Flying with Antares DLR-H2 - From Stereo images to multi view. Image making from the research of the German Aerospace Center (DLR)

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Abstract. 3-Dimensional scientific illustrations have been used by the German Aerospace Center for more than 20 years. Dietmar Öhlmann has transformed over the years scientific abstract information into visual presentations in hologram, S3D, and M§D media. The latest project Antares DLR-H2, the first emission free flying airplane in the world has been documented in 3D through stereoscopic video. Its research and progress have been documented in two and three dimensional media, a project still in progress.

1. Introduction

The digital hologram of the 4D arrival management system of flight guidance, the holographic animation of the Reichstag in Berlin, a flight with the atoms in a fuel cell for a glasses free multi barrier monitor and the first electric noiseless hydrogen driven plane of the world, the Antares H2 documented with a stereo rig: The German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; in this text used DLR) researches give incredible data base giving access to new vision of our realities, and new visual sensations. The artist and author Dietmar Ohlmann went through an astonishing journey to create the visualization of invisible world of information. From the scientific world into an artistic presentation, we transformed multidimensional data into animated holograms and stereo movie.

2. A timeline of 3D illustration

2.1 Reproduced Time Coordinates

Three dimensional reproductions give us the opportunity to zoom into complex process of natural science, and understand nanoscopic details. We can now follow an atom of Hydrogen on its way into a fuel cell, see the redox reaction between Anode and Cathode with Oxygen to water, watch how electrons are used to drive an engine, and watch the engine driving a car or even a plane. Modern illustration tool of 3 D gives us the freedom to move from flat plane graphics into space and observe the whole process in time. As one image can explains more than a description with thousand words, a 3 dimensional image of a hologram can show more than one thousand of singles two dimensional graphics.
2.2 Source of images making

The potential of illustrating spatial time, recording/illustration of scientific research at the DLR has been already used to illustrate a 4D arrival management system of flight guidance in 1997. Mr. Peter Gent (DLR Braunschweig)(1) used the hologram to illustrate the temporal relationship between space and time in the planning of runway approaches. To transform a multidimensional matrix of numbers with X-Y-Z-and time coordinates into a visual illustration we used the graphic power of an Amiga 500 and the Di-Ho System of Spatial imagine. The illustration engine of the Amiga reproduces the geography of Frankfort airport, the different landing lanes of the planes and very important the exact timing of the landing planes between 9:05 to 9:09 AM. Those images have been sent on a laser lit LCD screen and recorded for an embossed hologram. This hologram then has been printed on foil and placed on the cover of a book to illustrate the functionality of the management flight system. At this time, it was a technical novelty. Later the dot-matrix printer “lightgate” has been further developed by the team of Rob Munday and other companies. Today, digital holographic printers, like the one of Zebra imaging, or XYZ imaging and Geola give possibility to produce holographic images in the size of several meters. Power walls and cave system give feeling of being inside Michael Crichton’s roman “Disclosure,” and James Cameron Avatar brings back the stereogram into cinema. Media techniques reach a level of satisfaction with the public acceptance, and creative making of professionals. Now the question is: how do to get the content satisfying?

2.3 Stereo 3D for scientific illustration

Looking at scientific illustration, we find out that there are different groups of production, there are illustrations:

- Scientific correct, without esthetic and hard to understand.
- Good looking graphics, but lots of scientific errors.
- Good communication, good graphics and scientific correct.
- This later one requiring a lot of exchanges between the scientist and the artist.

