Institute of Art Design and Technology, Dun Laoghaire
Faculty of Creative Technologies

Underwater Cinematography:
Technology is transforming the art and craft of capturing images underwater which is leading to an increase of its prevalence in film today.

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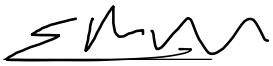
Signed: 

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Introduction

Underwater film making provides a sense of otherworldliness and a lack of boundaries, which can be used to create a sense of wonder and adventure. The underwater environment also offers a chance to create unique and visually stunning shots that are difficult to achieve or replicate on land, in a studio environment or through computer generated imagery. These shots can add a layer of uniqueness to films and can help to further impress audiences and add to the diversity in the art of film making.

This thesis argues that a combination of technological developments and the ingenuity of filmmakers in taking advantage of that technology is leading to an increase in the prevalence of underwater cinematography in narrative, documentary, and in television today. In Chapter one, the history of underwater cinematography is explored and we discuss how the lack of technology played a key role in the lack of underwater cinematography coverage in films in the past, particularly during the years 1916-1980. Chapter Two delves into the factors that have contributed to the rise of underwater cinematography in contemporary film. It also discusses how audience appetite is merging with technological developments in the film production process. With an abundance of content available, audiences crave more immersive and unique stories, and producers and studios recognise this. Therefore, underwater cinematography has become more valuable in the film production process. The film industry has recognized the value of underwater cinematography in meeting this demand. The final chapter expands on the argument in chapter two and provides case studies to illustrate how technology has strengthened underwater cinematography in terms of image quality, efficiency, and reliability.

Undoubtedly, audiences are now exposed to more underwater filmmaking than ever before. A rise in underwater cinematography has been observed recently as a result of the expanding availability and affordability of underwater camera equipment, the expansion of streaming services, and the demand for visually appealing content in general.

Particularly, nature documentaries and films about the ocean and marine life have grown in popularity, and filmmakers use underwater photography to get breath taking shots of the undersea world and marine life. For instance, the 2017 documentary "Chasing Coral" employs underwater photography to highlight the disastrous impacts of coral bleaching, and

the Netflix documentary series "Our Planet" offers magnificent images of the ocean and its creatures.

Underwater cinematography is not just utilised in nature documentaries but also in feature films and television shows to produce aesthetically stunning scenes and provide a sense of tension or mystery. For instance, the underwater sequence in the opening scene of the James Bond movie "Skyfall" is breath taking, and the second season of the Netflix television series "Stranger Things" also includes a disturbing underwater scene.

Apart from being a powerful storytelling tool, underwater cinematography can also help to raise awareness of the need to safeguard our oceans and marine life. Social media sites like Instagram and YouTube have played a significant role in spreading awareness of the ocean's beauty and significance.
Both amateur and professional filmmakers share breath taking images of the underwater world with a larger audience, aiding in the dissemination of information regarding the importance of protecting our oceans from environmental dangers like pollution and climate change.

Underwater cinematography is still relatively rare in film, compared to bygone years, which can make it a novel and unique storytelling technique. By using underwater environments and filming techniques, filmmakers can create a distinct and memorable visual style that sets their film apart from others.

Overall, underwater cinematography can be a powerful storytelling tool that can enhance the visual and emotional impact of a film. By capturing the unique beauty and dangers of the underwater world, filmmakers can create a distinctive and immersive experience that can captivate and engage the audience.

All of this comes together to help tell unique and visually impressive stories in film. Overall, the increasing prevalence of underwater cinematography in cinema today is a testament to the power of technological advancements and the creativity of filmmakers. By taking advantage of these developments, filmmakers can provide audiences with unique and engaging stories that transport them to new and exciting worlds.

Chapter 1

Chapter 1: The effects of the absence of technology in underwater cinematography.

Due to the lack of availability of technology in the past, underwater film making was too costly and inefficient and thus out of reach for a lot of film makers. As a result audiences were not exposed to the wonderful environments and immersive world building that underwater cinematography helps to create.

