Holographic Infra Red Air Traffic Control

Robin Johny K., Poorvika E.

Abstract— The current method used by Air Traffic Control (ATC) officers for managing the aircraft traffic, is the use of 2D Radar technology to scan the details of the whereabouts of an aircraft within a stipulated radius of an airport that causes accidents due to human errors. By our new method of HIATC, 3 dimensional holographic projectors are used to provide a clear cut view of the air traffic within a particular radius of any airport thereby allowing the ATC ,an easier and a much less-risky job operation. The usual way an ATC operates is by giving instructions to the pilot of all aircrafts landing and taking-off in that particular airport by looking the 2-D radar image of various locations of aircraft. In 2-D world only four degrees of motion are defined (left, right, forward and backward). But in 3-D world six degrees of motion are possible (left, right, forward, backward, above and below).The ATC officers can easily identify the altitude of aircrafts from ground with the help of this 3-D projection. By implementing this technique we can reduce the "holding time" of aircrafts and we can also achieve required separation between aircrafts.

Index Terms— ATC, Holography, Holding Time, Infra Red, Separation.

1 Introduction

THE Air traffic control (ATC) is a service provided by ground-based controllers who direct aircraft on the ground and through controlled airspace. The primary purpose of ATC systems worldwide is to separate aircraft to prevent collisions, to organize and expedite the flow of traffic, and to provide information and other support for pilots when able. In some countries, ATC may also play a security or defence role, or be run entirely by the military. The conventional 2D radar technology is improved to a 3 dimensional phase in this paper by the concept of 3D Holographic Projection for ATC. By utilizing this technology, more number of accidents sues to human error can be averted and makes a smoother functioning for the Air Traffic Management.

2 Air Traffic Control

An air controller especially trained for and assigned to the duty of airspace management and traffic control of airborne objects. Air traffic controllers manage aircraft through all aspects of their flight with the priority of safety, followed by other aspects such as ensuring arrivals and departures are on time. They use navigation and surveillance to communicate advice, information and instructions to pilots via radio.
Preventing collisions is referred to as separation, which is a term used to prevent aircraft from coming too close to each other by use of lateral, vertical and longitudinal separation minima In many countries, ATC services are provided throughout the majority of airspace, and its services are available to all users (private, military, and commercial). When controllers are responsible for separating some or all aircraft, such airspace is called "controlled airspace" in contrast to "uncontrolled airspace" where aircraft may fly without the use of the air traffic control system.

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2.1 General Working Procedure

The air traffic control system, which is run by the Federal Aviation Administration (FAA), has been designed around these airspace divisions. The air traffic control system divisions are:

- Air Traffic Control System Command Center (ATCSCC) - The ATCSCC oversees all air traffic control. It also manages air traffic control within centers where there are problems (bad weather, traffic overloads, and inoperative runways).
- Air route traffic control centers (ARTCC) - There is one ARTCC for each center. Each ARTCC manages traffic within all sectors of its center except for TRACON airspace and local-airport airspace.
- Terminal radar approach control - TRACON handles departing and approaching aircraft within its space.
- Air traffic control tower (ATCT) - An ATCT is located at every airport that has regularly scheduled flights. Towers handle all takeoff, landing, and ground traffic.

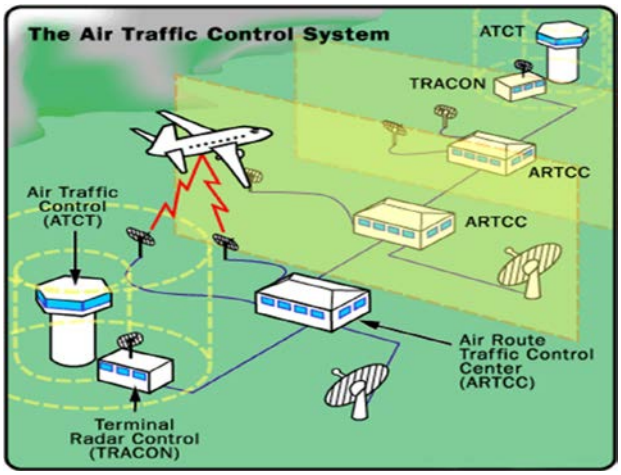


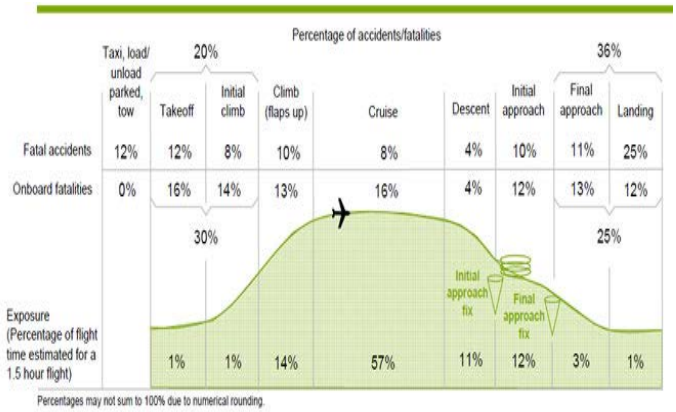
Fig. 1 The basic outline of a air traffic control system

- Flight service station (FSS) - The FSS provides information (weather, route, terrain, flight plan) for private pilots flying into and out of small airports and rural areas. It assists pilots in emergencies and coordinates

search-and-rescue operations for missing aircraft.

