

## Guidance Methodologies of Unmanned Aerial Vehicle Using Virtual Instrumentation Technique

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**Abstract** - The unmanned aerial vehicle guidance is very significant nowadays. Guidance of unmanned aerial vehicle generates commands to and controls the attitude to follow the reference trajectory. This paper presents a new guidance of unmanned aerial vehicle using virtual instrumentation technique. LabView is a system design platform and development environment for a visual programming language from national instruments and provides a virtual environment to guide the UAV in terms of bank angle and aileron angle. Aileron angle control the UAV roll degree of freedom and bank angle. In this method the guidance is considered under the atmospheric disturbance especially wind and. Aileron angle is used to direct the UAV against the wind. The gain of the system can also be controlled. Manual and automatic control of this vehicle is alsopossible.

**Keywords:** UAV, aileron angle, bank angle, visual programming

### 1. Introduction

UAV is an abbreviation of Unmanned Aerial vehicle which operates without a human pilot. UAVs are commonly used in both the military and police forces in situations where the risk of sending a human piloted aircraft is unacceptable or the

situation impractical. The UAV is also known as drone. The flight of UAVs may operate with various degrees either under remote controls by a human operator or fully or intermittently automatically by on-board computers. It can be not only in defence or police forces but also can be implemented in areas such as Disaster management, wildfire mapping, Thermal infrared power line surveys, Telecommunication, Agricultural monitoring, Weather monitoring, Law enforcement, Aerial imaging/mapping, sporting events and moviemaking, Environmental monitoring, Oil and gas exploration and Freight transport.

In aerial photography it plays an important role in unmanned vehicle. It is because that usually in aerial photography presence of human is required to take high quality images but while using these UAV's we can reduce the efforts of humans. For these kind of applications, the UAV's the body of the aircraft has to be made with heavy metal to resist the wind and gravity force at the maximum level of heights. The UAV can also be used in defence system by making it roaming around in the atmosphere. During it roaming, the entry of foreign material such as explosive from the air can be prevent by targeting it and deploy it at the air. It can also be used in artificial raining technology. Similar to the aerial photography in this also an unmanned aircraft which can be send along with sodium chloride with necessary arrangements and remote control. After the unmanned aircraft sent above the clouds, the sodium chloride can be released over the clouds to form the rainy clouds and make the artificial raining.

During tsunami occurs in December 26, 2004, lakhs of people died and lots of people got injured and lost. Similarly in bhuj earthquake thousands of people died and hundreds of people trapped under building materials and got injured. At the time of above mentioned situation to rescue the trapped and lost people sometimes the rescue force cannot reach them or find them. So in such condition the UAV can be used to detect the presence of people and the rescue force can be sending to help those people. UAV can be used for various types of missions including reconnaissance as well as attack roles. The main role of UAV in military is growing at unprecedented rates.

There are different of UAV's as target and decoy, reconnaissance, combat, research and development, civil and commercial. The unmanned aerial vehicles are preferred for the missions which are too dangerous or dull for the humans. They provide the attack capability for high risk missions and they originated mostly in the military

applications which offers less stressful environment. It is used for better decision making, it presents safer environment, they can fly longer hours as long as the vehicle allows for it, it can go faster even if the plan crashes the pilot will be safe, they can be used for border patrol security using the soft wares there is no need for qualified pilot to flight, they can flying in to the zones where it would be dangerous for the pilot. UAV's can save life greatly reduce putting the military personal in harm's way or in compact. A proper algorithm is necessary for guidance to reduce the accidents with other objects in the air. Both remote control guidance and automatic guidance are present.

Drone's offer low risk, since it was smaller and they can fly lower than the traditional air planes without the human pilot which can have more pin point accuracy from greater distance thus reducing the collateral damage to the civilians and the infrastructure. Unmanned aerial vehicles contains overall budget problems they are very expensive to produce and maintain. The human mistake in remote control can cause the plane to crash and they have limited abilities. This project is designed to reduce the risk in UAV guidance on normal environment and also presence of disturbance like wind using LABVIEW software tool. It uses g programming which is user friendly and modification of the model can be done easily. National Instruments is developed this software. Interfacing with different components is easy, and debugging is also done easily. It has two division of designing front panel as well as back panel.

