

Background on Watermarking

The internet as a carrier of digital media changed how we share music, books, video and other media. The integration of digital watermarks is becoming more and more popular to fight the fast-paced spaces opened to share pirated material. Currently, research on watermarking predominantly focuses on strengthening security; embedding robustness with respect to compression, image-processing operations, and cryptographic attacks (Shih, 2017). We now understand watermarks as being both digital and physical, but they are not new phenomena, and it is relevant to know where they come from.

The art of papermaking has its roots in China in the 1st Century. The process was first documented in 105 A.D. and ascribed to Cai Lun (Basbanes, 2014). Watermarks only appeared later in 1282. Watermarking happens during the process of making a sheet of paper whilst the paper is still wet. Watermarks are a result of changing the thickness of a specific part of the paper, creating a highlighted area and as a result, its shadow. We track the beginning of watermarks in the town of Fabriano (Hunter, 1987). It is essential to acknowledge the historical importance of the Italian city of Fabriano. From the name “Fabriano”, in Latin “Faber > Făbrīciŭs”, meaning “craftsman, artificer, maker” (Latin Dictionary and Grammar Resources - Latdict, n.d.). The practical skills in forging metal and shaping wire were crucial for building the frames used to remove excess water, gather the pulp and to start forming the first sheets of paper.

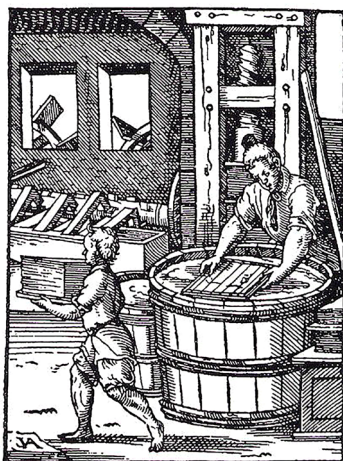


Figure 01
Illustration of a paper mill by Jost Amman. Frankfurt, 1568

Watermarks analogue Intention

The history of watermarks is still relatively obscure. It is not possible to fully trace back their ancient significance. A few different theories have been discussed on what was the actual purpose and use of these venerable watermarks. One that I came across with was to help with the production of the sheets of paper. Using them to identifying the size of the frames and the sheets of paper produced by these. (Hunter, 1987) Another hypothesis is that the craftsmen that were working in the production of paper were illiterate. Watermarks were then a strategy of appealing with pictures or symbols. This way of communicating a specification would lead to a smaller chance of creating misunderstandings. The first applications of watermarks compel these possibilities, but it is also possible that in parallel these may be an artistic production of the papermakers. These can also be no more than a fashionable imprint left by the artists making the frames, as a way to identify themselves, creating then an aesthetic enhancement or a signature of quality. (Watkins, 1990)

Watermarks are now valuable to establish provenance to manufacturers of papers, paper mills and manuscripts. These also provide evidence about the movement of paper across Europe, Africa and the Middle East. The use of watermarks was then a critical factor in recognition of paper quality contributing to the increasing desire of specific papers. It is wrong to immediately establish the provenance of a book to one particular place solely based on the watermarks due to the commercial trades of paper. While an Italian watermark may be found in a specific sheet of paper, this would only set provenance to where the paper was manufactured and not its afterlife. Watermarks would comprise graphics such as animals, plants and sacramental imagery but also were representations of geographical territories and in general depictions of Western culture. In Umbria, Italy, for example, the Benedictine monasteries endorsed the 3-hilled mount topped with a cross as their symbol. Developed by the French and Venetians, we identify watermarks imagery of the tre lune/three crescent moons. These strategies were adopted because of Muslims in the Ottoman market. They were expected to choose in favour of papers with these kinds of imagery rather than a Christian cross or other similar motifs. (makingmanuscriptsblog, 2017)

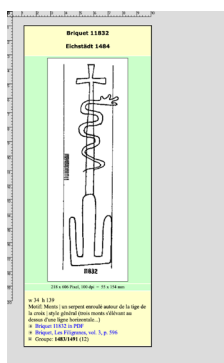


Figure 02
Western Watermark imagery, 3 Mountain Hill, Snake and Cross, Eichstädt, 1484

Connecting watermarks and library stamps

There is an active link between watermarks and the introduction of library stamps — both creating a body of evidence when trying to establish connections in a collection. Library stamps are also perceived as an imprint left visible and sometimes glued. Able to question ownership and acquisition. In libraries, books were stamped to record property of books. The relation was created between the physical medium and the library adding traces of provenance to the collection. Library stamps would not be related to the readers of a book, nor they were intended to do so. These connections would happen connecting circumstance and date of acquisition and creating relations in the library itself.

