

## **A topological space for design, participation and production. Tracking spaces of transformation**

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### Abstract

*Space of Transformation* is a concept borrowed from the Communication theory by Serres and here redefined after the evolution of the postdigital milieu and the materialistic critique of the same. Hackerspaces, fablabs, medialabs and other related collectives will be defined here as *Spaces of Transformation*, places for the encounter between humans and non-humans where hitherto severed disciplines and practices are bridged together, at the same time, that a speculative activity is developed, which will produce new things able to embody information and disrupt our socio-technical milieu. This text explores these spaces, its relation with art, technology, society and new social and educational conceptions by means of tracking and visualizing the topological space emerging from the interactions between them in the web.

*Keywords:* Postdigital, Space of transformation, ontology of becoming, hackerspaces, data visualization,

### **The Postdigital and the Pervasiveness of Data Processing**

After the accomplishment of the Digital Revolution, computing technologies have become stabilized and merged into the processes and infrastructures that are shaping and sustaining our environment. Remote sensors registering the rise of water in Antarctica, the RFID tags we use to access our transportation system, and the Machine Learning algorithms filtering the content we see on the social web are some examples of how computing systems had merged into daily life. Sensors and microprocessors transform physical interactions into data flows, which are processed for the control of our environment. This algorithmic management not only mediates our perception and knowledge of our surroundings but also predicts and shapes our relations with the same. The structural tasks accomplished by computing and communication systems has been highlighted by Lisa Parks [2015] and named 'radical mediation' [Gursin, 2015], cybernetization [Horl, 2015], these and other authors [Jussi Parikka, 2015, Sean Cubit, 2017 ] are unveiling the material infrastructures that remain obfuscated behind the interfaces of the user-centric vision.

The postdigital studies the deep social and physical transformations produced by this technological environment, focusing on its material conditions. In this way, the Postdigital investigates the rising of a new ecology populated by non-human agents that are embedding computing in our environment, until vanishing it into the background of

daily life. Characterized by a critical attitude, it investigates how the ubiquity of computing processes had spread beyond computers to be disseminated into physical space, which now is being subdued to the pervasiveness of data processing. In this space our social interactions - mediated by the web - the events and architecture happening in our environment - sensed by networked devices and scanned by omniscient machine-vision systems-, even our bodies and affects are continuously tracked and abstracted to data, sets of features classified in a databases and operated by software, which is increasing its capacity of abstraction until guzzle our world. Data has exceeded the field of scientific inquiry to become the new engine and fuel of our society, feeding the economy, mass-production, public opinion and the management of our space, and giving birth to a society conducted by opaque algorithms that are changing the way in which our culture is produced and transmitted.

In this environment arises a new form of representation in which the transcendence of the given and its repetition in tradition, perpetuating the mechanisms of power, is being substituted by the real-time tracking of the relations producing and maintaining a complex environment, which nowadays can be simulated on the controllable space of the screen. In this space of representation, power becomes pre-emptive [Massumi, 2007], at the same time, that new creative potentialities emerge.

The continuous surveillance characterizing Foucaultian biopolitics has become pervasive, embedded in the environment by the apparatus of a complex system, fuzzy and relational, in which we are always involved without being aware. This system able to abstract every time more elements of our reality to data is increasing its processing power and performing a probabilistic calculus that extenuates all possibilities towards the accomplishment of pre-emptive control, which anticipates changes and adapts the environment to foreclosing the future. However, at the same time, the capacity for connectivity and modulation that characterises this system produces a diagrammatic space where can arise unexpected encounters and hybridizations. Inside the virtualized space of screens and the networked communications of the internet arises new spaces for the encounter and the production of novelty.

