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Ghosts of inventions: patent law's digital mediations

It is a rare occurrence that the world of patent information appears on the radar of mainstream media. On 31 October 2016, the *Financial Times* published an article entitled 'Patent translator flies artificial intelligence flag for public sector,' written by its science editor, Clive Cookson, classified in the rubric 'Artificial Intelligence and Robotic.' What was remarkable about it was that the article was not about patents or inventions, but about the World Intellectual Property Organization's (WIPO) translation software which it had developed in-house with a consortium of universities. It was deemed to be more accurate than Google Translate for patent translations. Rather than being about inventive artifacts or knowledge, the article treated patents as information, and in corresponding logic, WIPO as an information service provider. The automated free online patent translator, based on artificial intelligence principles, would alleviate one of the weak points of the patent system: the difficulty of accessing and understanding multi-lingual patent information that resulted from the closer integration of the global patent system. Most poignantly, the artificial intelligence based patent translator would be clever enough to accurately translate the peculiarities of patent language that is not only technical, but also highly formalized and legally coded. It had been trained, or rather, it was programmed to train itself, to do so.

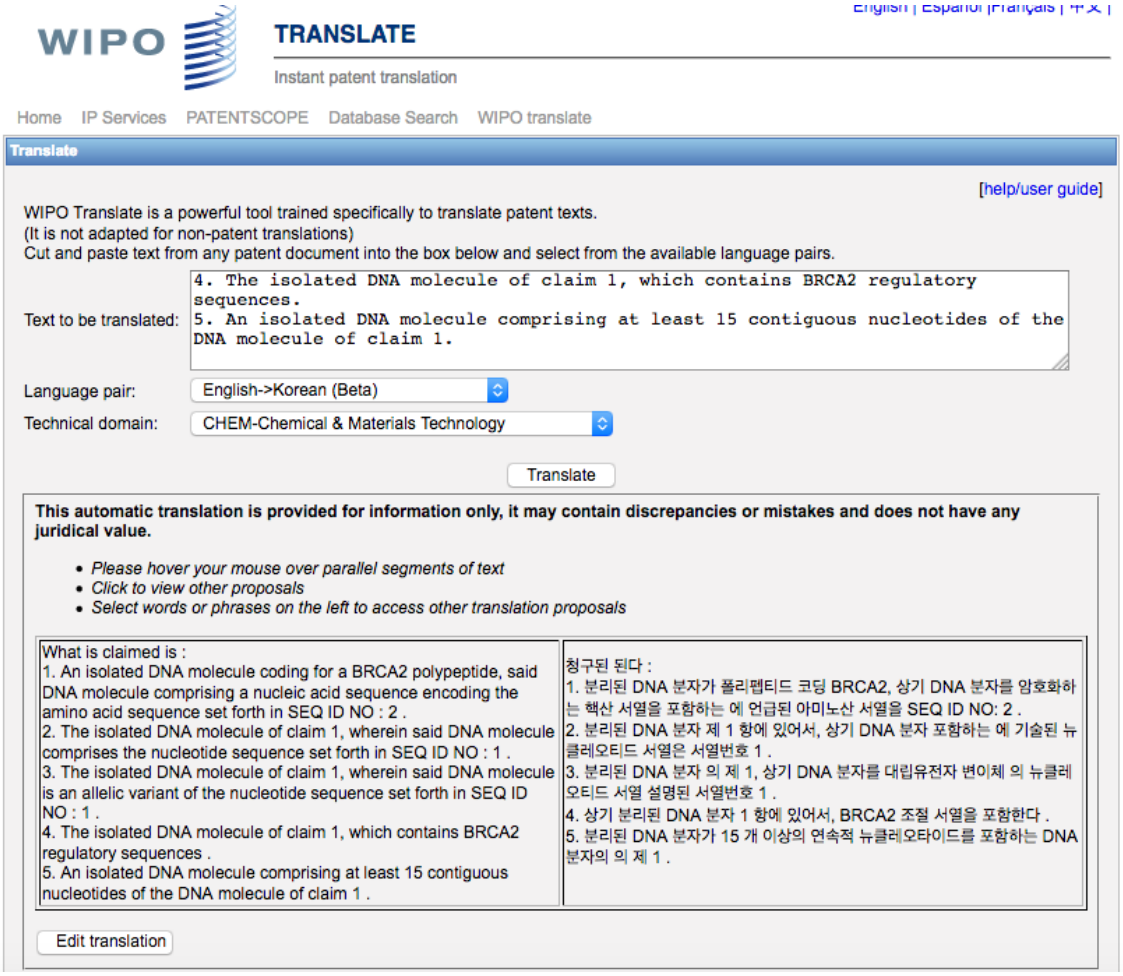


Figure 1: WIPO translate of patent claims of US Patent no 5,837,492 for 'Chromosome 13-linked breast cancer susceptibility gene' relating to BRCA2 gene

How did the patent system come to a point where artificial intelligence based software would automatically translate parts of the patent document, something which in itself is a legal transposition of a technical or scientific invention? This development could not have been possible without the digitization of information contained in the patent document. Such a digitization of a legal form blurs the identity presumed between a unitary invention and the patent document.[1] If a scientific and technological invention had been embodied in a patent document and the patent document is being deconstructed into digital bits and distributed across a networked database, *where* is the invention now in the digital patent database? Is the invention still a unitary entity or does it dissolve into digital textual data to be collected, compared and distributed in parts, either as metadata or as information? Does the medium in which inventive knowledge is transmitted affect its very

meaning, and if so, what are its effects? How does the choice of a medium stabilize or unsettle the legal concept of invention and its formation?

This essay identifies and analyzes the effects of digital mediation on the relationship between form of expression and knowledge in patent law. It starts from the premise that the diversity of and shifts in patent law's inscriptive practices and media, which often appear as legalistic and minute bureaucratic technicalities, frame and inform the ways in which inventions are understood as epistemic, legal, and cultural artifacts. Taking patent law's representational techniques as the object of inquiry requires attention to the specificities of its language and form, which have been predominantly based on textual semiotic logic and formats. The writings in patent documents are not only technical but utmost legal. They underlie specific word choices, style and syntax. Moreover, the patent is bound and modulated by the relationship of categories within the particular form of the patent document itself. How, if at all, does the meaning of invention - that is, the interpretation of both the inscribed legal concept and its original knowledge practice in science and technology – change with the latest shift in law's media, which dissociates words into digital codes, documents into electronic signs? The figures in this essay illustrate the material changes in the way patents are handled: they are all pictures of electronic interfaces, through which patents are interspersed across the transnational patent information network.

I outline practices of patent documents' digitization and explore their implications on the recognition of the inventive object by drawing on studies conducted at the intersection of intellectual property law and history of sciences. The insights from these historical and legal conceptual studies are read together with studies of digital material cultures in the humanities and mathematics.[2] The insertion of the word 'ghost' in the article title is inspired and borrowed from Brian Rotman's account of distributed human subject formation. Analyzing the process by which humans and digital material media mutually shape each other, Rotman argues that enormous, dispersed and simultaneous computing creates symbolic, virtual realities which shape human subjectivity. The difference in the context of this article is that the subject which is formed by the complex web of digital signs is the law. Taken together, these readings identify and raise questions about the ontological changes brought about by the digitization of patents as a legal form in terms of their visibility (relating to search, retrieval and storage), legibility (relating to sensorial perception

and experience, as well as the reader's interpretation), and instrumentality (relating to questions about ease of navigation, maneuverability, comparison, and translation). These questions are not only relevant from the viewpoint of science-law translation and knowledge transmission, but for the overall justification and legitimacy of the patent system as a whole in its self-understanding as a depository or an account of past inventions.[3]

From analog to digital materialities of patent law

Notational formats and media matter in transforming knowledge objects into property relations.[4] Legal forms and techniques of representation do not only mediate the scientific-technological invention into law, but they also shape the ways in which the invention will be understood and practiced. In this regard, patents are particularly difficult to grasp. Although they are categorized and named 'intellectual property,' patents are paradoxically both intangible and tangible. This is because the intangible nature of an invention – the inventive essence – has been traditionally articulated and adduced through tangible, physical representations in law: working models, court performances of machine model, paper documents in search rooms, deposit of microbiological and plant specimens.[5] As Pottage and Sherman write, "[i]ndeed, the irony is that although intellectual property is cast as a fictional analogue of property in tangible things, there is a sense in which patent law is more materialist than the paradigm on which it is modelled."[6] The material representations of what is taken to be an invention's essence have been important since the beginning of understanding a patent as a matter of right rather than as privilege, especially after the 1836 US Patent Act, which established the US Patent and Trademark Office and introduced the requirement of written claims as legal semantic constructions of inventions.[7] Patents and the inventions that these property rights would cover needed to be recorded in writing and accounted for by their classification, storage and access.[8] This was because a patent owner as well as the public needed to know exactly what a patent encompassed and where its proprietary boundaries started and ended in order to avoid duplicate property rights and contesting claims. In the context of modern patent law, patent law's materials have been mainly legal inscriptions, documents, files, classifications; although in some specific areas other non-semiotic

representations inform the law, such as in the case of plant patents or other biological deposits. What the historical and conceptual studies of patents have shown is that their form and formats, whether visual or verbal, are historically inflected and do not escape the specific circumstances of their making. The meaning of an invention has been informed by historical practices and representational techniques. They are constitutive of the establishment and stabilization of inventions as objects of intellectual property.