What I will be arguing in this chapter is how the lack of technology from as early as 1916 up until the 1980's played a major factor in the lack of appreciation from an audience perspective, of underwater filmmaking and the wonderful environments that it can create. I will be arguing how, like with other modern film making techniques, underwater cinematography can serve to enhance storytelling and world building in film and how it helps to immerse audiences into a story even more. While it is difficult to say whether all film audiences are becoming more hungry for new experiences, it is clear to say that due to the abundance of content that audiences have available to them, audiences have become more discerning and are looking for films that offer something different and distinctive from what they can watch at home. We see this with the release of new films today such as Avatar: The Way of Water which employs ground breaking underwater performance capture technology, along with advancements in computer generated imagery and visual effects to create a visually stunning and immersive experience which audiences are finding to be something unlike they have ever experienced before. The same can be said for blue planet II (2017), the film makers employed ground breaking technology to capture the beauty of the worlds oceans. They designed camera & lighting equipment that captured the environment in unprecedented detail. All of this comes together to produce images and tells the story of our oceans which highlights the beauty, complexity, and fragility of our planet's oceans.

Firstly however, I would like to give you a backstory on the origins of underwater cinematography in order to highlight how the combination of technology and the creative powers of cinematographers is merging together to increase the prevalence of underwater cinematography in film today and is thus strengthening the creative powers of film as an art form.

The early history of underwater cinematography:

Underwater cinematography has a long and fascinating history that dates back to the early days of motion pictures. In the early 1900s, pioneering filmmakers began experimenting with underwater cinematography, using crude underwater cameras and lighting equipment. Some of the earliest underwater films were documentary shorts that captured the beauty and wonder of the underwater world.

One of the first known underwater films was captured by the French researcher and filmmaker Jean Painlevé in the 1920s. Painlevé's films captured the beauty and grace of marine life and paved the way for further exploration and experimentation in underwater film making. He is considered one of the most important and influential documentarians of the 20th century and his films are celebrated for their stunning visuals, scientific accuracy, and imaginative storytelling. Painlevé first began experimenting with underwater photography in the 1920s, and went on to produce over 60 documentaries about the natural world, including a number of ground breaking underwater films. He is perhaps best known for his series of documentaries about marine life, including "The Love Life of the Octopus" and "The Man-Eating Sharks." These films combined innovative underwater photography with a poetic and imaginative approach to storytelling, and remain highly regarded to this day.
Painlevé was passionate about conveying the beauty and complexity of the natural world through his films and he did this by becoming an early adopter of new technologies[1] and made pioneering use of underwater cameras, lights, and sound recording equipment in order to tell his stories. Today, Painlevé is widely recognised as a major figure in the history of documentary filmmaking[2] and his work continues to inspire and influence filmmakers around the world. He is considered a visionary and a pioneer in the field of underwater filmmaking, and his legacy continues to be felt in the art and science of underwater imaging.

Due to the lack of accessible equipment in the past, underwater filmmaking was very difficult and expensive. Early filmmakers had to rely on cumbersome and unreliable gear, such as

[1] (*Science Is Fiction: 23 Films by Jean Painlevé — Cineaste Magazine*, n.d.)

[2] (*Review of Zoological Surrealism: The Nonhuman Cinema of Jean Painlevé*, 2021)

diving suits with built-in cameras or waterproof cameras encased in metal boxes in order to film their scenes. The calibre of the technology and the expertise of the divers using it severely constrained these early attempts at creating immersive visually impressive images. In addition, filming underwater needs specific training and gear, including scuba diving gear, underwater camera housings, and specialised lighting. Underwater filmmaking was a costly and difficult endeavour for the majority of filmmakers due to the cost of this equipment.

Recent technological developments have increased the accessibility and affordability of underwater cinematography, drones with underwater cameras have made it feasible to record videos in impossible to reach areas and waterproof cameras and housings have shrunk and become more dependable. As a result, a growing number of filmmakers are able to include underwater sequences in their movies and with a higher level of artistic freedom. Yet, due to the specific gear and training needed, underwater filmmaking may still be difficult and expensive, especially with the advent of new technologies. But, it is now easier than ever to record breath taking images of the undersea environment, providing filmmakers with fresh creative possibilities.

20,000 Leagues under the sea:

Early film cameras were not intended to be used underwater, and the underwater filmmaking equipment that was available was cumbersome, costly, and challenging to use. Filmmakers had to use crude cameras and improvised equipment in the early days of underwater cinematography to capture a world on film in an underwater environment. "20,000 Leagues Under the Sea," a feature film produced by Walt Disney films, was one of the earliest films that used extensive underwater cinematography. It was shot in 1954 using a specially constructed underwater camera, which was essentially just a wooden box with a lens attached. Although audiences were impressed with the images they were seeing, the solution that the film makers came up with to shoot this film using those methods was cumbersome and unreliable and the images were also pale in comparison to the results you would be able to get by utilising modern technology today.