Along the progress of this pervasive milieu is emerging a critique that studies the materiality and pragmatics of software [Fuller, 2012], the environmental effects of the pervasive computing systems [Jussi Parikka, 2015], and the critical epistemologies of feminist materialism [Haraway, 1988]. New theoretical perspectives that turn attention to artistic and collective projects working with the digital milieu to produce new assemblages in which human being interact differently with technology. The production of Pachube by Usman Haque, an affordable platform for the tracking of connected devices, the workshops proposed by Julian Oliver for producing alternative and collectively sustained networks, the proposal of participative and more inclusive procedures for data production and interpretation [Catherine D'Ignazio and Lauren F. Klein, 2017], and the multiple projects involving citizens in the use and production of DIY sensors for sensing their environment, are all examples of assemblages where humans and non-humans transduce producing new systems, at the same time that arises a new material literacy about the computerized environment.

The cited strategies are related to a new conception of what is a thing, linked to the Deleuzian ontology of becoming. In this ontology, aesthetics take on a political

commitment, the unveiling and critique of the processes in which we are entangled and that are producing our postdigital milieu. The things created by these strategies become *Spaces of Transformation*, places for the encounter between art, science, technology and social interventionism, where multiple agents are weaved together to promote new forms of rendering our environment.

The proliferation of new technological assemblages has made data processing available to non-experts giving birth to a new form of speculative experimentation, at the same time, that has promoted the formation of new collectives sited in the flux of interactions going on in the urban space and where are arising new forms of production and collaborative learning. Hackerspaces, maker spaces, media labs, fab labs and other collectively-owned spaces are spaces as diverse as the people that meet on them, but that share an experimental encounter with technology from where are produced new forms of collective innovation that go beyond traditional divisions of roles and disciplines, at the same time, that the commitment to digital literacy and the collective action aimed to improve the local environments where these spaces emerge.

This text will introduce the definition of *Space of Transformation* and its relation with the postdigital to follow with the summary of the evolution of hackerspaces and conclude with the tracking of the topological space that emerges from the on-line relations between these spaces. The visualization of the topological space will lead to the understanding of the diversity of these spaces, the global and local networks they mesh and how they are entangled with new social conceptions and collective forms of production, aimed to intervene in the formation of the techno-social milieu.

Concretely this work will track the online relations of the spaces assembled by the platform *hackerspaces.org*.

### **The Space of Transformation**

*Space of Transformation* is a concept introduced by Serres in his work *The Parasite* [Serres, 1982], in it the author addresses communication and the creative potential of noise. Serres defines the system as a place, a set of codified and black-boxed messages, and the Space of Transformation as the in-between systems. Space where codification ends and the message becomes noise. The *Space of Transformation* is the torus, or the infinite space spreading in the border of all system, the space of encounter or interference where noise becomes message and vice versa. In this space of encounter the noise can burst in the system to transform it - "*The noise is the end of a system and the formation of a new one*" [Serres 1982, 67] -, by virtue of this encounter, the black boxes open themselves to what is not codified or, what is the same, become deterritorialized, in a process that can transform the implied systems and that involves both invention and the formation of knowledge. At this way, the *Space of Transformation* resembles the virtual as elaborated by Deleuze after the philosophy of Whitehead and Bergson, a proposal in which the modern division between a space and time are mutated into a continuous field where space-time is reunited in the becoming of an active matter. The matter is always becoming, linked to the infinite reservoir of unactualized potentialities that is the Virtual. In the ontology of becoming, the Space of Transformation is the space of abundance, where the filters that representation imposes to reality can be removed and where can be encountered the excluded or non-codified towards the movement of

deterritorialization and reterritorialization that is creation. In this way, communication is not the repetition of the messages of power but the ontological encounter that produces reality.