The latest medial shift in law, from written inscriptions to digital codes, has received little analytical and interpretive attention, although the predominance of textual rendering of inventive knowledge on paper medium and their bureaucratic handling has diminished, if not almost disappeared, over the last ten years. There have been three locations central in law's representational and bureaucratic shift from analogue to digital: electronic scans of paper documents and their virtual location in image file wrappers; digital classifications and their linkage to databases containing the electronic patent documents; automated online translations of patent information by WIPO and the European Patent Office (EPO). They are presented and discussed in turn, raising more questions about their implications that would deserve further study.

Electronic images as documents

Since June 2003, the USPTO has implemented the electronic scanning, handling and storage of patent applications and documents. The electronic version of the patent application and/or document has been recognized as the official one for legal purpose: "All processing of the patent applications will be performed on the electronic file and will constitute the official file for all purposes."[9] The image file wrapper is an electronic file containing all relevant documentation for the patent application and the correspondence between the applicant and the patent office is accessible on the USPTO website. The web interface clarifies the legal status of the electronic representation of documentation being the official one as visible in Figure 2 below: "This application is officially maintained in electronic form. To View: Click the desired document. To Download and Print: …". The primacy of the PDF scan over the paper medium has been particularly made clear in the rule about paper and inscriptions having to meet satisfying imaging qualities. The text, drawings and the

papers on which drawings are reproduced, have to be satisfactorily scannable; otherwise applications need to be resubmitted due to informality.[10]

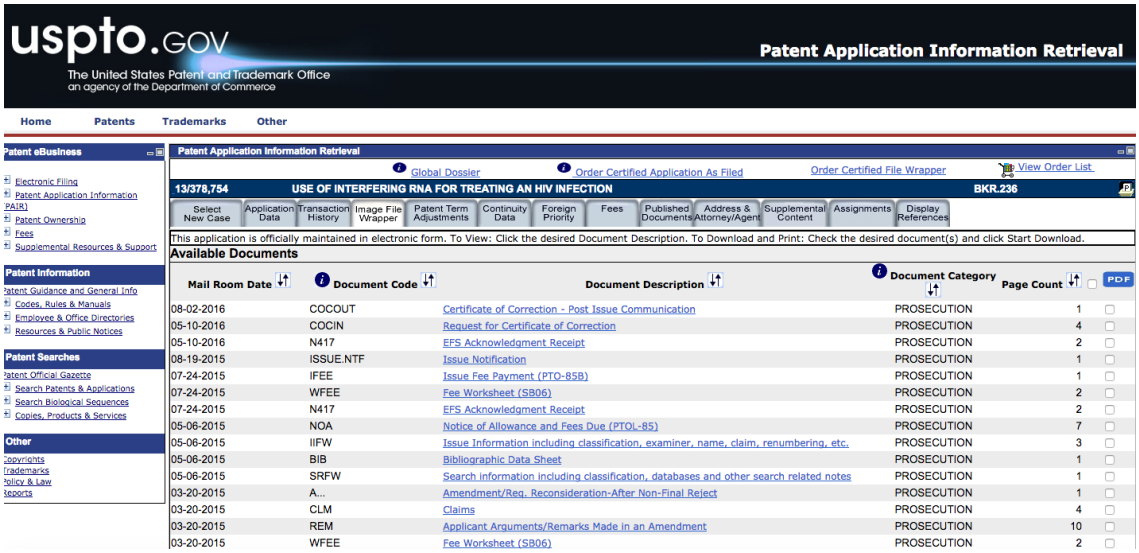


Figure 2: USPTO Image File Wrapper Interface

How do these medial changes affect the ways the patent document and its constitutive parts are understood? As the word '*image* file wrapper' implies, the official version of the patent document has transformed a written text into an image. If we take the patent document to be the legal construction of an invention, this means in turn that the embodiment of an invention has changed from a written sign to a visual one. The overall framework and identity of the invention in patent law is then visual rather than textual, although what is being visualized is not exactly the original invention but the patent document. The original referent, the invention, has been turned into an image of a text. And arguably it changes the way in which inventions are understood and perceived as legal formal signs. For if there has been something remarkably 'intellectual' in modern intellectual property law, it has been the elaborate and complex process of legal abstraction of scientific and technological inventions (both physical and procedural), precisely through techniques of physical remediation in the form of models, organisms and texts, into legal textual symbolic references. According to C.S. Peirce, a sign derives its significance symbolically from conventions and in relation to other symbols rather than by reference to the object it represents.[11] Similarly, patent documents do not resemble the objects they document, except perhaps in the heavily formalized drawings. The core part of the patent

document, the claims, is a virtual legal construction of the invention rather than its representation.[12] The writing of a patent application adheres to a peculiar textual format and style of writing that transforms the original inventive object to a degree which makes it almost unrecognizable for its inventor.[13] As Biagioli has written, since 1836 "checking text against text,"[14] has been patent law's central modus operandi for ascertaining that the requirements of novelty and inventive step had been fulfilled. The legal meaning of an invention has been elicited in a symbolic relationship to other patent documents rather than by reference to its original inventive object. The patent document itself has been treated as an independent symbol or token within a web of reference consisting of other patent documents. Inventions from the patent law perspective were derived virtually as textual documents in the realm of legal semiotics.

The electronic image of the document, however, changes such an understanding of a textual web of legal significance. This is because the scanned image does not refer to a different patent document, but is a digital identical *copy* of the original paper document. It also does not refer to the invention inscribed in the paper document: it is not a photographic image of the inventive object but of the patent document that has replaced it.[15] As a result, another additional layer of intermediation, or a duplicate, is wedged between the invention and its legal representation. When archives were first introduced in computing, they were intended to take online files offline. Digital archives, however, have become a storage of copies rather than of unique documents. [16] Similarly, digital copies of patent documents are duplicated in order to make them available to be acted upon as originals, as the USPTO had constituted the electronic file as the official one for all purposes. From a Peircean point of view, the electronic image is an icon in relation to the paper document by being its identical copy, however the icon has come to usurp the original. Paradoxically, precisely because the icon is a copy, it is ascribed legitimacy to act as an authoritative reference point for legal interpretation. Duplication becomes the condition for the creation of a legal invention.

It is unclear how images, albeit of texts, will relate to one another for legal reading and interpretation. Will the digital images become symbolic references, legal icons, themselves? Two relations are complicated by the iconization of the patent document. One is the relationship between the image of the document and the text that is still visible on the image. Is the scan an image or a writing? This resembles the

question of how to treat visual works of art that consist of words in copyright law. The other question is whether the primacy of the digital image as the official legal medium will lead to a different textuality: will drafting language change in order to adjust for the image being read on screen rather than being printed out? Will the graphic ordering of the image/text be changed to accommodate easier readability? Should the patent document as an image be designed to be 'easier on the eye'?

More fundamentally, the imaging of a document raises the issue of what the patent text means after its dissolution into black lines and curves on a white background: what *is* the text in the patent document? If the materiality of the patent has changed from textual document to image, how can legal and inventive meanings be elicited from an image of a text? Does it change the registers by which the reader can read or interpret? The .pdf file will be more frequently read on screen, however it will retain the same format as the printed paper patent document. Navigating the document will be different as pages need to be scrolled continuously. They can also not be easily recombined into different order, as the pages on screen will be in a linear one-dimensional order. The digitized files are texts but experienced utmost as visual glimmering images on the computer screen.