20,000 Leagues Under the Sea was a major box-office success. It was praised for its innovative visual style and technical achievements, and helped to popularise the genre of science fiction and underwater adventure films (underwater adventure films are a sub-genre of adventure and science fiction films that take place primarily underwater). Some modern examples of underwater adventure films include "Jaws," "The Deep," and "Abyss." Thanks to the innovations from the film makers on this film, the film received praise and was enjoyed by the audience. This film subsequently went on to win an Academy award for best production design and best visual effects. However, as mentioned above. The technology for filming underwater was simply not developed enough for this time and the studio encountered many problems during filming. As a result, producers and cinematographers for other pictures were hesitant to film underwater until technology had caught up.

Jacques Cousteau:

The underwater cinematography genre gained popularity during the 1960s and 1970s because of the work of French oceanographer and filmmaker Jacques Cousteau, whose documentaries and television shows won numerous awards. The underwater camera sled and scuba diving gear, which Cousteau and his colleagues invented, completely changed the underwater cinematography industry. And following this period, more and more audiences began to be exposed to the underwater cinematography. Often credited as the father of modern underwater cinematography. Cousteau was able to capture stunning footage of underwater creatures and landscapes, and bring the mysteries of the sea to audiences around the world. In 1956, he introduced the world to the underwater realm with the release of his first documentary film, "The Silent World." This film was a critical and commercial success and helped introduce the underwater world to millions of audience members all over the world. His footage was revered in the fact that it captured footage to a very high level of detail at the time and the colours that he was able to capture on film was considered very accurate and true to life [3] A lot of the material he presented had simply never been seen by audiences before. His film ‘’The Silent World’’ won the highest prize, the Palme d’Or, at the Cannes Film Festival.

In terms of innovation, his co-invention of the ‘closed circuit rebreather’ (scuba diving support equipment) continues to be used by underwater cinematographers and diving professionals to this day.

Over the course of his career, Cousteau made over 100 documentaries and wrote several books about the ocean and its inhabitants. It is also worth noting that Cousteau was an early advocate for ocean conservation and his worked showed this [4].

[3] *(Aboard the Calypso – Sea and Cinema with Jacques Cousteau, 2018)*
[4] (Blakemore, 2021)

Figure 7 - Jacques Gusteau

Technology advancements in the 1980s and 1990s opened up underwater filming to a wider audience than ever before. Drones with underwater cameras made it possible to record video at a distance, and waterproof cameras and housings shrank and grew more dependable. In order to create breath taking visuals and captivate audiences, filmmakers started including underwater sequences into their movies and TV shows.

Al Giddings:

Al Giddings is a renowned underwater cinematographer and explorer who is often referred to as the "King of the Underwater Cinematographers." Throughout his career, Giddings has captured some very iconic images of underwater worlds and he has contributed towards the advancement of underwater cinematography. He has worked on numerous high profile documentaries, television shows and feature films over his career including 'Titanic', 'The Abyss', 'The Deep' and many other as a second unit underwater cinematographer. One of Giddings' most notable achievements was the development of new underwater camera systems and techniques that allowed for longer and deeper dives, as well as the capture of high-quality footage in challenging underwater environments. Among this, he is noted as having a willingness to take on challenging projects[5] and to travel to remote regions and document underwater environments that have not been seen by audiences before.

Figure 8 - Al Giddings

[5] (International Training - SDI, TDI, ERDI, PFI, 2021)

Conclusion:

In general, it is clear to see how the lack of technology served as a key impediment to underwater cinematography's growth as a popular trope of film making in the past, although this has changed as technology has advanced.

As technology has improved and been more inexpensive, underwater filming has become more and more available to filmmakers of all experience levels. In order to produce outstanding and aesthetically appealing underwater footage, filmmakers may now select from a broad variety of specialised underwater cameras, housings, and accessories as well as cutting-edge lighting and post-production equipment in order to tell their stories.

Chapter 2

In the previous chapter, we illustrated how the lack of technological advancements was the main barrier for the widespread implementation of underwater cinematography in cinema today. I listed out examples why technology was necessary to overcome the challenges posed to the film makers at the time.

In this chapter I will be proving how technology was instrumental behind the improvement of underwater cinematography and the higher rate at which underwater cinematography is appearing in narrative, documentary and Television Content. And how thanks to these developments in technology film makers are utilising the tools available to them to help improve the storytelling capabilities in film.