In his work, "Difference and Repetition", Deleuze refers to the Simondon's theory of Individuation to exemplify this process. In his ontological theory of information, Simondon defines information not as a quantifiable content to be transmitted but as the production of something new. The result of a disappearance produced by the encounter between two open systems and its resulting re-structuration in a new functional whole [Simondon, 2007]. This encounter is defined as transduction, the process by virtue of which two differentiated systems enters in a relation of resonance that produces a restructuration, which propagates step by step being each restructured part the model of the next one until the disappearance of the two systems reunited in a new whole. Simondon considers transduction as a process, at the same time, ontological, psychological and social. Consequently, transduction is involved in the material production of new things, but also in the formation of knowledge and intersubjectivity. Accordingly, Knowledge is produced in the experimental activity that builds a bridge between the unformed matter embracing all the possibles and the becoming system. This is a speculative process in which the subject confronts a disparity between the schema of an anticipated result and the present state of a system that is solved by means of the application of the schema and its modification in contrast with the attained result until the concordance between both is achieved. This process opens the black box of the system by means of the hands-on involvement in the problematic of its setting up.

The same problem is what explains the formation of intersubjectivity. In front of a problem, several individuals reunite by means of their attached pre-individual parts to compose a group-individual, in which all individuals actuate modifying their environment at the same time that their identities. The formation of this group-individual is explained by Serres as the formation of a collective in which the *quasy-object* is the factor of intersubjectivity. The *quasy-object* is another name for the *Space of Transformation*, the thing that unveils the network of relations in which it is produced, nor an accomplished object or the solution of a problem, but the problematic encounter from where arises novelty. The *quasy-object* is circulating matter, working as a token in a children's game it assigns objects and subjects, as it is circulating from hand to hand weaving a not hierarchically organized collective, in which nobody is sovereign but all become involved parts. Participate is to mesh in the meshwork of legacies, assignments, loans and transmissions that codifies the individual-group. In this schema noise is the parasite, the newcomer able to disrupt the system making apparent the accepted codification, at the same time, that starts new processes to re-codify the system. In this sense, Serres says that the parasites are the producers of history.

In our contemporary situation deeply mediated by computing systems, we witness the multiplication of black-boxes. Considering the apparatuses that populate our environment as *Spaces of Transformation* propitiates the questioning of the processes and relations that had produced them and their role as agents and producers of intersubjectivity. This approach makes them available to the techno-aesthetic commitment steaming from Deleuzian philosophy and his understanding of the transformative capacity of art. The creative endeavour has the potential to overcome the codified systems and connect to the virtual, bringing differences that start processes of

territorialization, processes of transduction producing new places or sets of codified messages that increase our possibilities of life.

The techno-social environment produced during the digital revolution is the result of a meshwork of relations that entangle technological innovation with new artistic practices, the emergence of new conceptions of education, countercultural movements, and a flourishing civil society, which reaches the public sphere connected to the net of networks that is the Internet. These nets and their involved agents, all together, had contributed to the production of technological assemblages that made computing and new communication technologies available to non-experts spreading its use to differentiated fields of research, production, and social practice. In the 90's we attend to the emergence of new spaces of encounter where humans can learn and experiment with new technologies. Heirs of previous associations, Hackerspaces are spaces where people meet to do things together. They are considered here as *Spaces of Transformation* in the sense that these are the places of the lattice produced among recursive transductions: (1) Transduction between different systems to produce new things (2) Transduction between the individuals and the produced things, in which the individual becomes confronted to a problematic and experimenting with the system towards a possible solution in a process from where arises a shareable knowledge. (3) Transduction between the involved agents that becomes transindividualized participating in a common problem in a process that modifies their environment at the same time that their subjectivities.

These *Spaces of Transformation* become of special interest due to their commitment to the experimentation with the material components composing our techno-social milieu, its openness – these are non-hierarchical collectives, in which people from different backgrounds meet to produce things and share knowledge-, and diversity – they are project-oriented, engaging in enterprises that link multiple agents connecting in-situ and online to local and global networks. These characteristics are giving birth to a new form of production and research sited in the borders of the system and able to incorporate noise to disrupt the apparatus and envision new conceptions of society and education.

