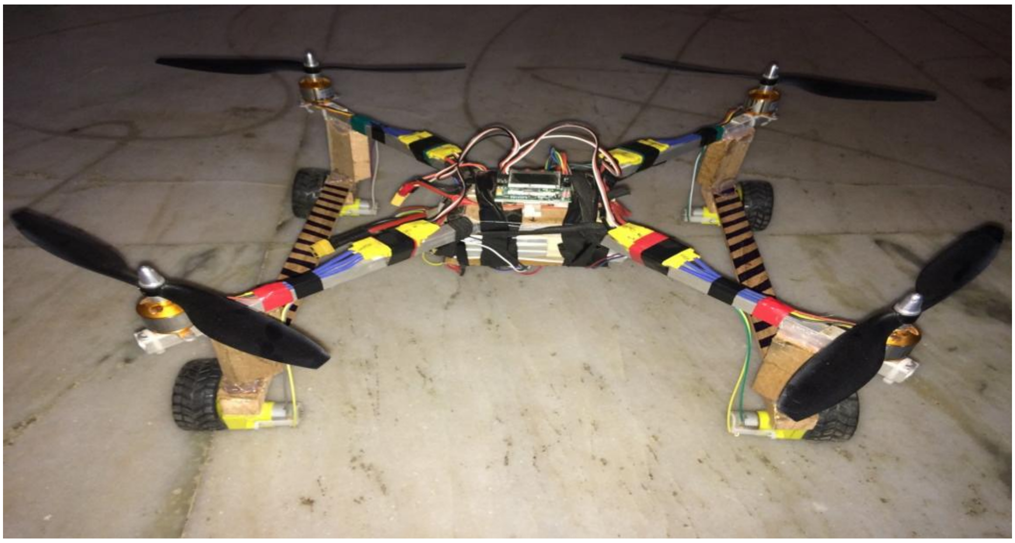


FIG. ARDUINO NANO TO MOTOR DRIVER

SO FINALLY WE GET THE 2 WIRE POSITIVE FROM MOTOR DRIVER 9/12V AND THE NEAGTIVE FROM THE ARDUINO NANO. THESE POSITIVE AND NEGATIVE CONNECT THE 12V BATTERY.



Unmanned Land & Aerial Vehicle

IV. Applications

There are five main areas of application that have been investigated for possibledeployment of UAV/UGV teams. The search problem requires the heterogeneous team to operate in an unknown environment in order to find a particular set of static targets. The combination of aerial and ground perspectives allows for rapid refinement of the target location estimates and broad coverage of a large search area in minimal time. The second application is target tracking, inspired by the dangers of high-speed police chases and similar military scenarios. The task is to use a mixed team of pursuers to track and potentially capture moving targets. Target tracking with a UAV/UGV team is also useful for wildlife monitoring and sport videography. The third application involves inspection of expensive or safety critical infrastructure, which can be defined with respect to a known environment, with a known list of inspection tasks to be assigned to a fixed set of UAVs and UGVs. Inspection can also be extended to perform specific tasks at the known locations,other than inspection, as is the case is forest fire fighting, where fire retardant can be deployed, for example. The fourth application is the persistent surveillance problem, where multiple aerial vehicles are used to monitor an area for intruder detection. This application differsfrom the inspection task in that the monitoring requirements are continuous instead of discrete, changing the nature of the underlying task assignment problem. Here, aerial vehicles perform station-keeping operations and distribute themselves to best cover an area, while ground vehicles can both complement the coverage and provide recharge and computation tasks for the aerial fleet. This application also encompasses the networking problem, which relies on UAVs to augment ground-based vehicle networks for remote operations through extended range line-of-sight communications. In both applications, a continuous task assignment problem must be solved. Finally, the mapping problem requires the heterogeneous team to operate in an unknown environment, localize each of the robots with respect to the environment and each other, and explore a bounded region of the unknown environment in order to either develop a comprehensive map. The difficulty in mapping lies in finding correspondences between the information collected from the very different perspectives of the aerial and ground vehicles, but once overcome, the resulting maps can be built extremely quickly, with both a good overview of the region and detailed information near the ground.