For another part of this chapter I will also seek out to prove how appetites from audiences for new experiences has also played a factor in the higher appearance of underwater cinematography in films. Essentially, how technological developments is merging with audience appetite.

Advancements in technology have made it possible for filmmakers to create immersive and interactive experiences that go beyond traditional storytelling techniques. Virtual reality, augmented reality, and other cutting-edge technologies are being used to create new forms of cinema that blur the lines between reality and fiction, providing viewers with an even more immersive experience. For example, advances in CGI and motion-capture technology have made it possible to create more realistic and visually stunning films, including fantasy and science fiction movies that would have been impossible to create just a few decades ago. For example, the improvements in digital cinema technology allows film makers to create films that appear to never cut camera angles and have a consistent flow from beginning to end,. This is down to the developments of technology. I will also be addressing both the negative and the positives outcomes that technology has had for film storytelling. Overall however, I will be arguing that technology has mainly had a positive impact in underwater cinematography. It is the opinion from several cinematographers that I will mention, that advancements in technology and innovation has helped to make the underwater filming process safer, more efficient and more accessible to film makers which has only helped to further strengthen the artistic abilities of film storytelling as a whole.

While technology has made underwater filming more accessible and has improved the quality of the images being captured It has also has had its negative impacts. It is important to note however that these negatives mainly apply to underwater film making in *wilderness areas*, outside studio walls which I will make a point to distinguish between the two. It mainly boils down to a responsibility for film makers to use the technology responsibly and with a duty of care for the underwater environment and the animals that inhabit it. Due to global warming we have seen an increase in nature and wilderness programming and documentaries but unfortunately, the way in which these programs have been captured has ironically resulted in further damaging of the environment [6] The amount of damage isn't sizeable to be fair, but the damage should be at zero. And it isn't.

It is important for film makers to use underwater film making technology in a safe and ethical manner that does not result in further disruption or harm to wildlife areas and the eco system that we are trying to document (usually with good intentions). This is now what I will begin to touch on below.

This has led to the application of cutting-edge technology, creative narrative methods, and novel and outlandish methods of filmmaking, including the use of underwater cinematography. Underwater scenes offer a unique and rarely seen perspective of the underwater world, which is often filled with exotic and colourful marine life. This otherworldly beauty captures the imagination of viewers and transports them to a world they may not have seen before. Moreover, the sense of adventure and exploration that comes with underwater cinematography is exciting and draws audiences in. The technical skill required to capture high-quality underwater footage, combined with the inherent dangers of shooting in such an environment, adds to the mystique and intrigue of underwater cinematography, making it a fascinating and captivating genre for audiences.

In today's society, where most people are aware of and accept climate change, the demand for content cantered around this topic is increasing. This demand has been further amplified by the recent technological advancements in underwater cinematography, which has allowed filmmakers to capture stunning footage of the underwater world like never before. As a result, we are seeing more and more content that features underwater cinematography as a

[6] (Aitchison et al., 2021)

major driving force that helps to bring the storytelling to life, and offers viewers a unique and visually stunning perspective on the world around us.

Technologies first impact on the improvement of underwater cinematography:

Technology began making its mark on underwater cinematography in around 2008. Coinciding with the advent of digital cinema cameras. Before 2008. Celluloid Film was the main format for capturing images. This presented the first major problem that needed to be solved. Film cameras were quite large, bulky and expensive. This therefore meant that capturing images underwater was a highly niched and expensive task and was not easily possible for a lot of low budget and even on big budget pictures [7] Screenwriters who had sections of their film in an underwater environment were often forced to re-write their scenes to get around this challenge.

With the advent of digital cinema cameras, it opened up the possibility for more people to shoot images at a lower cost. This was because more film makers began to own cinema equipment which meant that there was a market for manufacturers to fill and thus more people owned more underwater film making equipment.

[7] (Underwater Cinematography, Johnson William, 1952)

How technology has improved underwater cinematography:

Underwater filmmaking has seen significant improvements in recent years due to advancements in technology. Some of the ways in which technology has strengthened the artistic abilities of underwater cinematography and has thus led to an increased appearance of underwater cinematography in films.