### **The emergence and evolution of the Spaces of Transformation, short summary**

Hackerspaces, maker spaces, media labs and DIY workshops will be considered here as Spaces of Transformation and their mutual relations on the internet traced. From this operation, we will see how art, technology, and society mesh in the formation of these spaces and how they had evolved; which incidence they have in their environment; and how they link with activities that are transforming education, art, and production.

The history of these spaces traces a complex network, it is linked to the digital revolution [Levy, 2010], and the social movements emerging during the 70's that inspired the popular Whole Earth Catalogue, and the promotion of an individualized technological production of innovation that later on will inspire the Maker movement [Anderson, 2012]. In addition, the hacker underground opposed to the belief of the transformative potential of 'good technologies', and featured by activist's groups as the Cult of Dead Cow. Finally, the fictional dystopias emerging from the work of cyberpunk authors as "*Neuromancer*" (William

Gibson, 1984) and *“Snow Crash”* (Neal Stephenson, 1992), laying out worlds dominated by big corporations and the cyberspace or the multiverse as the only places available for the human and social agency. However, the first hacklabs emerged in Europe linked to the defence of civil rights and the promotion of digital literacy and open access to the new public sphere that was the web. All these influences encounter in the new connected world of internet but also had precipitated in the formation of physical places. These places will evolve, first dedicated to the media critique and the defence of the free and egalitarian access to the internet, and more recently -with the incorporation of computer connected machines- to the proposal of new forms of material-production that meshes with hands-on education proposals, anti-capitalism, and ecological concerns. In addition, these spaces have spread all over the world, migrating faraway of the white male boys championing the digital revolution and incorporating differences

Levy in his book *“Hackers: Heroes of the computer revolution”* situates the beginning of Hacker culture in the Tech Model Railroad Club, in this basement of the MIT, a group of freshmen met to update the system of command of train miniatures, by means of blending recycled switches and telephone connections. Making technology their playground, these young people will give born to a new form of programming and a new relation between humans and technology, summarized in a non-written ethics. They also introduced the word 'hack', referring to an innovative fix for a problem characterised with technological virtuosity and pleasure, and other words of a new jargon that will evolve through different AI labs and be compiled by Raphael Finkel at the University of Stanford in 1975 as the “Jargon File”, which will contribute to form the identity of this movement. The people of the TMRC will assist the courses of John McCarty, who was developing the language LISP at the electrical engineering department -before computer science was recognized as a discipline- and had access to the TX-0, the first interactive computer. Working with the TX-0 to create system programs and programming it to perform unexpected functions as composing music, perform as a calculator and typewriter, or play chess -the endeavour of McCarty aimed to show that computers can think- the first hackers will develop a new form of programming. Programming shifted from the development of logic functions to perform complex calculations to a pragmatic engagement. For hackers, coding is a way to understand the inner workings of the machine to get things done. This form of interacting with machines yield a hacker ethics based on the philosophy of sharing, openness, decentralization and getting your hands on machines at any cost to improve the machines and to improve the world. This mode of innovation will encounter DIY culture and will produce the Altair 8800, a microcomputer commercialized as a kit to be assembled and the Apple II. It also will conduct Stallman to circulate the GNU Manifesto and start the Open Source Software Foundation and was shared by many others that contributed to the Digital Revolution. The transformation of computers into multipurpose machines able to migrate from big labs to the domestic space of our homes. Hacker ethics can be attributed to the environment shaped by computer machines, an open system working with free flows of information, but it also evolved in the cultural ecosystem shaped by the seventies counterculture, assembled by Steven Brand and his team in the *“Whole Earth Catalogue”*.