Looking for new content in 3 dimensional illustrations, Dietmar Ohlmann was at first overwhelmed by the mass of information and impressions transmitted by Research Centers (i.e.DLR). The improvement in capturing images with scanning via satellite, plane, car or any other mobile recording system, provides a mass of data. These capturing devices record information from other planets, the earth, cities, and historical important places, like the building of “Schloss Neuschwanstein.” When searching our ways in Google Earth, road maps, walking maps we do not imagine the quantity of data it represents. With the data from DLR and RSS,(2) Berlin- Adlershof and Pfaffenhofen (Munich) we can have a virtual walk on the planet mars, fly over the Alps, or Berlin and choose to visit any historical places in Germany. When the artist got the data for the “Thronsaal from Schloss Neuschwanstein” (historical castle), he realized that the depth was so enormous that the whole holographic image was out of focus. So he had first to reshoot them by cutting the building in slices and place the camera out of the building to shoot inside (impossible without Virtual Reality). Then he was rebuilding the room step by step to produce the visualization. Finally the format of the visual has been transformed to fit the printing parameters of the Synfogram(3), a digital holographic recording method. For one Synfogram we use between 1200 and 2000 different stereoscopic images, divided them into pixel and merged those pixels into one holopixel of 0,8mm high resolution and 1,6mm for low resolution and large scale (Geola).
Hologram represents a good media for reproducing illustration of objects, like the “Reichstag in Berlin” (printed at Rabbit Hole), a throne Room of a castle. It is a kind of “hard copy” of the illustration, easy to carry and to show. If we compare the hologram to a stereo movie, the content has to be reduced to 2000 frames i.e. around 7 seconds’ animation. Careful! There is no real time, because the animation is dependent of the movement of the spectator and/or the light. The grammar and the vocabulary of stereo recording and holographic imaging are somehow different, like between 2 dimensional graphic and stereo 3D. The choice of a media depends of the target of your communication and the quantity of information you need to pass on.

The German Aerospace Center, Stuttgart, DLR, is working on innovative energy supply systems for aviation asked for my service. The Institute of Technical Thermodynamics at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt- DLR) conducts research in the field of efficient energy storage systems that conserve natural resources and is expected to supply the next generation energy conversion technologies. The Electrochemical Energy Technology Department works on development of efficient electrochemical energy converters, mainly batteries, fuel cells and electrolyzers; their importance for future power systems, both in stationary power supply and in electro mobility, increases continuously. The department's activities range from cell design, manufacturing processes, and diagnosis to system optimization and demonstration. The scientific and engineering challenges of electrochemical storage technology and energy conversion consist of handling the conflicting goals of efficiency, operating life, convenience, safety and costs.

There in Stuttgart an idea was born: produce the first noiseless, zero-emission aircraft and so the Antares DLR-H2 flies successfully on hydrogen fuel cell power alone. The production of a documentary 3D movie of this flight with the first noiseless hydrogen driven plane is one of the latest 3D productions. Dr Josef Kallo, Group Leader of Electrochemical Systems (5) at DLR Stuttgart had ordered the documentation of the flights with a JVC stereo camera. He indented to use it for visual documentation and education.

Before being able to see the Antares DLR-H2 flying, we need to understand what is new. A Fuel Cell produces electric energy through the reaction of hydrogen. This is fully noiseless, no sound comes out. We just hear the wind moving around the plane. This is nothing to compare with other reaction, like the explosion of a motor with petrol. And because hydrogen fuel cells only react with oxygen in ambient air, the lone byproduct is water, which has no ill effect on the environment. When flying in a straight line, the Antares DLR-H2 is capable of running at about 52% efficiency, drawing 10kW of power in the process (it's capable of delivering up to 25kW). It can go for roughly 450 miles, flying at speeds of 105 mph.

The final film shows different steps: the stereo recording of the plane Antares DLR – H2 as well as the scientific illustration of the function of the fuel cell. The 3 dimensionality allows us to show the integration of the payload pod of the Antares DLR-H2, what the interaction of producing energy is and how this is used in fly. This documentary presents a high level research between institute and Industry to produce the next generation of aircraft. More than effect and surprises, expected in 3D
cinema, here, the three dimensionality of the film served to enhance its educative components with a virtual flight through the energy process of a flying machine. The idea, to produce an animation giving a sensation of holographic perception, a feeling of “floating in space”, while maintaining a big scale of stereoscopic depth is a big challenge for this ongoing project. Already, to shoot real life recording of a plane with a stereo rig and to transform them later for a multi panel view presents some difficulties. The stereo-base distance of finished stereo camera, like the JVC GS TD1 or Sony HDR-TD10E, works super for most standard recording situation as used for home video. A professional rig certainly has more possibilities, but for price –quality relationship those cameras are worth their price. If we want to interpolate the stereo images to fit on a 5 view or 9 view stereo panels, we find that there is still some spatial correction to do. Professional software like the z.i.c.e.3D from 3D International can help to do so. Cheap solution does not exist for this task.