1. Improved Camera Equipment: The quality and versatility of underwater camera equipment have improved greatly in recent years, making it easier for filmmakers to capture higher resolution, true to life colours and to bring more support equipment into the underwater environment. In recent years, waterproof camera housing manufacturers have created housings that allow digital cinema cameras to be used. In addition, the housings allow for greater control over focus, a wider range of specialist lenses, greater control over exposure, and colour, all of which enables filmmakers to create visually stunning images [8]

2. Better Lighting Technology: The development of powerful and compact LED lighting systems has made it possible for filmmakers to create lighting effects that were once impossible or at least, expensive and difficult to create. This has opened up new possibilities for artistic expression and has allowed for the creation of more atmospheric and dynamic underwater images. With the invention of Hydrargyrum Medium-Arc Iodide (commonly referred to as ''HMI'' lighting) and LED cinema lighting it has allowed film makers to light their scenes with increased accuracy & clarity [9]

3. Enhanced Safety and Reliability: Technology has also improved the safety and reliability of underwater filming equipment, reducing the risk of damage to both the equipment and the environment. Equipment is now being made with renewable and non-toxic materials. This has allowed filmmakers to explore new locations and create images that were previously impossible due to safety concerns.

[8] (*Underwater Optics Innovations Serve Science and Cinema*, n.d.)
[9] (Staff, 2018)

4. Advancements in Post-Production: With the advent of high-performance computers and specialised software, post-production has become more efficient and accessible to underwater filmmakers. This has allowed them to make more detailed and complex image adjustments after they have filmed their scenes. It has even made it possible to add special effects.

Overall, technology has made it possible for underwater filmmakers to create more beautiful and artistic images and to tell more impactful stories through their work. It has also made the process more efficient and accessible to film makers with a smaller budget.

Appetite from audiences for new experiences:

In todays digital age, audiences have access to a seemingly limitless array of content and are being constantly bombarded with new, innovative ideas and visual storytelling techniques. In order to keep up with this demand, Filmmakers and production companies are continually pushing the limits of what is possible in film and researching new methods of storytelling and audience engagement in order to keep up with this audience desire for new and different experiences. This can involve the application of cutting-edge technology, creative narrative methods, and novel and outlandish methods of filmmaking.

This was very evident with the impressive immersive quality that audiences enjoyed recently with Avatar: The Way of Water. This film employed a film making technique that a lot of very experienced film makers said would not be possible [10] underwater motion capture. Underwater motion capture is a technique used to capture the movements of actors or objects underwater, allowing for accurate recreation of their movements in computer-generated imagery. This is achieved through the use of specialized motion capture equipment that can function in an underwater environment.

Audiences are captivated by underwater cinematography for several reasons. Firstly, it offers a unique and rarely seen perspective of the underwater world, which is often filled with exotic and colorful marine life. This otherworldly beauty captures the imagination of viewers and transports them to a world they may not have seen before. Additionally, the sense of adventure and exploration that comes with underwater cinematography is exciting and draws audiences in. Finally, the technical skill required to capture high-quality underwater footage, combined with the inherent dangers of shooting in such an environment, adds to the mystique and intrigue of underwater cinematography, making it a fascinating and captivating genre for audiences.

Not to mention, the speed at which content is being made is in stark contrast to the production speed in the past. Because of technological improvements, changes in production techniques, and changes in distribution techniques, the process of film making is now quicker than it was in the past. Traditional film has been entirely supplanted by digital cameras and editing software, which has sped up and improved the speed of film production. Filmmakers may

[10] (Marcks, 2023)

now reach audiences more swiftly and readily than ever before because to the growth of streaming services and internet distribution platforms.

Overall, it is clear that technological advancements have been essential in the evolution of underwater cinematography, and it will be interesting to see how new technologies will continue to shape this industry in the future.

Chapter 3

Examples from film productions where technology has allowed film makers to strengthen world building in cinema.

Introduction

In the previous chapter, I proved how technology has played a major part in the increased prevalence of underwater cinematography in film production today. I listed the ways in which film makers have utilised modern technology advancements in order to strengthen storytelling in film. In this chapter I will be describing exactly how film makers have used this technology in order to strengthen world building and created more immersive stories as a result. I will be dissecting four films which placed underwater cinematography as a crucial element in creating immersive films for audiences.

The films that I have placed on this list have all placed underwater cinematography as a key driving point for increasing audience immersion and strengthening the narrative of the stories they are trying to tell. All of the films on this list were successful in creating a sense of wonder, danger and realism that transports the audience into a different world. Additionally, by relying on the technology developed to improve underwater cinematography, the film makers have also been successful in creating unique world building which, in todays world of endless content, is important for production companies makers to strive for.