Though library stamps are helpful when determining the time frame and history of an item in a collection, the process of adding the stamps is not necessarily performed when a book enters a collection. The method of adding this imprint could happen later on. Unlike watermarks where it is unlikely that the act of tempering the paper fibres doesn't occur in simultaneous to when a paper sheet is made, stamps were commonly applied later from the date of item acquisition. This lead to mistakes that are now widely recognized. Along with stamps, to build a body of evidence for determining both the circumstance and date of acquisition clues may be found on bindings, bookplates or inscriptions. (Duffy, 2013)



Figure 03

Left: Oval hand stamp for manuscripts with the words *BRITISH LIBRARY*.

Centre: India Office hand stamp for non-small 'claim material' items. These items were treated as part of the British Library collection.

Right: Library stamp from previous Oriental and India Office Collections. Use of this stamp ceased on 1 September 2005

Watermarks got more significant with the introduction of paper currency. One of the notable shifts I identify is when they are first applied to a banknote paper in England, by a papermaker named Rice Watkins in 1697 (Mockford, 2014). Watermarks were added as a way to deter counterfeits and making the act of forging more difficult, enabling easier targeting to the ones who were doing it. In England, 1773, the death penalty was extended to those who would create watermarks with the name of the Bank of England.

Just as in paper money, watermarks are now used to establish authenticity and their digital implementation, started to get more popular. Emil Hembrooke patented the first digital watermark, "Identification of sound and like signals", US Patent 3,004,104 Filed 1954, Issued 1961. In the US patent, we can read: "The present invention makes possible the identification of the origin of a musical presentation and thereby constitutes an effective means of preventing such piracy" (J. Cox and L. Miller, 2002).

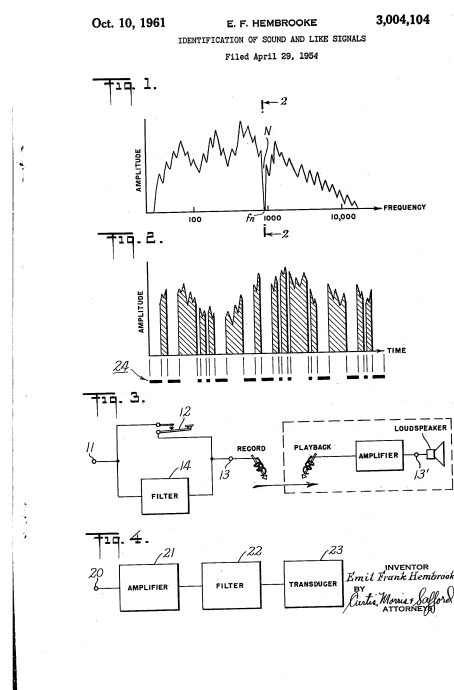


Figure 04
Identification of sound and like signals Patent <https://patents.google.com/patent/US3004104>

In the 1990's the interest in watermarks increased drastically. Currently one can find them in various forms of copyrighted watermarked material. Nowadays, as most information and data are stored in digital formats and not in physical ones, being able to provide legitimacy and to prove authenticity is progressively representing a more urgent task. (Shih, 2017) Digital watermarks are mostly known as being visual. The normalization of their use in photographs, on video stored on DVDs is a reality by now. In trial software, these also appear often. Instead of restricting the use of a programme, while exporting the final version of the work watermarks are appended. I read this action almost as an arrogant way of advertisement and capitalizing on the users. We are held responsible for using software and at the same time, we are targeted as a commodity. It might be read as a message where we are made aware that money will be made from their users in any way possible.