- For Surveillance
- Detection of Underground facility
- Civilian applications
- Commercial surveillance
- Rescue etc.

V. Conclusion & Future Scope

The field of UAV/UGV coordination has seen an extensive amount of attention over the last decade and continues to be an active area of research. The clear complementarity of the perception and motion capabilities of aerial and ground vehicles ensures that limitations that occur with one platform can often be addressed by coordinating with the other. From low-level improvements in vehicle localization and range extension through rendezvous to high-level applications such as mobile target tracking, persistent surveillance and mapping, many compelling examples of well-developed algorithms and successful field demonstrations in UAV/UGV coordination exist. There remain, however, numerous difficulties and open problems that need to be resolved for widespread deployment of UAV/UGV teams to begin. The following list touches briefly on the main challenges:

1. Vehicle autonomy: Many of the limitations of the team results hinge on the individual capabilities of the vehicles, either in terms of robust state and environment measurement, or dynamic motion planning and vehicle control. Aerodynamic effects that are difficult to model when controlling individual aerial vehicles are only made more complex when multiple vehicles operate in the same area. To fully exploit the benefits of small aerial vehicles, reliable tracking and landing in a wide range of flight conditions remains to be demonstrated, as do fully functioning multi-vehicle teams wherein repeated charge/discharge cycles occur.

2. Integrated formation control: Currentmethods in flocking and formation control of UAV/UGV teams treat the UAVs and UGVs as two distinct classes of vehicles and do not consider operations where both UAVs and UGVs are executing particular tasks in coordination with each other. The added complexity of heterogeneous formation control may not always lend itself to stability analysis or control law definition, but more opportunities surely remain in defining strategies for coordinationthat do not rely on large-scale optimization techniques. Themanner in which

surveillance, coverage, search, and tracking tasks can be efficiently achieved with formation control algorithms is not yet well understood, and a more systematic framework is needed to evaluate these methods against common optimization techniques and receding horizon methods.

3. Task assignment efficiency: The methods applied to heterogeneous task assignment with aerial and ground vehicles do not yet touch on the large body of work in approximation algorithms for routing problems. Many of the characteristics of the problem formulation are the same, and there is a clear gap between the small scale real-time solvable mixed integer linear programming approaches presented to date and the full-blown applications that have been proposed for UAV/UGV teams.

4. Multi-vehicle localization: Much of the relative localization work for UAV/UGV teams has assumed that the aerial vehicle motion is well understood and that GPS is at least sometimes available to ground vehicles. In dense forest, with small aerial vehicles, these types of assumptions may not be valid, and the value of multiple vehicles may become even greater, as mutual localization should be possible. Reliable intra-team

localization would also be a boon to the 3D mapping problem, as it should make feature matching from widely differing perspectives more tractable by providing good initial estimates for subsequent refinement.

5. Aerial/ground perspective correspondence: Finally, it has not yet beendemonstrated that aerial and ground data from lasers, cameras or both, can be reliably combined into dense 3D representations of the environment, without reliance on global positioning and expensive high-accuracy inertial measurements. The work in this area is promising but highlights a problem somewhat unique to the aerial and ground vehicle team coordination domain. Feature or structure correspondence from wildly different perspectives is not straightforward and involves matching point clouds with large amounts of occlusion, or of identifying the same visual elements from wildly different points of view. Most SLAM algorithms rely heavily on the ability to find correspondence between measurements from different viewpoints, and without this critical capability for UAV/UGV teams, it is not possible to fully exploit the information available to the team in reconstructing 3D representations of the environment.

In summary, the field ofUAV/UGVcoordination is both well established, in terms of the quantity of useful algorithms and convincing results developed to date, and wide open, in terms of the number of challenging problems that remain to be solved prior to full-fledged deployment in realistic applications. As such, the area is ripe for major contributions in the coming years, as more and more teams around the globe become proficient inUAV and UGVdesign and development and as the limitations of existing methods are brought more clearly into focus through experimentation.

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