Here Johanna Drucker's concept of diagrammatic writing offers a helpful understanding of texts as graphical expressions which relate to one another spatially.[17] It posits that formats produce rhetorical effects and semantic meaning. Meaning materializes within the silences between words or the white spaces on paper or screen between inscription: "The organization of a text, its graphical encoding as a text within a space that plays with the delimiting principles of boundedness to any degree, is subject to the systematic play of these semantically structuring elements."[18] Thinking about documents as diagrams, texts as diagrammatic writing, opens up the possibility to think of patent documents as semiotic images. Patent law scholarship has operated with the understanding that the patent document is an artifact of textual composition. The individual parts within such a composition and their assemblage had been very much taken for granted, and most patent scholars rarely paused to think about its overall framing and internal relationships, that delimit the meaning of an invention. Although some scholars had focused on the construction of patent claims as "textual machines" which require knowledge of the peculiarities of legal semantics for their interpretation, the format of the patent document and the relationship of each part to one another had received less sustained attention.

Drucker's concept helps to unpack the patent document as a unitary file and think through how patent documents will be perceived and interpreted differently depending on their media formats. For example, the status of abstract within the patent document has arguably changed with the digitization of patent documents into images which are accessed and read on a screen. Abstracts have become first impressions, or the faces, of inventions. Such a visibility however needs to be read carefully. It is not well known that abstracts are generally more reflective of the description than the claims which embody a patent's proprietary essence. They condense the whole patent document rather than the claims.[19] One also needs to know that the figures or drawings often placed below the abstract text are not necessarily a representation of the patented invention, but examples chosen by the patent examiner to be most characteristic of an invention. [20] There is no clear relation between the abstract text and the figure or table below, but they share the cover page of a patent document. Another diagrammatic dilemma is posed by converting patent drawings into digital bits. Patent drawings underlie exact formal requirements, which need to be "executed without colouring in durable, black, sufficiently dense and dark, uniformly thick and well-defined lines and strokes."[21] But how does this requirement translate digitally onto screen: what does "durable" and "sufficiently dense" mean in the context of a digital image? Does this imply that the alphabet letters or numbers on the screen also have to be "uniform" and "well-defined" like the lines of a drawing? Will drawings become more prominent features of a patent's .pdf image, whereas patent writings will become less comprehensible?

Although law's digital turn to textual image may be interpreted as a freezing of the text into a singular vision, it directs our gaze to the internal composition of the patent document and its rhetorical and functional force as a diagrammatic writing. Documents and forms do not inherently have meaning. Often they do not, because their formats are so difficult to decipher and read as a whole. The overall composition of the patent document as a form and its internal format are therefore interpretive and constitutive acts. From the pragmatic point of view of patent examination, the format and compositional structure of a patent document need to be consistently uniform, as differences between inventive objects and their property claims cannot be identified otherwise. The determination of novelty and inventive step (non-obviousness in US parlance) require differentiating between what there has been and the object claiming to be a patentable object. It is much easier to spot a difference if

the background is uniform. The internal organization of patent documents has categories that are assigned specific, separate roles, but are also linked to one another. For example, the claims section in the patent document denotes the boundaries of the property right in an inventive object. The description section contains detailed information about an invention and theoretically ought to enable a similarly skilled peer to understand what the patented invention is about. Drawings are standardized to an exacting degree, regulating the perspective of the viewer.[22] There are prescribed relations between these parts for interpreting the invention as elaborated by the courts and specified in the patent examiners' manuals. For example, the description and the claims are required to have sufficient correspondence; in other words, one cannot claim what one has not described in a sufficiently enabling manner.[23] It was previously prohibited to take into account the abstract when interpreting claims in the US patent jurisprudence, but now it is allowed.[24] Read together, a patent document can be understood as a textual ensemble, in which each part is individual yet only makes sense as part of an overall format of the document.

What the electronic image of the patent document effects, is a revision of the links between these different constitutive parts that are related diagrammatically to one another. It is not entirely clear how exactly the status of the .pdf file as the original copy has led to material changes in the ways in which an invention is understood. The overall structure and contents of the diagrammatic text do not change across the different media of paper and its digital image, but their appearance does: either as one page per sheet of paper or as a continuous scroll on screen. The documents will be read differently: for example, the .pdf file on screen will be read as a continuous forward and backward scroll rather than as individual pages that can be collated or juxtaposed. From an epistemological perspective of what happens to the represented scientific object, the electronic document arguably increases the semantic distance between the 'original' object of representation, the invention, and its legal construction. The electronic image becomes an autonomous legal symbol, regardless of its textual content, by virtue of it being an image of a document, and not because it represents the inventive object well in terms of its verisimilitude or indexical causality. The .pdf file on the screen *is* the patent document.

Inventions as electronic relations in patent networks

Although the electronic transformation of the patent document into a visual image may or may not have resulted in significant differences in the way in which patent documents are read and interpreted, what it has done is to significantly increase the transferability and connectivity of individual patent documents within an expansive information network. The electronic links between the national and regional patent administrations have expanded to such a degree as to form an almost seamless, all-encompassing international patent information network, linking several platforms of patent information, both as digital images and data, such as the international, regional and national patent documentations, as well as the respective patent classifications. It has evolved into a vast digital infrastructure, particularly from 2010 when the International Patent Classification (IPC), a classification scheme organizing all patent applications and documents by their subject matter, started to be published only electronically. The links between different databases have been particularly visible and have intensified over the last fifteen years amongst the so-called offices of "IP5" countries: European, Chinese, Korean, Japanese and American patent offices. From a practical viewpoint, the cooperation makes sense in order to share the burden of the growing number of patent applications originating from and being made in these jurisdictions, and which need to be searched and examined. However, it may have ambiguous effects on the non-IP5 countries at the margins of the international patent system.[25] Arguably the positive effects of these IP5 offices' initiatives could be that the non-IP5 countries can take advantage of the well-developed digital platform of search and examination, similarly to the US Office of Classification's de facto adoption of the European classification in the Common Patent Classification in 2015.[26] The concern, however, is that using the same electronic patent information infrastructure, as efficient as it might be, may lead to differential or insufficiently uniform search and examination procedures in the non-IP5 offices, let alone amongst the IP5 offices themselves. Moreover, following the same examination procedure may not necessarily be able to take account of the specific national legal jurisprudence, economic policy needs and legal-historical contexts.

Nonetheless the legal requirement of an invention's novelty is absolute, and therefore prior art search has to be international. As a result, patent search has always required an international coordination of availability and access of patent documents and the information contained within it.[27] Similar to the way patent

classification had directed the workflow of patent documents within the patent office buildings in the past, the electronic infrastructure also appears to have a vision of a virtual, transnational patent office sharing and managing workload and workflow, without being entirely clear how the different legal standards, examining manuals, internal organizational structures and professional requirements would be harmonized.[28]

The most significant event relating to issues of patent materiality and mediation has been the IP5 offices' launch of a free and publicly available "Global Dossier" platform at the end of 2016. The Global Dossier enables free and public access to complete IP5 offices' file wrapper information, including correspondences of patent examiners relating to a patent application and its family, i.e. all related applications. It also links into dossiers or file wrappers of other non-IP5 offices through the IP5 offices' patent databases, such as the European Register.[29] From the public perspective, the Global Dossier is a significant development that gives detailed insight into hitherto difficult to obtain information: it represents the legal documentation of the life of a patent and traces its status and movement. For example, when searching for the patent granted on the BRCA 2 gene, entitled "chromosome 13-linked breast cancer susceptibility gene"[30] on the USPTO's public Patent Application Information Retrieval page, the interface links to other international applications and documentation related to the same invention (called "patent family") in one click, and so affords an insight into all related correspondences and filings at, for example, the European Patent Office (EPO) dossier in a pop-up window. Previously, this would have required physical retrieval or a separate database search on a separate platform. The Global Dossier is different in its contents from previously existing patent databases of the patent offices, as well as from the Google Patent search engine, because it allows access to the contemporary archive of the life of a patented invention rather than only retrieving a patent document as the codified and coded legal end product. Moreover, it links different offices' examination and search results into one screen. For example, the Global Dossier makes it easy to access and view the Notice of Opposition to a European patent, filed by Assistance Publique Hospitaux de Paris on 9 June 2015 after the US Court of Appeals for the Federal Circuit ruling that confirmed the patent-ineligibility of the BRCA2 gene sequences in *Univ. of Utah Research v Ambry Genetic Corporation* in December 2014. Here different legal spaces, actions and timelines are brought together onto one screen. The interface of the screen, the

software of the Dossier and the database networks depict and document the making of legality of an invention as an open-ended and contested process.