Another significant shift on the use of watermarks happens with their appropriation in the publishing business. Watermarks are now used to create a body of evidence on users, adding traces that relate to the subject more precisely with geolocation, IP addresses, mac addresses, email addresses, etc. An excellent example of this is phenomena is Verso Books publisher. They sell their books in an online ebook store. In this store, Verso books appends a new page in the begging of each book with the downloaders name and his' or her's email address. It also watermarks the IP address of the downloader in the footer of the first page of every chapter.

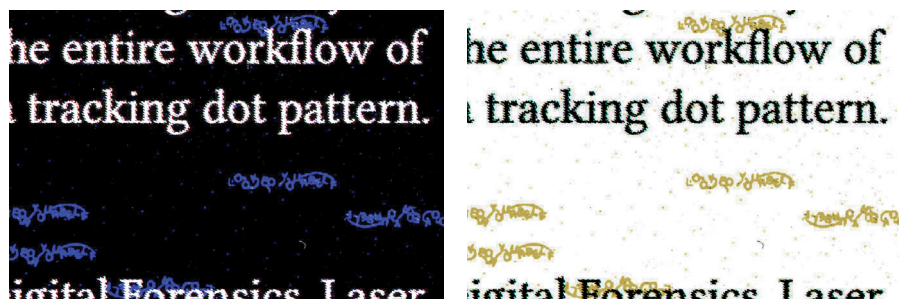
During my research, I stumbled across an article about different forms of DRM. In this article, the writer starts by giving a disclaimer where he begins by portraiting himself as "a supporter of milder types of DRM like digital watermarks". What caught my attention was how the mode of address changed when he started to identify all the unnecessary strategies implemented by Verso Books in their ebooks. More important we can understand that their watermarks didn't pass unnoticed to the store users. A source interviewed states: "Personally, I felt like I was constantly being sent a stalker's note saying, 'I know where you live.' It put me off reading the books entirely." (Hoffelder, 2014) The increase of imprints that identify us as downloaders and as printers is alarming. Verso Books are calling out their users as pirates and companies, such as BooXtream are making this possible, using us as an asset to capitalize on.

I was then able to identify the company that develops the watermarks to Verso Books. It is a Dutch DRM company called "BooXtream®". It is worrying how they portray themselves; the first quality that they promote on their DRM methods is traceability. We can read in a bold font: "A publication that has been BooXtreamed can be traced back to the shop and even to the individual customer." (BooXtream, n.d.) Watermarks are now perceived as something to fear, used to make us feel uncomfortable. Surveillance might be quickly spotted as it commonly happens with CCTV because we can establish a physical connection with it, we can see it, we can choose a different path to walk from it or even try to disguise ourselves. We were able to accept that digital surveillance is a reality, but we didn't feel a close connection to it yet. I consider that digital watermarks are a vehicle establishing this direct connection. It is still tricky, though, to predict what will be the impact of these techniques if users are afraid to share an ebook that they bought and paid for.

Surveillance in publishing not only manifests itself in obvious ways. Another article that I came across was from the Electronic Frontier Foundation, raising awareness of the Machine Identification Code. First published by the PC World as "Government Uses Color Laser Printer Technology to Track Documents" in 2004, this code is formed by a pattern of dots that are appended to every printed page. The printer software adds it in the process of printing. These are almost imperceptible yellow dots carrying information as the date of print, time and the serial number of the machine. Similar technology is used when you try to scan a banknote. A sequence of yellow dots in the printed in the paper triggers the printer to add a striped pattern on the top of the copy, preventing you from copying it.