The WEC publication was started in California in 1968 influenced by social movements linked to beat culture, civil rights, student protests, and the defence of the environment, and reached a notable popularity becoming the only catalogue rewarded with a National Book Award. Under the motto “action for creating a better world” the *“Whole Earth Catalogue”* was a compilation of useful information for humans, aimed to give access to tools which empower individuals to conduct its own education, find its own inspiration, shape its own

environment and share their adventure with whoever they are interested. These ideas of self-management linked to the ecological conception of the earth as a complex whole, which evolves with the actions of everybody and everything. This conception inspired by the cybernetician Buckminster Fuller and exemplified in the cover of the catalogue -featuring the first image taken from the space and showing the entire globe- and the innovative design of the publication. Across eight dedicated sections, the catalogue juxtaposes images and texts in double pages creating a meeting place where readers can think about the relations between things. Aimed to create a particular ambience for communal action, risk-taking and experimentation the catalogue was considered as a socio-technical genesis of the internet and the early promoter of cyberculture and post-capitalism.

Despite the centric-American origin of Hacker culture and its popularization – Brand brought the hackers to the pages of the popular magazine "*Rolling Stone*"- Maxigas situates the emergence of the firsts hack labs in Europe and differentiates them from Hackerspaces, which will appear shortly after, in its political aims and scope of action [Maxigas 2012]. Hacklabs were linked to the squad movement and the Postmedia epoch -described by Guattari as a new epoch of collective empowerment fostered by the spread of electronic media and the egalitarian access to culture and its materials-. Sited in squads, spaces occupied in the city town and providing free access to the internet, Hacklabs were aimed to appropriate the capitalist structures of power to produce public spaces in both, the city and in the cyberspace. With this aim, they engage in free software development, electronic art and the organization of workshops. The collectives assembled in these spaces were involved in media production, inheriting the appropriation of technologies as radio and TV for communal use and social change, that was started by the first pirate radios established in the 60's and projects as Franco Berardi's *Telestreet Movement*, aimed to threaten the hegemony of media. They considered the internet as a new public sphere and the place of digital democracy from where exercise media critique and the proposition of alternative forms of life. Therefore, they engaged in the defence of online anonymity, free and open access to internet and copyright criticism and were related to movements like the media critique, hacktivism, alter-globalisation, and indie media. In addition to the activities of artistic groups as the Critical Art Ensemble, whose video actions and internet projects were aimed at digital disobedience and electronic disturbance.

In his turn, the Hackerspaces emerged from the libertarian scene of the Chaos Computer Club, a civil group of hackers created in 1981 and aimed at the liberation of technological knowledge, The hackerspaces shifted from discursive interventionism to a more pragmatical endeavour. They considered freedom as the knowledge and capacity of intervention in the techno-social system. Consequently, they reincorporate the interest in innovation characterising hacker culture and focused on the research and the realization of projects. Among them, projects related to free software development, computer recycling, encryption and self-defence of privacy. Hackerspaces will be characterized for a political shift. The appropriation of technologies to participate in the public space of communication turned into the internal organization of self-managed spaces where arise collectives of humans and non-humans that can communicate to disrupt the system.

Another influence in the emergence of these collective spaces of production comes from artistic movements experimenting with new technologies and committed to digital literacy. In addition, Hackerspaces also take advantage of artistic projects aimed to make technology available for artistic production, jut like Processing, a programming language based on Java and enabled for artistic and educational use. Developed by Cassey Reas

and Ben Fry at the MIT Media Lab it was the precedent of Wiring, a version to work with electronics, created by Hernando Barragan, which will be the antecedent of the popular Arduino started by Massimo Banzi, a must stay in most of the hackerspaces. Another artistic project which influenced the evolution of hackerspaces is Physical Computing, popularized by Dam O'Sullivan and Tom Igoe in the book *"Physical computing: sensing and controlling the world with computers"*. It describes a framework and experimental methods to work with the physical grounding of Human-Machine-Environment, it dedicated to pedagogy, based on a hands-on approach and aimed to the understanding of how the human being relates to the technological milieu.