Compared to the previous efforts involved in researching patent information, this is an extraordinary and exciting development in the rather technical world of patent information, particularly with regards to the scope and scale of the networked patent documentation. All relevant and minute correspondence, even the address changes of representing law firms, is uploaded as scans. The Dossier, the entire image file wrapper containing complete documentation about a patent and linked across different patent jurisdictions, allows a more complete reconstruction of the invention in the realm of patent law. Its effects, however, are paradox. On the one hand, the Global Dossier simultaneously emphasizes and heightens the patented invention as a partial, distributed artifact across different legal spaces; the patent family of the invention is scattered across the globe: Europe, Japan, the US. On the other hand, the members of the patent family and their histories in the patent files are finally brought together on a single screen and documented as images. They are family pictures.

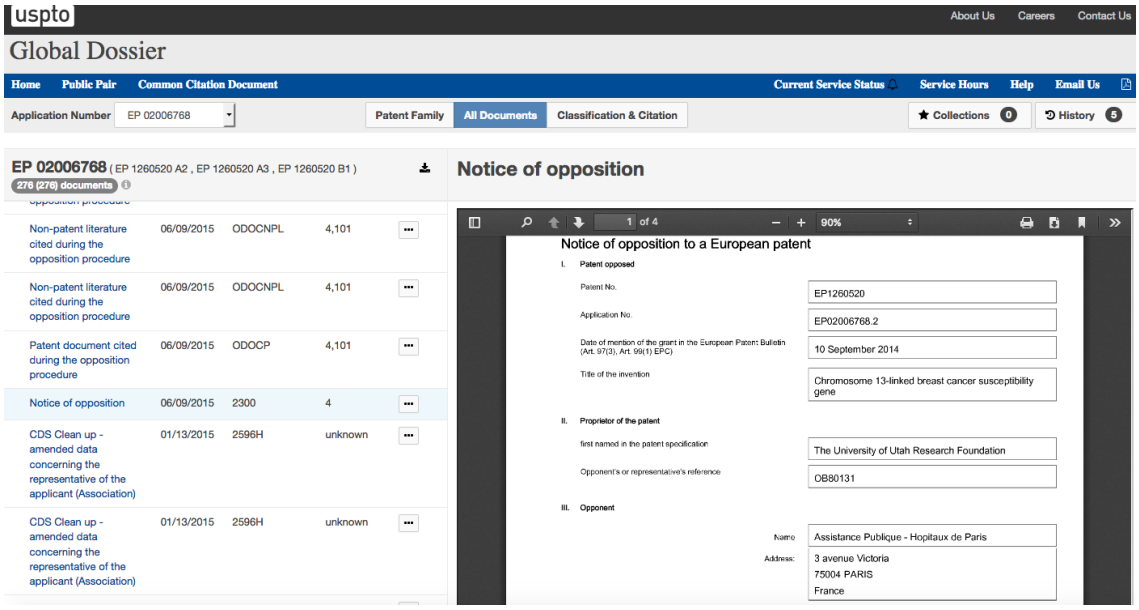


Figure 3: From the Global Dossier of US Patent no 5,837,492 "Chromosome 13-linked breast cancer Susceptibility gene". Notice of Opposition to the European patent.

Another important shift in post-2000 patent mediality is the digitization of the International Patent Classification (IPC) and its transformation into an online

database. Two years after the introduction of the Image File Wrapper at the USPTO, in 2005, the electronic version of the International Patent Classification (IPC), published online by the WIPO, was declared the official version of the classification. Since 2010, the IPC has only been available in electronic form without a paper embodiment. The IPC is an overarching international classification of all patent subject matters and serves patent information users, both patent examiners and the public, in their search for relevant past inventions. Searches are particularly important in order to establish legal novelty of new inventions. What is new in ordinary sense of the word might differ from what is held novel in the meaning of patent law.

The harmonization and linking of patent databases were predicated on the lending of computing infrastructure by one patent office to another, as well as a concerted effort to link different regional classifications and the patent documents contained in them. The computing power seems to be predominantly provided by European Patent Office's network structure, as well as its storage servers.[31] WIPO's Master Classification Database, a link to all patent documents with an IPC classification, is stored in the EPO servers. The introduction of the image file wrapper at the USPTO was built on the digital information storage "architecture" of the EPO. The EPO servers also store and process international patent applications submitted under the Patent Cooperation Treaty to the WIPO. EPO's classification, itself based on the IPC, albeit being more detailed, provided the basis of the Common Patent Classification. The IPC's significance derives from being the only common organizational principle that represents the legal archive of past inventions. It acts as an index to different past and present classifications. It now does so in a digital form, and previous paper documents are still in the process of being scanned. The IPC moreover channels the distribution of workflow of patent application through the examination procedure and the bureaucratic space. In this sense, it acts is an epistemic-pragmatic grid for the spatial organization of patent bureaucracy.

The materiality of patent information is now almost fully electronic and vast, interlinking different geographical spatial jurisdictions in a digital network. In the legal field, it is hard to think of other electronic databases and archives of a similar scale. The patent databases act as an archive of past patented inventions and the legal communication around them. But they also simultaneously form the material basis of determination of an invention's legal status across different legal practices of search

and examination by being indispensable for patent examination. The materiality of the patent documents and their classification is thus significantly different today from the early days of classification: the digitization of patent information establishes multiple and combinatory associations between electronic patent documents rather than a singular, spatial identity. The automatic organization of patent documents into patent families in the IPC and the Global Dossier furthermore constructs a legal genealogy of patented inventions, which is completely independent of its geographical location. A patented invention can exist separately in Japan and in Europe, but it is associated and visualized into a single patent family by linking the patent database archives. What are the implications of such digital archives on the identification of the invention in patent law? Matthew Kirschenbaum points out that "the idea of archiving something digitally is … an ambiguous proposition, not only or primarily because of the putative instability of the medium but also because of fundamentally different understanding of what archiving actually entails."[32] He argues that if one accesses digital files, even identical copies are never literally the same. With each access, the file acquires a differentiation which individuates it at the physical forensic level: "Access is thus, duplication, duplication is preservation, and preservation is creation and re-creation."[33] The identity of the invention then becomes less contained in the single patent document itself, or a single electronic image thereof, but is scattered across different databases as différances. This implies that the invention needs to be constructed by association to its digital doubles and relatives.