I delved into trying to understand if this code was still in use, and I had to be able to prove its existence for myself. I started by using methods to identify these invisible dots, such as UV lights, different printers, from HP to Canon and from Inkjet to Lasers printers. Almost when I was giving up, disappointed with all the time invested in this, I started to reverse engineer this machine identification code and implementing my own. While creating messages printed in minimal font size and scanning these printed pages, I began to understand better how to turn them visible. With a new scanner with a resolution of 1200 dpi and after inverting the colours, they suddenly appear. Just as by magic, a mesh of my messages and the

tracking dots started to emerge. Ultimately, I was able to identify them in all the printers provided by the school in the Blaak building. It is worrying that this hidden code is infiltrated in documents and can be seen by anyone. They are not only used in case you are a suspect of a crime, but they are also available for anyone at all times. Coming across with them made me rethink what did it mean to publish in print, how safe is it, and how it might affect the ones who depend on printed forms of publishing.



During this second chapter, I explored the progression of watermarks. From their background, until their appropriation, as an asset to incite fear, self-awareness, and to remotely control and constrain user actions. It was essential for the development of my project to emphasize the value of ancient watermarks at this moment. During the next chapter, I will expand my research from the point of view, where I consider the early framework of watermarks crucial to prevail. I desire to demonstrate that what lies at the heart of their use is their ability to portrait crucial interrupted actions and moments in history, granting insights into hidden processes of fabrication documented in the sheets of paper. While at the same time carrying clues to comprehend their artisans, the historical timeframes and different imagery. I will then extrapolate on how the use of digital watermarks can still be prominent apart from what I recognize as their misappropriation, exploring that the current attitude towards digital watermarking is not the only valid. I focused than my research on how the discourse around these reinforcements of copyright can be flipped around. I will delve into how tactics that seem mainly negative can be re-appropriated.

Introduction to my creative response

With Tactical Watermarks, I describe ways of living within and displaying resistance against a culture of surveillance in publishing. It is relevant to understand and explore what it is living in a culture of increasingly constant tracking, rather than aiming to solve the many problems of surveillance. During my use of watermarks and more specifically, with my creative response, the main objective was to create a positive discourse around the act of watermarking. This discourse is then changed while using them to create a top layer of information, able to embed traces of provenance in different texts. By provenance, I intend to express all the traces not used to surveil users but the ones able to trace historical importance to files and that facilitate precise documentation within an archive or library. Tactical watermarks is not only a system but I will also delve into how it can be deployed, comparing it to what other projects or approaches I have encountered and reflect over their influence in my project.

While challenging centralised distribution channels, I ventured on how the process of adding stains can be twisted and revived. Stains are what I will call user patches or marks that are difficult to remove and that do not play an active role in archives. While exploring the process of adding imprints, different discourses were arising from this: as a way to obscure previous ones, of commenting on the situation and encouraging behaviours, to create relations and communities, augmenting the sense of solidarity in archives, for digital enhancements, marks of quality, etc.

I aim to link my creative response on the case of digital watermarking to what has been happening in parallel within different cultures, from graffiti culture to “crack intros”. Crack intros appeared for the first time in the ‘80s; they were not commissioned for a commercial purpose. Instead, these were introduced by a programmer or a group of coders, graphic artists, and musicians that were responsible for removing the software’s copy protection and that made this crack public (Green, 1995). Watermarks may form a discourse around topics such as anonymity, borders, archives, and provenance; while rethinking watermarks, exploring their hidden layers and aspects of surprise, visibility or invisibility, on different forms of communicating. I find it essential to acknowledge that watermarks have the power to infiltrate and perform different roles and to create a parallel stream of information within various texts. When it comes to publishing, how can watermarks create a critical discourse around the right to access knowledge and represent the ones that fight for it?

It is crucial to consolidate how the term *provenance* will be used. By provenance, I aim to unify all processes that provide clues and evidence from the moment of the origin of a file documenting its life span — providing information on what might be the source of a text, such as, its place of origin. Until the history of its ownership and even the motivation to why an individual made it public. Unifying all this voices part of a stream of empathy, decisions, hidden tasks and actions.

The same way I have delved into the first chapter, the flow of texts, downloads and users are always constrained by the politics of platforms that grant access. It is essential to acknowledge that these platforms more often than not share documents and versions of the same file in between them. With *Tactical Watermarks*, I aim to create also documentation to make this process visible. With watermarks and without compromising on the users' identities, I aim to set ground to what I find noteworthy. Such as finding ways to translate the flow of users and texts, within this complex mesh architected in a rhizomatic structure.