Already in the XXI century, appeared new technological assemblages as the already quoted Physical Computing and Arduino -microprocessor and a programming language- at the same time that Computer Numerical Control Machines as mills, laser cutters, and 3d printers become affordable to non-experts and collectives with small budgets. These machines allow embody information processing and produce new things. Digitation becomes linked to production and the spaces before aimed to media critique and the disruption of the global network can engage with the material production of the postdigital space, in which computing embeds in the connected objects we interact with on a daily basis. Makerspaces are playful environments where people encounter with technology for a big range of purposes. Among them the creation of artistic projects, exploring the borders of technological systems and its disruption, but also hobbyists activities that assimilate the capacity of personalized production of 3d printers to produce small gadgets -ready-made forms of self-expression-; the experimentation with technological assemblages to improve awareness of the techno-social system and create new possibilities to interact with it, but also the quest for the new innovative gadget able to hit the market and produce economic benefits. They have been addressed as the places of a new industrial revolution, facilitated by the democratization of the tools of invention and production allowing fast innovation, high personalization and on demand on-site production. Makerspaces also had contributed to shaping a new educational approach to STEM students, based on hands-on involvement in collective projects shared locally and on-line. The evolution of these spaces takes advantage of affordable prototyping machines as the Makerboot – an easy to use 3d printer developed after the collaborative and open source project, RepRap - and their associated platforms, in this case, Thingiverse, which allow share 3D models that can be modified and printed by everybody having a Makerboot. In addition to publications as the *Maker* magazine - a catalogue of Instructables published by O'Reilly Media- and events as the Maker Fairs promoted by Dale Dougherty. They are also linked to the FabLab project, started by Gershenfeld at the Centre for Bits and Atoms of MIT in 2007 and aimed to foster the innovation of tangible computing and reimagine the production system under the inspiration of peer production. The FabLabs consist of a low-cost and standardized set of tools to make tools that can be easily deployed at educational centres and universities from all over the world and a platform that provides support, mentoring and educational materials.

The evolution of the introduced Spaces of Transformation will mesh with the proposal of other collective spaces as co-workings, startup accelerators, media labs and citizen labs. In these spaces, the concerns arising from the postdigital space as the defence of privacy and civic agency, encounter with the playful experimentation with technological gadgets as drones, robots, facilities related to the Internet of Things, environmental



issues and the management of public space. People interact with technology to confront local issues and producing knowledge shared on the Internet to be reused, at the same time, that engage with the processes of feedback and databasing processing that fuels our current techno-social milieu.

### **Tracking Spaces of Transformation: The Network of Hackerspaces.org**

*"Hackerspaces are community-operated physical places, where people share their interest in tinkering with technology, meet and work on their projects, and learn from each other.*

*hackerspaces.org is an informal volunteer network of such spaces, maintaining community services - including a wiki for everyone who wants to share their hackerspace stories and questions, mailing lists, XMPP services, a blog and a feed aggregator, and many others.*

*[www.hackerspaces.org](http://www.hackerspaces.org)*

*Hackerspaces.org* was founded in 2007 as a collective online platform for the hackerspaces and their users. It is a platform that agglutinates available tools for collaborative work as wikis, blogs, RSS feeds, Freenode channels and so on, to improve communication among hackerspaces and maintain a set of available resources. In addition, a user-maintained list of hackerspaces, and sites to communicate events, residence opportunities, on-going projects looking for collaborators and hackathons. These resources are aimed to facilitate the local development of these spaces by means of a network feedback that shares tools, fosters collaborations and facilitates the mobility of people.

This project analyses the topographic space emerging from the interactions among the hackerspaces that meets around this platform by means of applying computational methods to the tracking and visualization of their on-line relations. Concretely I applied network analysis and visualization to track the links that relate the hackerspaces listed in the wiki *hackerspaces.org*. This analysis will allow defining the hackerspaces and related shared workshops as Spaces of Transformation, spaces of interference for the encounter between complex networks of collectives of human and non-human agents, which engage in transformative activities that involve both creation and knowledge. At this way, the cultural phenomena related to hackerspaces is considered as emerging from a topological space, which is not formed by points or identities but as a conglomerate of local spaces and the contiguous connections between them. The visualization of this topological space will allow to consider this culture in its making and understand a series of questions: how hackerspaces connect between them? Which are the global and local networks this phenomenon is distributed? There are connections where the history and evolutions of these spaces can be traced? Finally, which clusters are locally and globally formed around specific subjects of research and how they are connected among them?