By utilising underwater cinematography they have had the following effect on their audience:

1. Visual immersion: Underwater environments has the potential to create visually striking images. By using underwater cinematography, filmmakers can create a beautiful and majestic world which can create a sense of visual immersion that can draw the audience into the story. The sense of visual immersion can make the audience feel as though they are a part of the story. By providing a glimpse into the underwater world, which audiences rarely get to see, filmmakers can create a sense of wonder and fascination that will leave a lasting impression on the audience.

2. Sound immersion: Filmmakers can use the unique way sound travels underwater to create an immersive audio experience. By using sound effects and music that reflect the underwater environment, they can enhance the emotional impact of the film. Advanced audio technologies like *binaural recording can also be used to capture sound in three dimensions and create a more realistic experience for the audience. By carefully crafting the soundscape of the film, filmmakers can transport the audience to the underwater world and make them feel like they are a part of it[11]. This can lead to greater engagement and emotional investment in the story and characters.

   **Binaural recording is a method of capturing audio using two microphones placed at certain distances, which creates a 3D stereo sound that has the effect of replicating human hearing*

3. Emotional immersion: Underwater environments can be dangerous and unpredictable, and filmmakers can use this to create a sense of emotional investment in the story. By using underwater cinematography to create suspense, tension, and danger, filmmakers can engage the audience emotionally and increase their investment in the story.

[11] (The power of sound design, CHRISTOPH LOUVEN, 2018)

Avatar: The way of water

The Way of Water is the long-awaited sequel to the 2009 box office hit Avatar, directed by James Cameron. It follows Jake and Neytiri as they explore the wonders of Pandora and team up with a young Na'vi girl to save their home from a new threat. This film employs an extensive use of underwater motion capture technology and underwater cinematography which allows them to capture the movements of the actors even while they are submerged in water. Tracking points were placed on actors and cameras filmed and tracked these points digitally. These tracking points were then placed into a computer which generates an animation. Underwater motion capture, according to the films visual effects supervisor Daniel Barrett had never been done before to the extent at which is was used in the production of the film and countless technological leaps were needed in order to create an immersive and visually appealing film. One of these leaps was being able to film high resolution 3D images underwater. A technology dubbed as 'Deep X' was created by underwater cinematographer Pawel Achtel. This technology significantly reduces distortions caused by particle movement in the water (such as air bubbles and wave currents). The Deep X makes use of two perpendicular Nikon UW-Nikkor underwater lenses. This setup gives the viewer an unsurpassed sense of depth by creating a hyper realistic 3D image for large format cinema screen [12]

Essentially, the technology created by this cinematographer drastically reduced the chromatic aberration, horizontal distortion and image softness that modern underwater housings has yet to solve. This step forward in underwater film making technology is an example of the next pivotal step necessary to elevate the image quality of underwater cinematography.

[12] (Mendelovich, 2022)

Figure 9 - Underwater motion capture

Jago. Life Underwater

Jago tells the story of an 80 year old sea nomad called Rohani who has spent his life in the waters of South East Asia's Coral Triangle. The story is told entirely from Rohani's perspective, against the spectacular backdrop of the Togian Islands, and recreates events that capture the turning points in his life, as a hunter and as a man. The film uses stunning underwater photography and footage to showcase the diverse marine life in the region, as well as to illustrate Rohani's hunting techniques and way of life. The film was praised for its beautiful cinematography and insightful portrayal of a unique way of life that is threatened by environmental change and the film won multiple awards at film festivals around the world, including the Grand Jury Award for Best Documentary Feature at the 2016 Guam International Film Festival.

The film's cinematography was primarily captured by underwater cameraman and director of photography, Simon Spear. The underwater scenes were shot using high-quality underwater cameras and equipment, which allowed the filmmakers to capture the beauty and intricacy of the marine life in the region.

Figure 10 - A still from Jago. Life Underwater - this still illustrates the impressive dynamic range that is made possible with modern digital cinema underwater housings.

Figure 11 - A still from the film Jago. Life Underwater

The filmmakers used a combination of close-up shots, wide-angle views, and slow-motion footage to create a visually stunning and immersive experience for the audience and the use of natural lighting and the diverse range of colours and textures in the underwater environment were also highlighted through the film's cinematography. This was made possible by the cinematographers using a specially adapter underwater housing for a Canon C200 digital cinema camera.

In addition to the underwater cinematography, the film also features interviews with Rohani and his family, which were shot using a mix of handheld and static camera shots to provide an intimate and personal perspective on the sea nomad's way of life.