The presentation has been planned to be presented at a special environmental “parcour” to a passing by public at the Stuttgart Airport. A stereo system with glasses would have been impossible because the installation should stay for a long period and in a free public access. A large size 3D panel, say a 55/60 inches wide panel, looks great with the flying Antares DLR-H2, but this size of monitor needs a long viewing distance of 5 to 8 meters to see a sharp image, not being into it. So it was not possible to place it in a gangway. To satisfy the spectator in close and far distance, a special 26 inches monitor for medical application has been used.

3. Discussion

An illustration for 3 Minutes video would need the capacity of 5 multiplexed holograms. The multiplexed recording system, first formulated by the Nobel Prize winning physicist Gabriel Lippmann in 1908 is quite difficult to use in real time recording, while stereo riggs and electronic interpolation provide good results.(6) The documentation and the illustration of the Antares DLR-H2 show a new need and potential for scientific documentation, education and communication given by 3D media. The floating images of a hologram is finally the most despaired wanted constructed perception, still we have to reach it on the base of physical availability and affordable bases. Legal fights between different patent, like different AVHC Format and incompatible viewing bases. Without those problems, the way for S3D, M3D and digital holography is open and gives us access to new media to illustrate a growing complex world of scientific and artistic image making and discovery. Nevertheless, as fantastic as the image of S3D cinematographic production looks like, do not you think it needs further education of a proper grammar in content production? Should not we prepare all together, artists, scientists, educators, the time where 3D is not just “nice to have”, but “useful to read”?

4. Conclusion

The world of 3D is able to give us access to a new perception of the micro- and the macro-cosmos. The most fascinating images are created by natural phenomena, modern instrument are able to capture. There are a few historians who mention, if the history of image making would not have had the strong focus on fine art, the images of the Hubble telescope would be the great art of our time(7). 3D has its fantastic resources, but still the difficulties of its technological imperfections: we need to wear glasses, fight with lenticular distortions or be confronted to external sources of constructing light sources and clipping windows. Still, researchers and visual creators are pushing those media to the outer limit, showing us a world of surprise and fascination. In art, holography is not accepted because it is too technical, in advertisement, it is too imperfect, for technical illustration is a true need but a too slow interface.
References

(1) Prof. Dr. Heinz Winter, Peter Gent, Dietmar Öhlmann 1997 *an intelligent solution: the four dimensional arrival management system of flight guidance.* (The first synthetic 4D hologram for the DLR flight Braunschweig)

(2) Dipl. – Geol. Frank Lehmann, Leiter der Struktureinheit Sensorkonzepte und Anwendungen 2007. Using 3D capturing and mapping to create a true colored hologram of Berlin Reichstag.. DLR Berlin. Synthetisches Hologramm

(3) Odile Meulien Dietmar Öhlmann 2007 *Synfograms: a new generation of Holographic Applications* (Proc. on CD Holopack-Holoprint, Hong Kong)

(4) Dr. N Wagner P Szabo M Lang D Öhlmann *Stereo Illustration of energy storage and extraction.* Video Production 2010 (DLR Stuttgart, Institut für Technische Thermodynamik, Elektrochemische Energietechnik, 5view)

(5) Dr. Josef Kallo, Projektleiter D Öhlmann 2011 *Stereo recording with 3D camera: Antares H2, the electric plane.* „Antares“/ DLR Stuttgart, Institut für Technische Thermodynamik, Elektrochemische Energietechnik. Stereo recording and multi channel conversion for 5-view presentation. The film is in permanent presentation at Stuttgart Airport, terminal 3, on a glasses free stereo panel. DLR Press.

(6) Odile Meulien Dietmar Öhlmann 2008 “*Syn4D displays for a new generations of Holographic Applications*” (Proc. SPIE Europe, Strasbourg. Vol 7001)

(7) James Helkins, art historian, School of Art, Chicago, 2009, “*Masslose Bilder*” I.Reichel, Siegel, Wilhelm Fink Verlag.

Images

Pic 1: Antares DLR-H2, ©DLR 2010
Pic 2: Integration of PEM-FC, ©Syn4D2012, research by DLR, Lange and HYGS
Pic 3: Design of a 4D Hologram for embossing, DLR 1997, ©Dietmar Öhlmann

Pic03: Holographic illustration of the 4D arrival management system of flight guidance, printed as Hologram by the DiHo System, 1997.