I feel essential to merge the hidden processes behind the upload of a new file within itself, documenting this stream of options. This is achieved by documenting the invisible natural connections formed by platforms' uses, adding memory to a collection, while materialising the hidden tasks of digitising a book, processes and motivations behind its selection and all the actions along this process.

2 – *Signatures*

In *Tactical Watermarking*, I also purpose that digital watermarking may be used as a signature, just as we can spot in graffiti culture or crack intros.

Just as distributing copyrighted material and cracking software, graffiti is a controversial subject. It has a rich background dating back to several cultures like the Egyptians, Greek or Romans, where writing or drawing in walls or other surfaces was common to be found. Graffiti nowadays is seen as a form of artistic expression without permission. Just as in crack intros where we can discover pseudonyms to protect identities and thwart prosecution, in graffiti, a subculture to challenge authority, the same thing happens.

In Crack intros, such signatures referred to as “crack screens” were customarily included in-game title screens displaying the game name, the logo of the producer, and a graphic that provided the player with a glimpse of the game theme. The signatures were initially simple statements, such as “cracked by ...,” sometimes intentionally misspelt as “kracked by ...” (Reunanen et al., 2015). The main difference I aim to emphasise between graffiti and crack intros is the is text screen is in many ways similar to graffiti, although the so-called crack-intros invaded the private sphere and not the public space. (Cubitt and Thomas, 2009)

An essential link to all these formats of signatures is found in ancient ways of watermarking. Craftsmen would explore pseudonyms, in this case, in the form of imagery built in the paper frames. This opens a path of exploring digital watermarking to almost an arrogant way of identifying us as liable of the process and decisions without carrying any liability whatsoever. Tactics as using pseudonyms will be reappropriated to challenge authority and to challenge digital identity and accountability.

Tactical Watermarking is not only a system about revealing hidden layers and augmenting the memory of an archive. It is also about creating strategies to suppress unwanted information. It is valuable to stress that in the contemporary panorama of digital watermarking, calling out user identity is the ultimate goal. While recognising the intention to remove this layer of information, I felt like it was relevant to create parallelism to the project *SecureDrop*. This project was first released under the name *DeadDrop*, designed and developed by Aaron Swartz and Kevin Poulsen. *SecureDrop* is a free software platform that enables safe communication between whistleblowers, journalist and different organisations. In this platform, whistleblowers, which are the sources, submit documents and data while avoiding most common forms of online tracking (Ball, 2014). During this process, sources are also assigned a random user name, allowing a journalist to contact and privately chat with them.

The connections I intend to make between my system and *SecureDrop* are that both main intentions are the creation of strategies to anonymously disseminate files not intended to be part of the public sphere. Establishing parallelisms between how either private or public organisations protect secrets and how publishers protect copyright material. In their core, the critical aspect to them is how they facilitate the anonymisation of files. In *SecureDrop* by using private, isolated servers, and using encryption and decryption tools. In using watermarks as a way to obscure already existing one, by overlaying existing marks found, and by re-writing new subjective metadata to documents, obscuring user traces aimed at making them accountable as explored in the previous chapter of my thesis.

4 – *As a means to expression*

Within this framework, and throughout the act of watermarking, I aim to create a space to publish undercovered personal, political and other kinds of messages. With my creative response, I consider that users commenting and publishing their thoughts disseminated hand to hand with the actual circulation of a file is relevant. Having the power of saying that I am here, and I disagree with how paywalls, borders, and how rules are structured and reinforced is compelling and pertinent. These messages must be published and made public.

This being, we can compare these ideas commenting as a strategy of contemporary political resistance to what has been happening in cracked of software, such as Adobe Zii. Adobe Zii or Adobe Zii Patcher is a one-click software program patcher or activation tool for Mac. The developers of this software inserted the quote “why join the navy if you can be a pirate” during the actual process of patching the desired software. It is striking how this intention differs from the one in Crack Intros, creating a reference, not to the one who released this patch but creating a relation to the actual act of copying, commenting on a situation and encouraging provocative behaviours.