## **2. Related work**

The guidance of the unmanned aerial vehicle is carried out by different methods and algorithms. In UAV a coordinated control technique is used that allows heterogeneous vehicles to autonomously search a track target using recursive Bayesian filtering. The vehicle can switch its task mode between search and tracking while maintaining and using guidance low that can interceptive target within the acceptable miss-distance. Fast adaptive control is used it shows a satisfactory performance of the guidance low, with the absence and presence of measurement noise.

A cooperative control of multiple vehicles is developed. It consists of fault diagnosis scheme and its fault tolerant controller. Fault tolerant approach estimates the tale of the

caused function it presence of large time delays to improve cooperation performance. The atmospheric disturbance is not considered, which is the main problem in UAV guidance now dealing now.

### **3. Proposed system**

A novel aircraft path following guidance algorithm based on a model predictive control is proposed in this paper. The algorithm tracks a pre-computed trajectory and produces reference commands. To solve the associated nonlinear optimization problem, an iterative scheme is proposed, using as a feasible hot start the guidance solution provided by a well-behaved L1 navigation law. LabVIEW show the effectiveness of the algorithm, even in the presence of disturbances such as wind.

Traditionally the airplane guidance systems have been based on classical missile guidance laws. Proportional navigation and pure pursuit are applied to UAVs. Similarly, a good helmsman behaviour strategy is employed for UAV path following. The basis of these algorithms is to introduce a virtual target that follows the reference and then apply missile guidance to track the virtual target. While these laws are simple (being easily implemented on board) and robust, they are reactive (not using future information about the reference) and tend to be aggressive, often demanding high control power (leading to efficiency loss). These limitations have motivated the development of guidance laws based on modern control techniques, such as gain scheduling, optimal control, sliding mode control [11], control Lyapunov functions , vector fields , or even extreme seeking .

Kinematic aircraft model is,

$$\frac{dx}{dt} = V \cos \gamma \cos \chi + w_x \dots\dots\dots (1)$$

$$\frac{dy}{dt} = V \cos \gamma \sin \chi + w_y \dots\dots\dots (2)$$

$$\frac{dz}{dt} = -V \sin \gamma + w_z \dots\dots\dots (3)$$

x, y, and z are the coordinates of the centre of gravity.

w<sub>x</sub>, w<sub>y</sub>, and w<sub>z</sub> denote, the north, east, and down components of the wind speed.

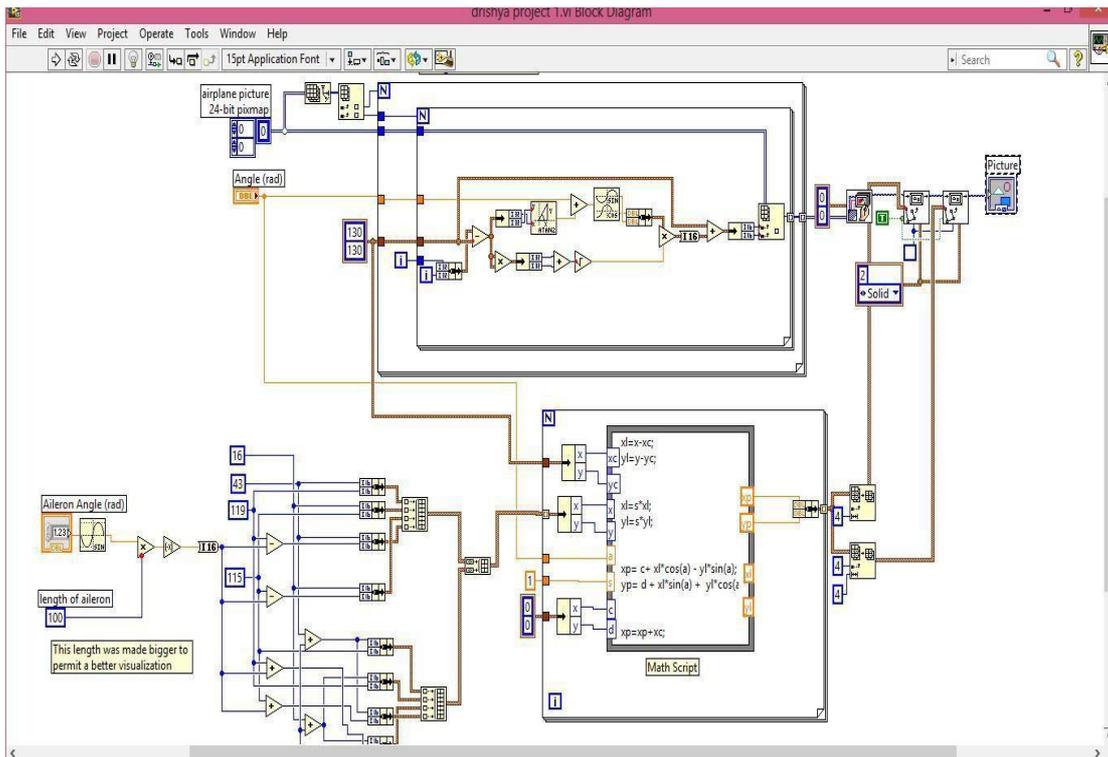
A control method with potential applicability to guidance is model predictive control. This technique is based on the idea of computing an optimal sequence of control