2.2 Accidents and Casulaties

Being an ATC is a very risky job that demands a lot of attention and concentration. Since it is a manual job, human errors



are inevitable. And even more, being an ATC, the works load is very high. Some of the accidents and casualties that took place in the past few years due to errors by the ATC alone are:

Fig. 2 Graphical representation of casualties in airfraft

- 2001 Japan Airlines mid-air incident
- 2007 San Francisco International Airport runway incursion
- ADC Airlines Flight 86
- Aeroflot Flight 3352
- Aeroflot Flight 8381
- Avianca Flight 52
- Court Line Flight 95
- 1979 Dniprodzerzhynsk mid-air collision
- Flying Tiger Line Flight 66
- Gol Transportes Aéreos Flight 1907
- 2005 Logan Airport runway incursion
- Thai Airways Flight 365
- Überlingen mid-air collision
- USAir Flight 1493
- 1976 Zagreb mid-air collision

3 2D vs. 3D World

3.1 2 Dimension

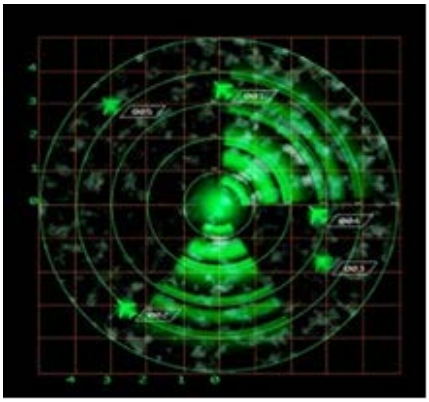


Fig. 3 Conventional ATC display

In a 2 Dimensional world, only four degrees of freedom or only four directions of motion are possible, which are left, right, forward, backward. Now, in the case of the 2D radar technology used in the ATC, the location or position of each aircraft in the flight zone is denoted by a small dot and it's necessary information such as aircraft identification number, altitude, speed are displayed along with it, which makes it more hard to read and requires immense amount of concentration. This is the main reason or the main drawback. The work load of the ATC is drastically increased.

3.2 3 Dimension

When in the third dimensional world, six degrees of freedom or six directions of motion are possible, that are, left, right, forward, backward, above and below. This provides a much better visual advantage to the ATC. By using Holographic 3D projections of the aircrafts around a stipulated radius of the airport, the work load of the ATC officers can be drastically decreased and passenger safety is increased.

4 3D Holograph

Holography is a technique that enables a light field, which is generally the product of a light source scattered off objects, to be recorded and later reconstructed when the original light field is no longer present, due to the absence of the original objects.

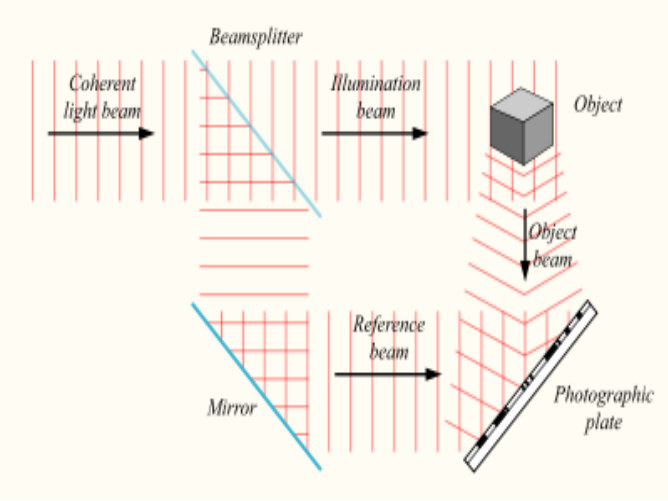
4.1 Laser

Holograms are recorded using a flash of light that illuminates a scene and then imprints on a recording medium, much in the way a photograph is recorded. In addition, however, part of the light beam must be shone directly onto the recording medium - this second light beam is known as the reference beam. A hologram requires a laser as the sole light source. Lasers can be precisely controlled and have a fixed wavelength, unlike sunlight or light from conventional sources, which contain many different wavelengths. To prevent external light from interfering, holograms are usually taken in darkness, or in low level light of a different colour from the laser light used in making the hologram.
Holography requires a specific exposure time (just like photography), which can be controlled using a shutter, or by electronically timing the laser.