I believe that using watermarks as a way of commenting on power structures, dissemination of knowledge and other equivalent situations and opinions will also function as a political mirror to what has been happening to free access to knowledge and information. While achieving this through digital watermarking, we are not only able to reach the ones that are already fighting within this culture, but also the ones that might be uninformed users of shadow libraries and other grey publishing platforms, creating a political discourse around such topics.

During the first chapter, I have explored how different media are used to publish ideas through alternative forms of publishing. This used to happen through zines, the underground press or other types of publishing as the Samizdat. Currently, parallel streams of publishing exist mainly in the form of online platforms, opened to publish all sorts of copyrighted and forbidden materials. Within the context of *Tactical Watermarking* seems relevant to delve further into strategies that facilitate communication, especially the use of steganography.

Even though several forms of communication responsible for avoiding conventional methods of surveillance are achieved mainly by writing an encoded message and by the use of a decoding system when it reaches its target, with steganography, this happens differently. The message is hidden in plain sight as the main strategy. Steganography allows two parties to broadcast a message deceived or disguised within other data. Watermarks and steganography both happen in digital and analogue formats. While both terms can be applied to the transmission of information hidden or embedded in other data, they are often wrongly merged and is vital to clarify them. Steganography relates to undercover point-to-point communication between two parties. (Katzenbeisser and Petitcolas, 2000) Watermarking has the extra demand of robustness towards potential attacks (Katzenbeisser, 1999).

Steganography is an important subdiscipline of information hiding. In the book, *A Cookbook of Invisible Writing* from Amy Suo Wu, alternative forms of communication are published in the format of recipes documenting techniques reused from spies to prisoners, but not only old tactics of steganography exist. In China, researchers understood that while digital communications and data security are becoming more sophisticated, there is still the need to develop ways to send hard copy messages securely. These have developed a printing technology only be read with a UV light over the printed medium (Davis, 2019).

All this set of parallel techniques of communication led me to explore which strategies can we reappropriate using watermarks as a way of annotation. How can we open space to communication between users of a system while maintaining their anonymity? One might have felt the thrill when a downloaded file from Libgen or similar library still contains traces of previous users. It is quite amusing this relation established with someone we are not related with. You feel part of a movement, as you had a glimpse of a moment, captured in time.

With Tactical watermarks, I want to open spaces to dialogue, to publish displays of interest, as well as, demonstrations of solidarity. This can be done, just as writing a message in a paper, drop it in a public space and wait for someone to find it. In a big picture, I do not plan to make this something you may find by chance; I aim to explore what are the possibilities of making someone thrilled to see these messages as a compulsory or a regular habit.

At last, I propose that digital watermarks still have space to produce sensorial enhancements. Enacted through watermarking and with a background in the practice of graphic design, I reckon that we might be able to establish different rhythms and hierarchies within a narrative. Just as introduced earlier in this text, watermarks might have had their origin concerning manufacturing processes, but they might have been an artistic method of expression by papermakers aswell. With *Tactical Watermarking*, digital watermarks may substitute digitally the impact that graphic design has in the process of creating books as a physical media, where they can be recognised as an object by themselves. In graphic design, choices such as the paper, the binding, or even how different chapters are separated become part of an endeavour to heighten the narrative. Interestingly, mixed attitudes can exist towards this process. Either by trying to respect the text, without overpowering it, but also, as a way of exploring it as a medium where restructuring may form new ways of reading and understanding. Two constants are then present, the exploration of repetition and absence of it, and the experimentation regarding text flows.

The main drive during my research was to explore how can analogue techniques be appropriate and transported into digital watermarking. I find particularly amusing unconventional strategies, such as the use of scented paper in print. Such methods allow us to rethink the flow of information and takes part in shaping the perception we have from texts. Through this scented technology, we explore the vision and the scent at the same time, transporting us to different realities, creating a stimulus that we don't usually experience while reading. In digital files, I compare this to the feeling of encountering graphic elements that exist outside the main narrative. While most digital files lack personality, with new visual elements appended, I aim to incite new sensation while building new experiences through paratextual components.