signals that optimizes a certain cost function, possibly with state and control constraints.

Once the first inputs are applied and the aircraft moves, the prediction and optimization steps are again repeated and a new control sequence is obtained, thus closing the loop. This procedure is difficult to implement because it requires solving a nonlinear optimization problem online. In addition, there is no guarantee of finding a feasible control solution.

#### **4. Result and discussion**

LabVIEW 2015 (32 bit) is used to design the guidance system of unmanned aerial vehicle (UAV). Which provide a virtual environment. Using this we can demonstrate and test the guidance of the unmanned aerial vehicle. This procedure is difficult to implement because it requires solving a nonlinear optimization problem online. In addition, there is no guarantee of finding a feasible control solution. Two parameters are used to control the UAV, Angle (rad), Aileron angle(rad).These angle is specified using radian. The unmanned aerial vehicle guidance is very significant nowadays. Guidance of unmanned aerial vehicle generates commands to path follow and control the attitude to follow the reference trajectory. This method presents a new guidance of unmanned aerial vehicle using LabVIEW (Laboratory Virtual Instrument Engineering Workbench),is a system design platform and development environment for a visual programming language from national instruments. LabVIEW provide a virtual environment, where we could guide the UAV in terms of bank angle and aileron angle. Which UAV roll degree of freedom and hence bank angle. In this method the guidance is considered under the atmospheric disturbance especially wind.



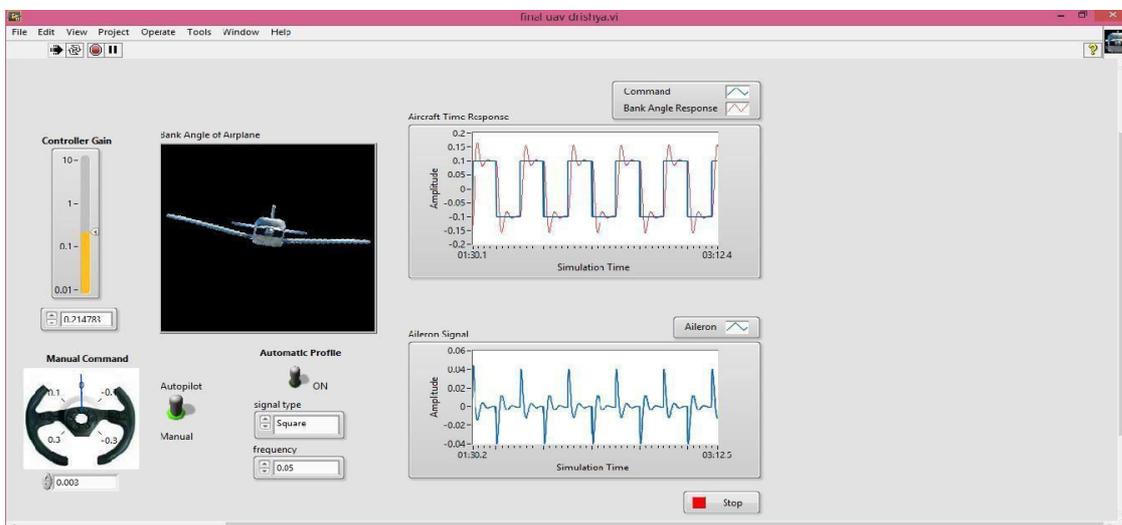
**Fig.1. Block representation of manual control**

Aileron angle is used to guide the UAV against the wind. The gain of the system also can be controlled. Manually controlled method and autopilot method is employed. The angle (rad) and aileron angle is the main two parameter used in the design. Angle is used to control the movement of the unmanned aerial vehicle, the main problem which is analysed by various paper is the guidance system doesn't considering the atmospheric disturbance like wind. In this design the wind or disturbance is considered. The aileron angle is used to guide the unmanned aerial vehicle with the presence of wind also.