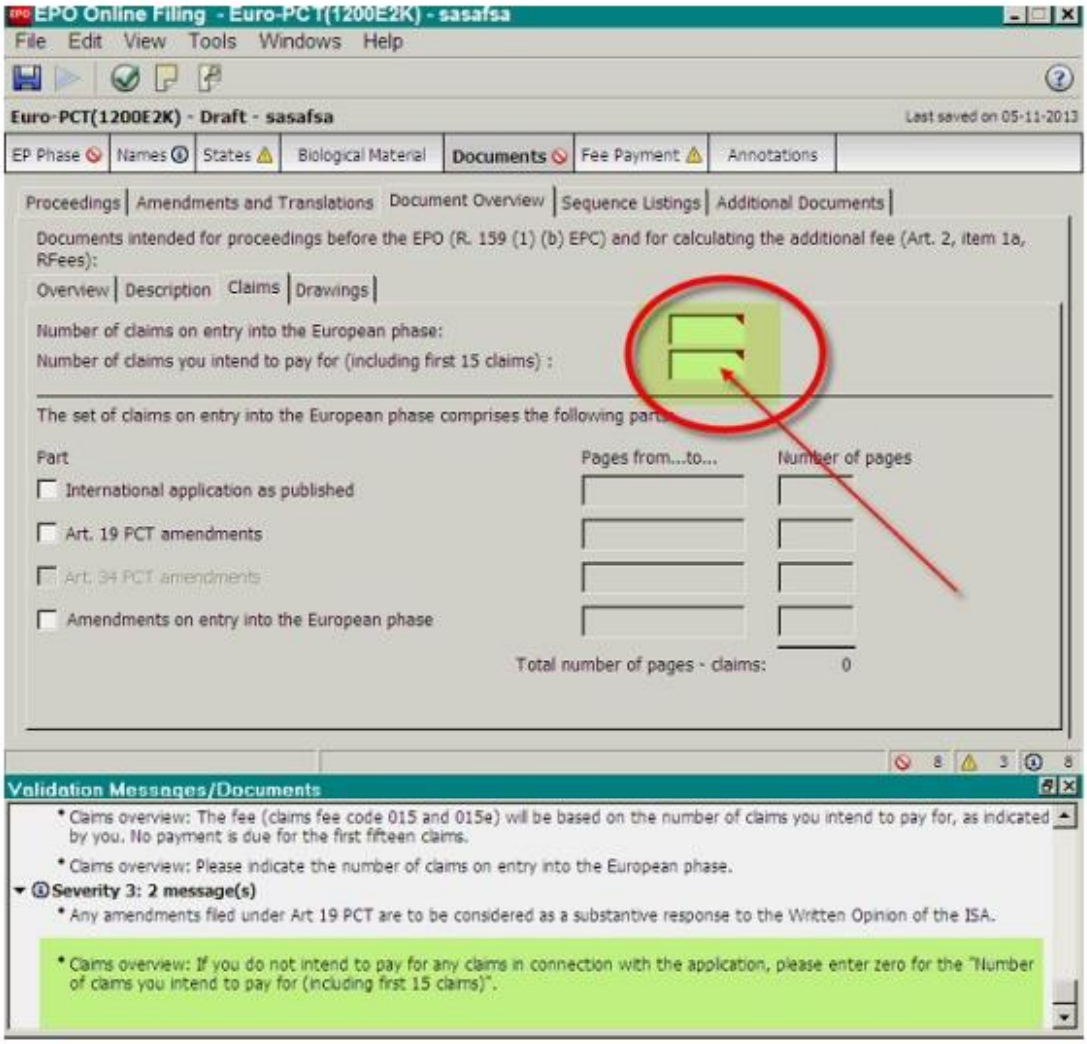
Inventions as patent data

The German media theorist, Wolfgang Ernst, wrote that archival memory is "nothing but information scattered on hard or floppy disks, waiting to be activated and recollected into the system of data processing".[34] In the electronic network of patent archives connected either through classifications, such as IPC or linked image file wrappers in the Global Dossiers network, electronic patent documents are increasingly turned into numerical, calculable tokens in their systematic organization as patent information.[35] Patent information at the level of data denotes all data contained in patent documents (abstract, descriptions, claims), as well as other

metadata that could be derived from individual documents (size of its classification group, patent family, citations, quantity of web traffic, numbers of filings by applicant name, geographical location, jurisdiction, company size). The dissolution of patent information into data appears to be aided by the introduction of an online filing system that requires data input into graphic interface categories rather than uploading the patent document as a text or image file. This has the advantage that the application is not a document that needs to be optically converted and its information can be directly processed as data.

How do I fill in the field "Number of claims you intend to pay for" in form 1200?

The new feature in Form 1200 or 1001 can be filled in as follows;



If you are not paying for any additional claims, enter "0" as stated in the validation panel of the Online filing software (see above).

Figure 4: EPO online application form interface

However, the EPO Online Filing Guide runs to 243 pages in its PDF version, allowing intimations about the difficulty and questions posed by the shift in legal media.[36] Decomposing the patent document format into digital data seems to pose considerable problems because the change in medium also results in a qualitative difference to the way in which inventions are figured in patent law. Patent documents constituted a peculiar genre that required training for drafting, writing, reading and interpretation, resulting in a specific expertise.[37] They involved "the ingenuity of human (and lawyer's) minds in formulating patent applications."[38] Even as paper or an electronic image, understanding patents has required a broad range and constellation of both legal and technical knowledge and practical experience. For a person wishing to access patent information, in modern US patent law, for example, this was best done by finding the relevant patent document. This involved expertise and skills in search. Traditionally a search involved knowing the classification system, the physical location of the file wrapper in the search rooms and understanding the meaning of the documents' order within the file wrapper. The searcher could copy sections by hand and later photocopy whole patent documents. The other side of the coin of the human skill involved in handling patent information was that even if a patent document was located, the patent document was very difficult to open up in a meaningful way. It required the ability to interpret the patent document as a whole: its formal categories, language elements, such as word choices in prepositions and words, and the skillfulness of claim drafting techniques. How would one read a patent as a form mediated by a graphical user interface on the computer screen? The frame of the document or image is substituted by the frame of the electronic form. Physically, the inventive information is embodied by electronic currents and come into being by the digital codes that run the software. The software becomes the metatext which enframes legal meaning.[39] Although using the same content categories as in a patent document, the format of the digital online form will not produce the same meaning as the paper document. Its compartmentalized linear order and spatial boundaries cannot be juxtaposed or read as a composition. On screen, the interface does not allow for a possible rearrangement or association between the different sections of, for example, description and claims. However, hyperlinks in electronic texts create many associations which would have been less noted or visible before. What precisely gets lost and gained along the novel mediation

is not entirely clear, as multiple media for patent filings are still being used, despite the increasing dominance of electronic applications. At the moment, there is a proliferation of media in patent law, with a tendency to turn patents and the inventive knowledge inscribed in them from text into information, and information to data. What is certain is that with the media changes there will be an effect on the way we read patented inventions and interpret them, for "electronic metatexts are more dramatically performative than print texts … they model content and configure conditions for use."[40]

A recent development in the digital enunciations of inventions in patent law has been the introduction of automated translation software. As described in the opening of this article, the WIPO launched WIPO Translate in October 2016, a neural-machine translation service, which has been trained to translate specifically patent texts. It was developed in-house and was based on open-source softwares and libraries.[41] In May 2017, the EPO announced its own automated neural-machine translation service, this time in co-operation with Google. It is not entirely clear from the EPO announcement whether its translation service would also be tailored specifically for patent texts.[42] Would the patent text, with the human ingenuity that had gone into claiming the invention for proprietary interests, be translatable in a meaningful way? Would the self-learning software translate the specificity of patent writings and a text's diagrammatic location? I was curious to take up the claim on WIPO Translate's interface that "WIPO Translate is a powerful tool trained specifically to translate patent text. It is not adapted for non-patent translation." As shown in the figure 1 above, the software's translation from English into Korean of a patent claim for a recombinant DNA seemed accurate enough. Then I let WIPO Translate tackle a fragment of Anne Carson's poem (from English to German). The translation result was awkward, if not entirely non-sensical.

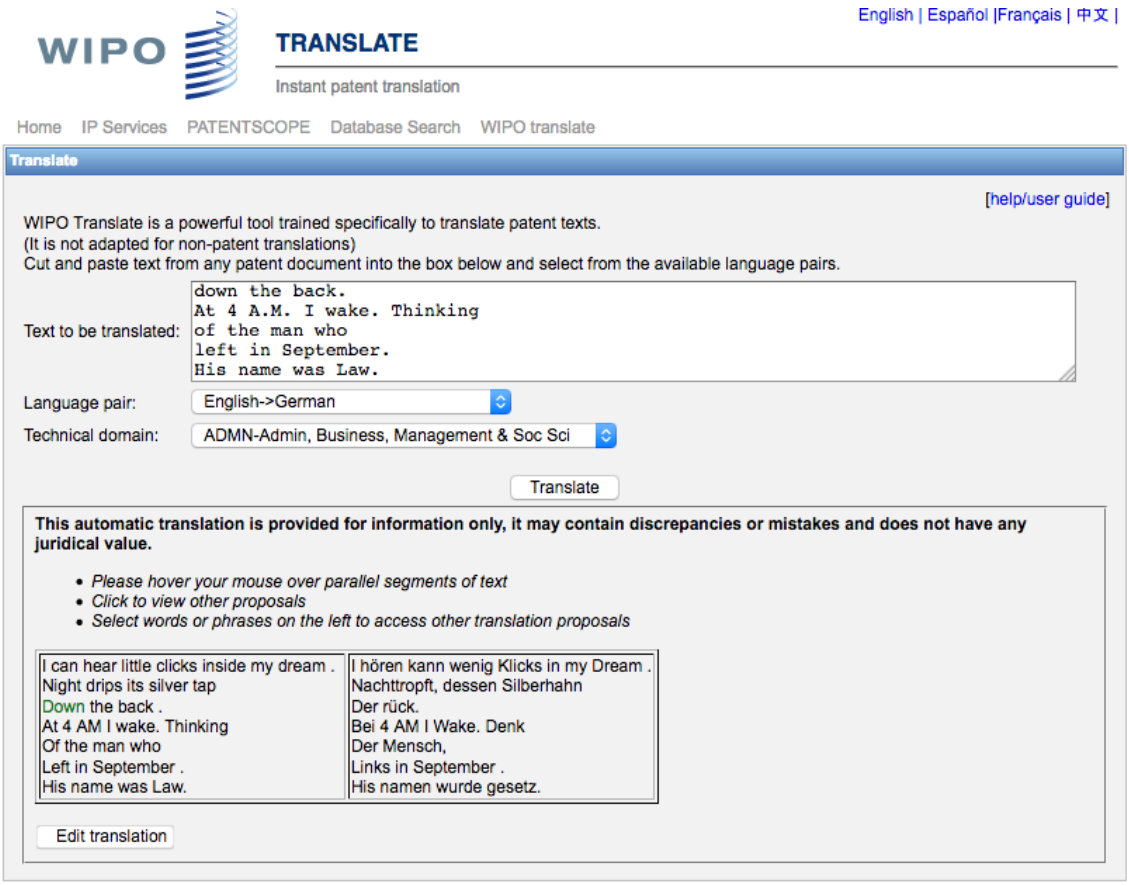


Figure 5: WIPO Translate's result of the beginning of Anne Carson's poem, *Glass Essay*

The WIPO Translate seems indeed to be trained to make sense of patent writings exclusively, and it is remarkable that the particularities of technical language and its peculiar syntactic meaning are understood by a learning software. The website interface furthermore allows for more calibration by offering a menu of different technical specialties as an option to refine translation results.