Overall, the cinematography in "Jago: A Life Underwater" is a major highlight of the film, and plays an important role in creating a vivid and immersive portrait of the unique underwater world and way of life of the sea nomads in the Togian Islands.

Blue planet II

"Blue Planet II" is a nature documentary television series produced by the BBC Natural History Unit. The series is well-known for its stunning cinematography, which captures the beauty and complexity of the world's oceans and marine life.

The cinematography in "Blue Planet II" was captured by a team of expert underwater cinematographers, who used a range of cutting-edge camera technologies to capture footage both above and below the surface of the water. The series was shot in ultra-high definition, which allowed for stunningly detailed and immersive footage that showcases the diverse range of colours, textures, and behaviours of marine life.

The series also utilised new camera technologies, such as underwater robots and specially designed underwater drones, to capture footage of marine life in ways that were previously impossible. This included capturing the first footage of a live giant squid in its natural habitat, as well as stunning footage of bioluminescent creatures and deep-sea creatures that had never been seen before.

In addition, the camera team designed a one of a kind lens system that distorted light and allowed them to film a split screen image of the top side and underneath the ocean at the same time to illustrate the hunting tactics of a sea lion. The result was the image below which looks surreal to the viewer. What the cinematographers have managed to represent here is demonstrate how differently light functions in an underwater environment, due to the nature of light refraction*. Essentially, underwater light that hits the sensor has a magnification effect compared to that on land. Objects appear closer than they are [13]

*Light refraction refers to the bending/distortion of light rays.

[13] (Understanding Light for underwater photography, 2023)

Figure 12 - A still from Blue Planet II – illustrating the split screen image effect.

In addition to the impressive technical achievements, the cinematography in "Blue Planet II" is also noted for its stunning visual storytelling. The series employs a range of techniques, such as slow-motion footage and time-lapse photography, to create a cinematic and immersive experience for the viewer. Time-lapse photography was used to capture the movement and behaviour of marine life over extended periods of time, which provided a unique and visually stunning perspective on the natural world. The series camera technicians also designed, for the first time, ultra low-light and Infrared cameras to capture footage in the dark depths of the ocean, revealing previously unseen creatures and behaviours. This same technological achievement was employed in netflix's production of 'A Night on Earth'. In this series, creatures from the deep were revealed in a brand new light. Footage of the animals behaviours were never quite seen before at night time and thanks to the technology that was developed by the cinematographers on this show were used in this production to strengthen the narrative and provide images for audiences that has never been seen before.

Figure 7 - A still from Blue Planet II – illustrating low light image capturing.

Overall, the cinematography in "Blue Planet II" is a major highlight of the series, and has set a new standard for nature documentaries in terms of its technical achievements, visual storytelling, and stunning beauty [14]

[14] (*Underwater World: The Amazing Tech Behind Blue Planet II | loveexploring.com*, n.d.)

Chasing coral

"Chasing Coral" is a 2017 documentary film directed by Jeff Orlowski that explores the impact of climate change on coral reefs around the world. The film's cinematography is a major highlight, and plays an important role in both showcasing the beauty of coral reefs and highlighting their rapid decline.

The filmmakers used a range of camera technologies to capture the footage for "Chasing Coral," including time-lapse photography, extreme macro lenses, microscopic image capturing, and underwater camera systems. The film features stunning close-up shots of coral reefs, capturing their vibrant colours and intricate structures in detail.

In addition to showcasing the beauty of coral reefs, the cinematography in "Chasing Coral" also serves to illustrate the devastating impact of climate change on these delicate ecosystems. The filmmakers used time-lapse footage to show the rapid bleaching and death of coral reefs due to rising ocean temperatures and acidification.

The film also features stunning underwater shots of marine life and the various human-led efforts to save coral reefs, which were captured using a mix of handheld and underwater camera systems. The use of natural lighting and the diverse range of colours and textures in the underwater environment were also highlighted through the film's cinematography. The use of macro lenses helped capture the stunning beauty and intricacies of coral reef structures, providing a unique perspective on the ecosystems.

Figure 8 - A still from Chasing Coral – Illustrating microscopic image capturing.

Overall, the cinematography in "Chasing Coral" is a major strength of the film, and plays an important role in both showcasing the beauty of coral reefs and highlighting the urgent need to protect these vital ecosystems. Technology was critical to its success as it helped capture the stunning beauty of coral reefs, their rapid decline, and the impact of climate change on these vital ecosystems. Without technology, it would not have been possible to showcase the urgency of protecting and preserving these underwater wonders.