4.2 Apparatus

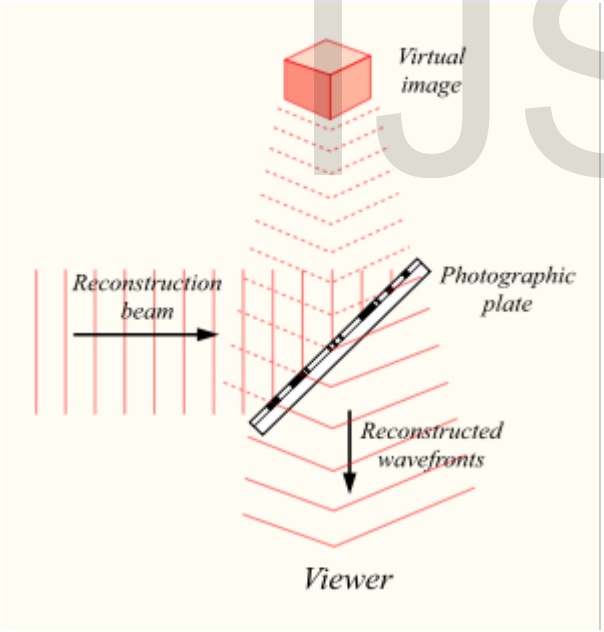
A hologram can be made by shining part of the light beam directly onto the recording medium, and the other part onto the object in such a way that some of the scattered light falls onto the recording mediumA more flexible arrangement for recording a hologram requires the laser beam to be aimed through a series of elements that change it in different ways. The first element is a beam splitter that divides the beam into two identical beams, each aimed in different directions:

- One beam (known as the illumination or object beam) is spread using lenses and directed onto the scene using mirrors. Some of the light scattered (reflected) from the scene then falls onto the recording medium.



- The second beam (known as the reference beam) is also spread through the use of lenses, but is directed so that it doesn't come in contact with the scene, and instead travels directly onto the recording medium.

Fig. 4 The process of construction of a Holograph



Several different materials can be used as the recording medium. One of the most common is a film very similar to photographic film (silver halide photographic emulsion), but with a much higher concentration of light-reactive grains, making it capable of the much higher resolution that holograms require. A layer of this recording medium (e.g. silver halide) is attached to a transparent substrate, which is commonly glass, but may also be plastic.

Fig. 5 The process of reconstruction of a Holograph

4.3 Porcess

When the two laser beams reach the recording medium, their light waves intersect and interfere with each other. It is this interference pattern that is imprinted on the recording medium. The pattern itself is seemingly random, as it represents the way in which the scene's light interfered with the original light source — but not the original light source itself. The interference pattern can be considered an encoded version of the scene, requiring a particular key — the original light source — in order to view its contents. This missing key is provided later by shining a laser, identical to the one used to record the hologram, onto the developed film. When this beam illuminates the hologram, it is diffracted by the hologram's surface pattern. This produces a light field identical to the one originally produced by the scene and scattered onto the hologram. The image this effect produces in a person's retina is known as a virtual image.

5 Advantages of Holographic ATC

- Air crashes can be reduced.
- Required separation between aircrafts can be easily achieved.
- Holding time can be reduced.
- Altitudes of aircrafts from the ground will be calculated easily.
- Less possibility for Human Errors.

6 Disadvantages

Eventhough there are various advantages by 3D-HIATC it possess some demerits because the source used is laser light.

- Limited wavelength range.
- Laser exposure may create dangerous conditions such as flash blindness.

But these demerits can be overcome by following some preventive measures such as

source for creating holographic images.

- Installing interlocks and automatic shutdown.
- Using protective eyewear.

Fig. 6 Laser Radition

7 Infra Red Rays

Exposure to laser light for a long time may affect human eyes. This problem can be solved by using Infra-red rays as a source for producing 3D – Holographic projection. The fig shows the 3D image of an aircraft taken by infrared photography. Infra-red light is the waves of illumination between the visible and the microwave levels of the electromagnetic spectrum. Infra-red light ranges from red to violet. Because infrared light is part of the visual spectrum that we can't see without infrared lenses, infrared photography is literally opening our eyes to a brand new element of our world.

Fig. 7 Infra red image of an aircraft

8 Overall Advantages

Infrared lenses capture what the human eye literally cannot see. This means that any photo you take with your infrared

- Using Infra-Red rays as a lens won't be seen in the same style by anyone without an infrared lens. The image will be unique.

9 Conclusion

This paper recommends the implementation of 3D Holography technique for air traffic control. Thus by using the new technology of 3 Dimensional Holographic Projection for Air Traffic Control, we can minimize the work load of the ATC officers, minimize casualties and human errors, maximize passenger safety and thereby, make Air Traffic Management more efficient. By using this new method in aviation sector a greater technological milestone will be achieved and reduce the risks in ATC.

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