The apparent race for a reliable automated patent translation between the WIPO and EPO seems to be the consequence of connecting a vast number of different language patent documents, which are now depicted, uploaded and visibly demand to be taken into account in patent searches and examination through connected databases. It is doubtful, however, whether the accuracy of translation of fragments of patent text also guarantees an adequate translation of the entire patent document. Translation does not equate to reading and interpretation. Somehow even more fragmented than the interface of an online patent application form (the EPO one at least groups different sections into different tabs), the WIPO Translate can only

translate parts of the document and it does so without taking into account their relative diagrammatical location. Textual fragments are hence translated without embedding them in the diagrammatical format of the document. Or rather, fragments of texts are calculated as digits in a computational diagrammatic framework.

Are the latest media changes of patents from writing to electronic data all that novel, and if so, what precisely is different about them this time? What happens to the meaning of the invention, the original entity that was represented and reconstructed by way of models, writing, image and now coded digits? In literary studies of (analogue) writing, it has been argued that the mediation of speech into written inscription does not only shape the meaning of what is being inscribed but transforms the consciousness of the writer herself: "Writing alters consciousness."[43] Transferring this insight into digital writings, it could be argued that both material developments, the electronic online patent filing and the automated translation software, do not only result in the re-inscription, re-configuration of the patent text, but also the object of its representation, the invention that is claimed in law.[44]

The representation of the invention in the modern patent law regime has changed from a paper document, to a digital image and finally to abstract digital signs. These remediations have altered the meaning of an invention in law, its ontological status, from a semantic textual composition into electronic data. Remediations effect "a clutch of interconnected discontinuities in the milieu of what preceded it: a disruption of the previous space-time consensus of its users and an altered relation between agency and embodiment giving rise to new forms of action, communication, and perception," as Brian Rotman points out. They give rise to "a domain of virtual, seemingly 'unreal' objects, entities that are without context, endlessly repeatable, and free to be reproduced at any time, place, and cultural situation.... As a result, all communicational media have about them an aura of the uncanny and the supernatural, a ghost effect which clings to them."[45] In the environment of WIPO Translate, words are translated as symbolic references in a seemingly decontextualized way. The patent document is disassembled, its textual fragments or 'ghosts' are stirred and multiplied across different electronic platforms of the patent data network. The ghosts are recombined and manipulated in different ways. Inventive knowledge, the original object of a patent's representation, is re-formatted depending on the specific contexts in which it is used: as patent

information, as statistical meta data or simply as a memory fragment of a scientific invention to which it had originally referred.

Conclusion

The post-2000 shifts in patent law's materiality configure the invention differently. These novel techniques of representation and media matter to the legal form and interpretation of an invention. If intellectual property law has been more materially informed than other areas of law, this was because intangible property needed to be re-materialized and mediated as legal semiotics.[46] Historical scholarship of patents has shown that patent law concepts have shaped and in return have been informed by the techniques and media used to represent scientific-technical inventions in law: as hand-written and sealed letters patents, working models of machines, biological sample deposits, and textual claims within a highly specific documentary genre. The last two of these legal materialities and techniques have not disappeared today, but they are complemented and replaced (especially the paper document) by digital modes of materializing inventions.

The analysis that I have offered here supports the argument that the introduction of the Image File Wrapper at the USPTO in 2005, the online ordering and storage of digital patent files by the International Patent Classification in 2010 and the launch of the Global Dossier in 2016 have introduced significant shifts in the ways in which intangible inventive essences are figured in contemporary patent legal practice: from textual elements on paper to digital data enframed by software and networks. The File Wrapper which used to denote a folder that was wrapped around paper documents for patent filing and examination is now a digital folder containing .pdf files. No longer a copy, the digital image copy has become the original patent. The origin of patent rights was premised on the physical medium and format of paper. Now it rests with the digital image, an immaterial medium itself. In addition to the digital image, with the introduction of online filing software, a patent no longer refers to a document or an image, but to a set of digital data disconnected from its diagrammatic format. The invention which was embodied in the patent document is disassembled into different input fields modulated by algorithms. Reflecting the treatment of patents as part of a networked database, at the practical level, the IP5, the most heavily used patent offices, forms a virtual office with distributed workflow.

The latter is managed through a network which is organized around the Global Dossier and online classifications rather than being contained spatially within a building. Different from past technique of eliciting the intangible inventive essence through material and physical articulations, the materiality of the intangible invention in law has become more intangible and algorithmic.

In light of these observations, I return to my initial question: where is the invention now? Previous studies have shown that the scientific-technological invention is not identical to its legal representation and that there are divergences in what can and cannot be claimed as a patentable invention in law.[47] The novel digital figurations of an invention in patent law may result in an even more unsettled and distributed reality of the invention in law as digital traces, or more precisely, as ghosts in the digitized legal semiotic realm. Although the textual claims are still understood to form the core of a patent in legal doctrinal interpretation, in practice, the invention, as a scientific-technological-legal-economic hybrid object, is no longer neatly delimited within an individual patent document, if it ever was. Individual patent applications have always had their foreign doubles, ancestors and other relatives filed earlier in time or in different jurisdictions.[48] However with the novel visualization of associations and quasi-instantaneous linkages through the digital International Patent Classification, the Global Dossier and automated patent translations, the invention in law is now perhaps best not understood as a localized, unitary documentary artefact, but as digital traces of linguistic claims and algorithmic data in different local contexts and times. The invention could have multiple locations and identities in law, and the latter may be contradictory, incomplete and tangled. The Global Dossier network helps to delineate the legal transposition of the scientific and social controversy around an invention as a global matter of concern (figure 3) with relative ease and speed, compared to the previous searches of paper documentation. The patent application filed by Myriad Genetics and others in relation to the BRCA2 gene (US patent number 5837492) serves as an apt example of the instability of the meaning of an 'invention' in different legal times and local contexts. The legal mediation through digital documents and networked databases multiply the BRCA2 'invention' as a contested entity in multiple spaces and times. The BRCA2 patent family documents in the Image File Wrappers show that the first patent application was made in 1996 and published two years later. Its European relative was filed in December 1996 (EP1260520), which itself was based on and carries on another

previous application (EP785216) that had been contested in an opposition proceeding at the European Patent Office. The BRCA2 gene patent was revoked partially at the US Supreme Court in June 2013 in a landmark ruling which held that merely isolated naturally occurring DNA segments were not patent-eligible subject matters. However, the Global Dossier reveals that the EPO communicated its intention to grant patent on its European patent 'relative' for method claims of BRCA2 only a month later after the Supreme Court ruling in July 2013. Such an asymmetry and shifts in the meaning of the 'BRCA2 invention' and the 'patent' continued: at the EPO, the BRCA2 patent was granted in autumn 2013. In June 2015, Assistance Publique Hospitaux de Paris filed an opposition to the patent grant at the EPO. In the meantime, courts in Australia and Canada had deliberated on other variants and relatives of the same patent application, albeit in the context of their national legislations and policy rationales.[49] Finally, the Global Dossier database records the death of the BRCA2 invention at least in the European legal context by a voluntary request of revocation of the application by the patent applicants themselves in September 2015. What the networked patent information database provides is a record of the scope and meaning of Myriad's invention as a contested and fluid legal entity across different local practices and at different points in time. The identity of the invention in law remained indeterminate from its inception as an application in 1996 until its revocation in 2015 in the European context. The meaning of the invention is therefore relationally determined by legal techniques and orders in the digital database: what makes an invention uniquely inventive is relationally determined and dependent on the status of its 'relatives' in its patent family and the 'peers' within its patent class.