Conclusion

To conclude, after examining the history of underwater cinematography, it is evident that technology has had a crucial role in the development and improvement of underwater cinematography. The improvements in the camera housing compared to the technology first used in 1916 was the first crucial step in reducing image imperfections and was a major milestone which helped greatly in making images more vibrant and immersive.

In todays climate conscious world, underwater cinematography will continue to be a much needed visual storytelling tool that shows the beauty and importance of our oceans and thanks to the developments of technology and the ingenuity of cinematographers to utilise it well, the future of the art form is bright.

We have seen how technology has made underwater filming less expensive and thus has become more and more available to filmmakers of all experience levels. In order to produce outstanding and aesthetically appealing underwater footage, filmmakers are now in the position to select from a broad variety of specialised underwater cameras, housings, and accessories as well as cutting-edge lighting and post-production equipment.

The pioneering work of Pawel Achtel as mentioned in chapter 3 is an example of a cinematographer who’s work is elevating the capabilities of the art form. Further work like this is needed from film makers to help push the boundaries of what is possible.

Bibliography

Aitchison, J. D., Aitchison, R., & Devas, F. (2021). Assessing the environmental impacts of wildlifetelevision programmes. *People and Nature*, *3*(6), 1138–1146. https://doi.org/10.1002/pan3.10251

An investigation into the equipment, techniques, and problems associated with underwater cinematography. : Johnson, Robert William. : Free Download, Borrow, and Streaming : Internet Archive. (1952). Internet Archive. https://archive.org/details/aninvestigationi1094514290/page/n69/mode/2up

Blakemore, E. (2021, October 29). *5 ways Jacques Cousteau pushed to protect the planet*. History. https://www.nationalgeographic.com/history/article/5-ways-jacques-cousteau-pushed-to-protect-the-planet

International Training - SDI, TDI, ERDI, PFI. (2021, September 23). *Al Giddings - International Training - SDI | TDI | ERDI | PFI*. https://www.tdisdi.com/diving-pioneers-and-innovators/al-giddings/#top

Marcks, I. (2023, January 26). *Total Immersion for Avatar: The Way of Water*. The American Society of Cinematographers (en-US). https://theasc.com/articles/avatar-the-way-of-water

Mendelovich, Y. (2022, October 24). *The Underwater Cinematography Behind Avatar 2: 3D Beam Splitter and Nikonos Lenses*. YMCinema - News & Insights on Digital Cinema. https://ymcinema.com/2022/10/24/the-underwater-cinematography-behind-avatar-2-3d-beam-splitter-and-nikonos-lenses/

Review of Zoological Surrealism: The Nonhuman Cinema of Jean Painlevé. (2021, April 29). Leonardo/ISASTwith Arizona State University. https://leonardo.info/review/2019/07/review-of-zoological-surrealism-the-nonhuman-cinema-of-jean-painleve

N. (2023, January 5). *Understanding Light for Underwater Photography*. DeepDive - Scuba.com. https://www.scuba.com/blog/scuba-guides/understanding-light-for-underwater-

photography/#:~:text=Bending%20of%20light%20Underwater&text=This%20bending%20of%20light%20is,are%20causing%20a%20magnification%20effect.

S. (2018, September 27). *Aboard the Calypso – Sea and Cinema with Jacques Cousteau*. Make Mine Criterion! https://makeminecriterion.wordpress.com/2017/06/09/aboard-the-calypso-sea-and-cinema-with-jacques-cousteau/

Science is Fiction: 23 Films by Jean Painlevé — Cineaste Magazine. (n.d.). Cineaste Magazine. https://www.cineaste.com/fall2009/science-is-fiction-23-films-by-jean-painleve

Staff, A. (2018, December 11). *Industry Insight: LED Lighting in Modern Cinematography*. The American Society of Cinematographers (en-US). https://theasc.com/articles/industry-insight-led-lighting-in-modern-cinematography

The Power of Sound Design in a Moving Picture: an Empirical Study with emoTouch for iPad | Empirical Musicology Review. (n.d.). https://emusicology.org/article/view/6572/5208

Underwater optics innovations serve science and cinema. (n.d.). https://spie.org/news/photonics-focus/septoct-2021/underwater-optics-innovations-serve-science-and-cinema?SSO=1

Underwater world: the amazing tech behind Blue Planet II | loveexploring.com. (n.d.). loveexploring.com. https://www.loveexploring.com/gallerylist/69517/underwater-world-the-amazing-tech-behind-blue-planet-ii