REFERENCES

- Basbanes, N.A. (2014) *On paper: the everything of its two-thousand-year history*. New York: Vintage Books.
- BooXtream. (n.d.). Available at: <http://www.booxtream.com/> (Accessed: 1 December 2019).
- Dam, K.W. (1999) Self-Help in the Digital Jungle. *The Journal of Legal Studies*, 28 (2): 393–412. doi:10.1086/468056.
- Harris, N., Ecole de l'institut d'histoire du livre (Lyon) and Institut d'histoire du livre (Lyon) (2010) *Paper and watermarks as bibliographical evidence*. Lyon: Institut d'histoire du livre.
- Hays, M.L. (1975) Watermarks in the Manuscript of Sir Thomas More and a Possible Collation. *Shakespeare Quarterly*, 26 (1): 66–69. doi:10.2307/2869274.
- Hoffelder, N. (2014) Verso Books Shows That it is Possible to Use Customer-Friendly DRM While Still Calling Customers Pirates. Available at: <https://the-digital-reader.com/2014/06/07/verso-books-shows-possible-use-customer-friendly-drm-still-calling-customers-pirates/> (Accessed: 17 November 2019).
- Hunter, D. (1987) *Papermaking: the history and technique of an ancient craft*. New York: Dover.
- J. Cox, I. and L. Miller, M. (2002) The first 50 years of electronic watermarking., pp. 26–132.
- Latin Definition for: faber, fabri (ID: 20146) - Latin Dictionary and Grammar Resources - Latdict (n.d.). Available at: <https://latin-dictionary.net/definition/20146/faber-fabri> (Accessed: 25 November 2019).
- makingmanuscriptsblog (2017) Watermarks! Making Manuscripts in the Medieval and Early Modern World. Available at: <https://makingmanuscriptsblog.wordpress.com/2017/10/02/watermarks/> (Accessed: 11 December 2019).
- May, M. (1997) INVISIBLE WATERMARKS. *American Scientist*, 85 (2): 124–125.
- Mockford, J. (2014) “They are Exactly as Banknotes are”: Perceptions and Technologies of Bank Note Forgery During the Bank Restriction Period, 1797-1821.
- de la Passardi re, B. and Bustarret, C. (2002) Profil: An Iconographic Database for Modern Watermarked Papers. *Computers and the Humanities*, 36 (2): 143–169.
- Shih, F.Y. (2017) *Digital watermarking and steganography: fundamentals and techniques*. Boca Raton: Taylor & Francis, CRC Press. Available at: <http://www.crcnetbase.com/isbn/9781498738767> (Downloaded: 25 November 2019).
- Stevenson, A.H. (1948) New Uses of Watermarks as Bibliographical Evidence. *Papers of the Bibliographical Society, University of Virginia*, 1: 149–182. doi:10.2307/40368928.
- Tanselle, G.T. (1971) The Bibliographical Description of Paper. *Studies in Bibliography*, 24: 27–67.
- Woodward, D. (1990) The Correlation of Watermark and Paper Chemistry in Sixteenth Century Italian Printed Maps. *Imago Mundi*, 42: 84–93.
- Ball, J. (2014) Guardian launches SecureDrop system for whistleblowers to share files. *The Guardian*, 5 June. Available at: <https://www.theguardian.com/technology/2014/jun/05/guardian-launches-securedrop-whistleblowers-documents> (Accessed: 24 October 2019).
- Cubitt, S. and Thomas, P. (2009) *Re:live Media Art Histories 2009 conference proceedings*. Melbourne: The University of Melbourne & Victorian College of the Arts and Music.
- Green, D. (1995) Demo or Die! *Wired*, 1 July. Available at: <https://www.wired.com/1995/07/democoders/> (Accessed: 10 January 2020).
- Katzenbeisser, S. and Petitcolas, F.A.P. (2000) *Information hiding techniques for steganography and digital watermarking*. Boston: Artech House.
- Reunanen, M., Wasiak, P. and Botz, D. (2015) *Crack Intros: Piracy, Creativity, and Communication*. In 2015.