In order to understand the transposition of scientific invention into an object of property right, different and possibly also more opaque layers of representations and meanings will need to be excavated and traced outside the representative confines of a patent document. Villem Flusser characterized the fluid co-constitution between the individual and the ‘social’ in digital information flow as immaterial culture into which the individual almost dissolves: “What is concrete, is the intersubjective relation (the “cable”), of which society and the individual are nothing but horizons. It no longer makes sense to try to distinguish between artificial and human intelligence, and it will continuously make less sense, because concrete reality is not in them, but

in the informational relations that link them."[50] The different enunciation of an invention in patent law's increasingly digital materiality weaves an inherently multiple, interconnected presence of the patented invention. This means that its multiple re-inscriptions across different electronic platforms make it more difficult to maintain a unified picture of its inventive essence. Within the digitized environment of patent administration, the meaning of inventive essence arises relationally in-between the different material media practices of digital forms, electronic images, their organization and linkages across a web of patent information databases, platforms and software. The hitherto dominant form of diagrammatic writing, the patent document, is complemented by electronic tabs, fields, and forms emerging on computational graphical user interfaces. In the latter, the document as a frame disintegrates into a formal relationship of categories. This raises significant questions about the reality of patented inventions and how they will be perceived and understood: how ought the invention be *sensed* and *read* in such multiple, distributed semiotic environments? Should or will the writing practice change as a result? The core of the patent right used to be the claims; but will the abstracts play a larger role in the sense of giving a literal snapshot of the inventive contents of a patent on the screen? Flatscreens are diagrammatically less sophisticated than the three-dimensional written objects, which have implications on reading and writing of the patent document. Most poignantly, the represented object, the invention, seems to have moved to a second order ghostliness, as patent documents, as their symbolic references, have also been virtualized.

Despite the feeling of ghostliness of the invention and its decomposition and ghost-like presence across different digital technological platforms, the feeling of immateriality and the appearance of a virtual reality of inventions in database networks should not be overestimated. The previous discussion has tried to hint at the enormity of the data infrastructure which underpins patents' electronic textuality in terms of storage hardware, software and networks of people and information.[51] They deserve closer study as history of the present. However, physical matter is not identical to materiality.[52] In the patent law context, materiality is law's articulation of its meaning which is shaped and molded by concrete matters and through mediation. Legal materiality is a semiotic relation of how physical things come to matter to law as being meaningful. So how does an invention matter now? In the legal context, the answer is: as digital data.

Notes

[1] In the European patent jurisdiction, a patent application/document has to embody "one invention only, or to a group of inventions so linked as to form a single general inventive concept." Art. 82, European Patent Office (EPO), "European Patent Convention of 1973" <http://www.epo.org/law-practice/legal-texts/epc.html>. Corresponding provision is found in the Patent Cooperation Treaty of 1970 Art. 3 and 34 relating to requirements of an international application and international search, as detailed in PCT Rule 13. WIPO, "Patent Cooperation Treaty (1970)" <http://www.wipo.int/export/sites/www/pct/en/texts/pdf/pct.pdf>

[2] I have been informed particularly by Matthew Kirschenbaum's work on textuality and forensic materiality in "The .txtual Condition," in N. Katherine Hayles and Jessica Pressman (eds.), *Comparative Textual Media: Transforming the Humanities in the Postprint Era* (Minneapolis: University of Minnesota Press, 2013), pp.53-70; Johanna Drucker's work on material semiotics and her concept of diagrammatic writing in "Diagrammatic writing," *new formations: a journal of culture/theory/politics*, 78 (2013): 83-101; "Diagrammatic writing and stochastic poetry," *The Iowa Review*, 44(3) (2014/5): 122-32; *Speclab: Digital aesthetics and projects in speculative computing* (Chicago: University of Chicago Press, 2009); as well as Brian Rotman's analysis of digital computing in relation to semiotics of alphabetic and numeral inscriptions in *Becoming Beside Ourselves: The Alphabet, Ghosts and Distributed Human Being* (Durham & London: Duke University Press, 2008).

[3] Joseph Rossman, who was a patent examiner at the US Patent Office between 1923 and 1935 and the editor of the *Journal of the Patent Office Society* from 1931 to1935, described the patent classification as "the central storehouse of the accumulated technologic experience." "Editor's Page: Emergency Funds of the Patent Office Classification Work," *Journal of Patent Office Society* 16, no. 1 (1934): 3–4.

[4] Dagmar Schäfer, *The Crafting of the 10,000 Things: Knowledge and Technology in Seventeenth-Century China* (Chicago: University of Chicago Press, 2015), see Chapter Four 'Written Affairs' on the particularity of writing in knowledge-making and claiming, and on the relationship of text to images in Song Yingxing's documentation of ways of making during Ming dynasty.

[5] For a historical analysis of the material articulations of invention in US patent law and their effect on legal interpretation, see Alain Pottage and Brad Sherman, *Figures of Invention. A History of Modern Patent Law* (New York: Oxford University Press, 2010). For emergence and conceptualisations of intellectual property rights in plants, see Brad Sherman, "Taxonomic Property," *Cambridge Law Journal* 67, no.3 (2008): 560-84.

[6] Pottage and Sherman, *Figures of Invention*, p.11.

[7] Mario Biagioli, "Patent Republic: Representing Inventions, Constructing Rights and Authors," *Social Research* 73, no. 4 (2006): 1129-72.

[8] Hyo Yoon Kang, "Science Inside Law: The Making of a New Patent Class in the International Patent Classification," *Science in Context* 25, no.4 (2012): 551-594, 558-68.

[9] United States Patent and Trademark Office, "Notification of United States Patent and Trademark Office Patent Application Records being Stored and Processed in Electronic Form," 1271 *Off. Gaz. Pat. Office* 100, 17 June 2003, <https://www.uspto.gov/web/offices/com/sol/og/2003/week24/patstor.htm>.

[10] USPTO's *Manual of Patent Examining Procedure* (MPEP) §507 unambiguously establishes the primacy of electronic scan as the official medium over paper: "Office of Patent Application Processing (OPAP) inspects the drawings to see if they can be effectively scanned and adequately reproduced. If the drawings are not acceptable, OPAP will object to the drawings and notify applicant that a timely submission of acceptable drawings (e.g., drawings which can be scanned) is required. Under the OPAP review process, OPAP may object to and require corrected drawings within a set time period, if the drawings: (A) have a line quality that is too light to be reproduced (weight of all lines and letters must be heavy enough to permit adequate reproduction) or text that is illegible (reference characters, sheet numbers, and view numbers must be plain and legible)." Available at

<https://www.uspto.gov/web/offices/pac/mpep/s507.html> Also specified in MPEP, Appendix R – Patent Rules, 37 CFR 1.84 (l) and (p)(1): <https://www.uspto.gov/web/offices/pac/mpep/mpep-9020-appx-r.html#d0e320999>.

[11] In Rotman, *Becoming Beside Ourselves*, pp.114-5. Referring to Terrence Deacon, *The Symbolic Species: the Co-Evolution of Language and the Brain*. (New York: Norton, 1997).

[12] See discussion of patent claims, Kang, "Science Inside Law," p.562 (note 8). See also Dan Burk and Mark Lemley, "Quantum Patent Mechanics," *Lewis & Clark Law Review* 9 (2005): 29-56, 29.

[13] Greg Myers, "From Discovery to Invention: The Writing and Rewriting of Two Patents," *Social Studies of Science* 25, no. 1 (1995): 57–105.

[14] Biagioli, "Patent Republic," p.1152 (note 7).

[15] Photographs in patent applications are rare and generally discouraged: "Photographs, including photocopies of photographs, are not ordinarily permitted in utility and design patent applications. The Office will accept photographs in utility and design patent applications, however, if photographs are the only practicable medium for illustrating the claimed invention." United States Patent and Trademark Office, *MPEP*, Appendix R – Patent Rules, 37 CFR 1.84 (b). Also they are not allowed if they are illegible after scanning (MPEP, 507 (f)). This restriction could be perhaps interpreted as stemming from the fact that an invention can have different embodiments so that a photograph would not necessarily reveal the essence of the invention and its mechanisms, whereas a technical drawing could better depict the workings of invention by its chosen focus.

[16] The media theorist Matthew Kirschenbaum notes that computational archiving originally meant to "take something offline, to relegate it to media that are not accessible or indexical via random access storage. It has come to do double duty with the act of *copying*, so archiving is coterminous with duplication and redundancy," in Kirschenbaum, "The .txtual Condition," p. 58 (note 2).