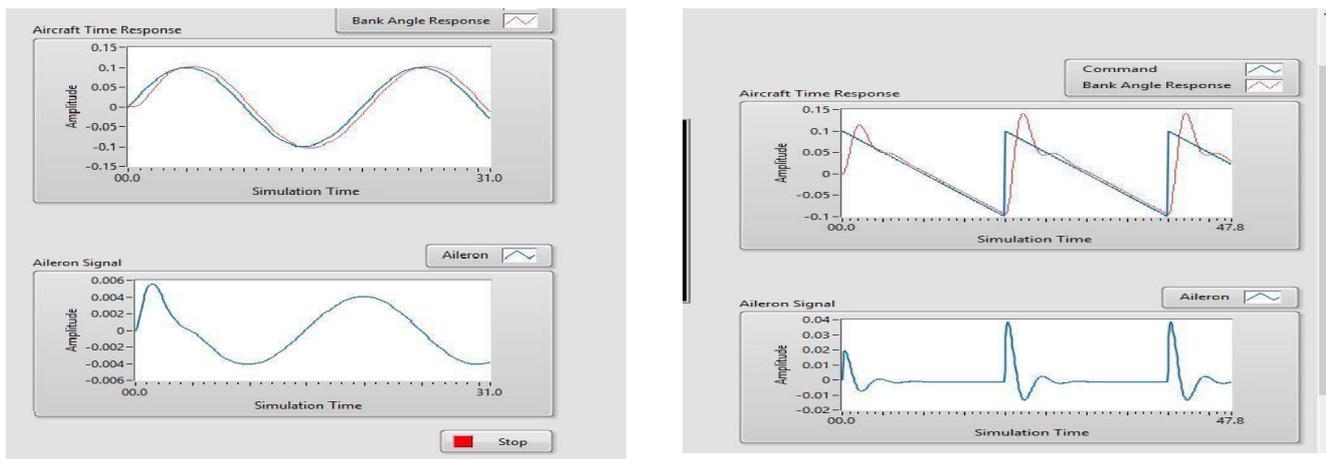
**Fig.2.Front panel of manual control**

The system can be guided by manually or fully automatically, The designer can select the mode of operation. First the manual control block is created which is shown above. The system analyses the input give based on that it modifies is alignment. LabVIEW helped to create a virtual environment of unmanned aerial vehicle guidance. Which gives a realistic view of the method and its very flexible and effective. Fully automatic method also implemented, the below figure shows the view before running. The aircraft response is noted as a wave for analysing and studying. The user can select the waveform, sine wave, square wave etc.



**Fig.3.After running**

The aileron angles oppose the wind and allow the unmanned aerial vehicle to move against the wind. Mostly ada based software's are used to design the guidance system. Based on the response obtained the performance is analysed. Signal type box is provided to select signal.



**Fig.4.Output waveform**

The gain of the system also can be adjusted using the graphical icon in the front panel. The waveforms obtained are shown here. User can decided which type of signal is needed.

## 5. Conclusion and future work

The unmanned aerial vehicle can be used in many applications, such as in aerial photography, monitoring, defence etc. The application of UAV is increasing day by day. Labview is the software which helps us to create a virtual environment; it is not any language based so designers can easily design and diagnose a problem is also very easy compared to other software's. This environment is based on g-programmingIt is used to design a guidance system and analyse the design. Before implementing practically the vehicle tested and guided using the environment. It has front and back panel design, front panel shows the vehicle diagram and output of the system, background system has detailed block diagram.The controller gain is fixed based on the

calculation, manual and an automatic profile icon is included. By clicking on the icons the user can change the angle. LabVIEW 2015 is used to design the guidance system. Main advantage is that it considered the atmospheric disturbance.

In the future work, visual guidance and iterative model predictive algorithm is used guide an unmanned aerial vehicle.

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