[17] Johanna Drucker, "Diagrammatic writing" (note 2); Drucker, "Diagrammatic writing and stochastic poetry" (note 2).

[18] Drucker, "Diagrammatic Writing," p.124 (note 2).

[19] European Patent Office, *Guidelines for Examination*, Part F, II, 2.3 Content of the abstract. < http://www.epo.org/law-practice/legal-texts/html/guidelines/e/f_ii_2_3.htm>.

[20] European Patent Office, *Guidelines for Examination*, Part F, II, 2.4 Figure accompanying the abstract. < http://www.epo.org/law-practice/legal-texts/html/guidelines/e/f_ii_2_4.htm>.

[21] European Patent Office, European Patent Convention, *Implementing Regulations*, Part III, Chapter II, Rule 46 Form of the drawings (1) < http://www.epo.org/law-practice/legal-texts/html/epc/2016/e/r46.html>.

[22] United States Patent and Trademark Office, *MPEP*, Appendix R – Patent Rules - The Drawings, 1.81-1.85. See also Bill Rankin, ""The 'Person Skilled in the Art' Is Really Quite Conventional: U.S. Patent Drawings and the Persona of the Inventor, 1870–2005," in Mario Biagioli, Martha Woodmansee, and Peter Jaszi (eds.), *Making and Unmaking Intellectual Property: Creative Production in Legal and Cultural Perspective*, pp.55–78. Chicago, IL: Chicago UP, 2011.

[23] See Biagioli, "Patent Republic," p.1151, p.1163 (note 7).

[24] *Hill Rom Co. v. Kinetic Concepts, Inc.*, 209 F.3d 1337, 1341 n.*, 54 USPQ2d 1437, 1440 n.1 (Fed. Cir. 2000), as reflected in MPEP §1.72(b)

[25] In 2014, about 93% of worldwide patent applications have been filed by inventors originating from the blocs of IP5 Offices. IP5 offices represented 88% of filing by destination. IP5 Offices, *Statistics Report 2015 edition*, available at <http://www.fiveipoffices.org/statistics/statisticsreports/2015edition.html>.

[26] The European and US patent classifications have been merged into the Cooperative Patent Classification based on the previously existing European one. The European Classification had been regarded as the more detailed version of the IPC: <http://www.cooperativepatentclassification.org>. It can be accessed through both offices' websites.

[27] The international coordination of patent information is to be separated from international coordination for administering international filings for the purpose of priority date, although it is not wholly unrelated to it: 1883 Paris Convention for the Protection of Intellectual Property introduced the

system of international priority with a grace period of a year. The 1970 Patent Cooperation Treaty established an international filing system by which one application could be filed to the WIPO for all state parties of the treaty. The Strasbourg Agreement of 1971 introduced the International Patent Classification was the first attempt to link patent information together by way of an international classificatory system which would apply to all patent applications and documents of signatory states.

[28] For the epistemic and bureaucratic overlap between classification and patent offices' administrative structures, see Kang, "Science Inside Law," pp.558-61 (note 8). The stated aim of the 'IP5 Patent Prosecution Highway project' of the five dominant patent offices is to avoid duplication of examination. This initiative, however, can only succeed if the examination status and information are shared in a timely manner, patent information is accurately translated, as well as the uniform quality of examination is guaranteed. It is furthermore not clear how the differences in the respective five jurisdictions would be accounted and adjusted for. See <http://www.fiveipoffices.org/activities/ws.html>.

[29] Only if the patent family also extends to non-IP5 jurisdictions. European Patent Register, accessible through: <https://register.epo.org/regviewer>. The IP5 patent examiners already shared file wrapper data amongst themselves since 2013, on a more secure platform "One Portal Dossier," and since 2016, it has been linked to the WIPO-led equivalent dossier sharing system, which is used by more countries than the IP5: <http://www.wipo.int/case/en/>. It is not entirely clear whether the Global Dossier mirrors the One Portal Dossier.

[30] US Patent no 5,837,492. Application no 08/639,501. Filed by Myriad Genetics, Inc. (Salt Lake City, UT), Endo Recherche, Inc. (Sainte-Foy, CA), HSC Research & Development Limited Partnership (Toronto, CA), Trustees of the University of Pennsylvania (Philadelphia, PA) in 1996, granted 1998, held patent-ineligible in 2014 after the 2013 US Supreme Court's ruling in *Molecular Pathology v. Myriad*, 133 S. Ct. 2107 (2013) by the Federal Circuit in *Univ. of Utah Res. Foundation et al. v. Ambry Genetics Corp.*, No. 2014-1361 (Fed. Cir. Dec. 17, 2014).

[31] On the materiality of patent classification, see Kang, "Science Inside Law" (note 8).

[32] Kirschenbaum, "The .txtual Condition," p.58 (note 2).

[33] Kirschenbaum, "The .txtual Condition," p.60 (note 2).

[34] Wolfgang Ernst, "Agencies of Cultural Feedback: the Infrastructure of Memory," in Brian Nevillle and Johanna Villeneuve (eds.) *Waste-site Stories: The Recycling of Memory* (Albany: State University of New York Press, 2002), pp.107-20, 109. Cited in Kirschenbaum, "The .txtual Condition," p.58 (note 2)s.

[35] This was apparent in the model simulation used in order to create a new category in patent classification, see Kang, "Science Inside Law," pp.581-86 (note 8).

[36] EPO, "New Online Filing (CMS). User Guide. CMS Version 1.13", Version 25 November 2016. Available at <http://documents.epo.org/projects/babylon/eponet.nsf/0/8DAE7713B5318E3EC1257FAB002B217B/$File/New-online-filing-CMS_user-guide_1-13_EN.pdf>.

[37] Myers, "From Discovery to Invention" (note 13).

[38] Bernd Wolter, "It takes all kinds to make a world – some thoughts on the use of classification in patent searching," *World Patent Information* 34, no.1 (2012): 8–18. P. 8.

[39] Johanna Drucker writes that "formats are information, rhetorical and semiotic structures that offer instructions for the production of a text through reading." *Speclab*, p. 152. (note 2)

[40] Drucker, *Speclab*, p.110. (note 2)

[41] WIPO, "WIPO Develops Cutting-Edge Translation Tool for Patent Documents." Geneva, October 31, 2016, Press release PR/2016/799. Available at <http://www.wipo.int/pressroom/en/articles/2016/article_0014.html>.

[42] EPO Patent Information blog, "A new benchmark for patent translation" by Benoît Battistelli, EPO President. 15 May 2017, available at < http://blog.epo.org/patent-information-2/new-benchmark-patent-translation/>.

[43] Walter Ong, *Orality and Literacy: The Technologizing of the World* (London: Methuen, 1982), chapter 4. Cited in Rotman, *Becoming Beside Ourselves*, p. 5 (note 2).

[44] WJT Mitchell and Mark Hansen (eds.) *Critical Terms for Media Studies* (Chicago: University of Chicago Press, 2010).
[45] Rotman, *Becoming Beside Ourselves,* p.6-7 (note 2).
[46] Alain Pottage and Brad Sherman, "On the Prehistory of Intellectual Property," Helena Howe & Jonathan Griffiths (eds.) *Concepts of Property in Intellectual Property Law* (Cambridge: Cambridge University Press, 2013): pp.11-28.
[47] Kang, "Science Inside Law" (note 8); Myers, "From Discovery to Invention" (note 13).
[48] For history of chemical patenting strategies across Europe and the transatlantic, for example, see Ernst Homburg, Anthony S. Travis, Harm G. Schröter (eds.) *The Chemical Industry in Europe, 1850-1914* (Dordrecht: Springer, 1998); Kathryn Steen, *The American Synthetic Organic Chemicals Industry: War & Politics, 1910-1930* (Chapel Hill, NC: University of North Carolina Press, 2014).
[49] For a timeline of the different BRCA disputes, see <https://dukespace.lib.duke.edu/dspace/handle/10161/7413>.
[50] Vilém Flusser, *Into Immaterial Culture* (Metaflux, 2016), p.39.
[51] The role of hardware and servers underpinning the material digital storage infrastructure has been elucidated by Matthew Kirschenbaum *Mechanisms. New Media and the Forensic Imagination* (Cambridge, MA: MIT Press, 2007). Tung-Hui Hu's *A Prehistory of the Cloud* (Cambridge, MA: MIT Press, 2015) offers a genealogy of the term 'cloud'.
[52] N. Katherine Hayles, *My Mother Was a Computer* (Chicago: University of Chicago Press, 2005), p.2.