The tools used to perform this analysis are a web crawler and a network visualization and analysis program. A web crawler is an Internet bot that systematically browses the World Wide Web for the purpose of web indexing. In this case has been used the tool Firefox Navi crawler, a Firefox extension that allows to automatically look for the links in

a web page and select them to a corpus of relevant data, at the same time that registers your navigation and store the links you follow. After assembling the data corpus -nodes or websites and links- the program Gephi is used to lay out visualizations of the data for the discovery of the structure of the net that allows answering the research questions. The analysis will outline how hackerspaces are a complex phenomena, encompassing different ideologies and practices, such as the media critique of hackerlabs, the defence of civil rights and privacy attributed to hackerspaces, the focus to innovation and the new economy of startups attributed to maker spaces, the education-based project of Fablabs by MIT and artistic endeavours in which art meshes with technology, speculative design and ecological concerns. The first conclusion of this analysis will be that all these ideologies and purposes are deeply intertwined inside the drawn topological space. In conclusion, these spaces are linked by shared projects and local relations more than by its denominations and definitions.

### Visualizations and analysis

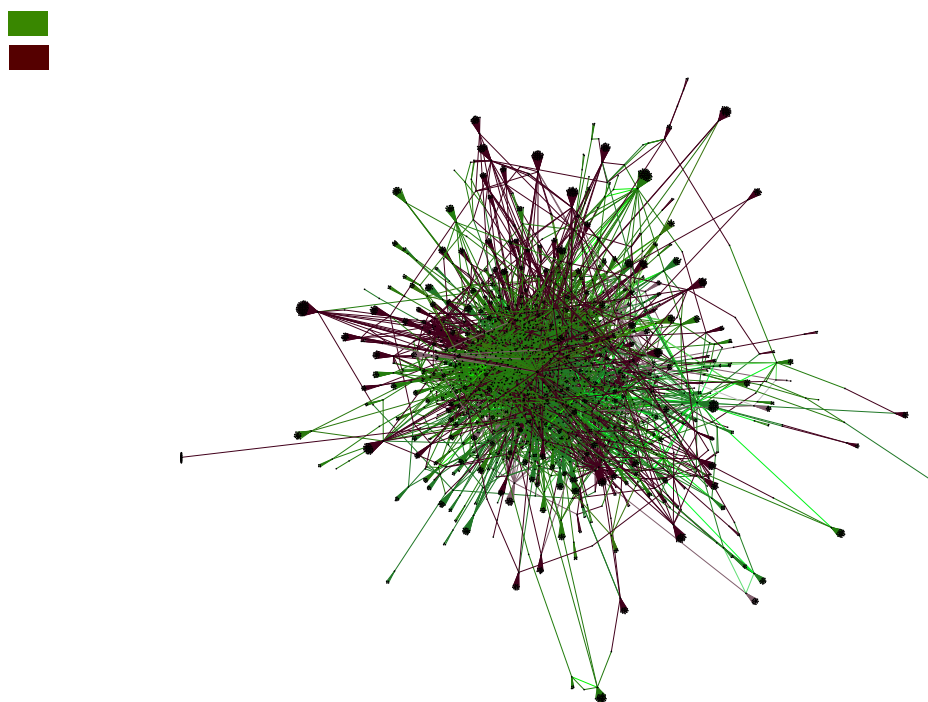


Fig.1 Network showing the websites from *hackerspaces.org* included in the corpus (green colour) and the multiple websites they are linked to (next links in dark red colour)

After cleaning the list of hackerspaces in the *hackerspaces.org* to retain the active hackerspaces having an operative website, I visualized the entire net constituted by the spaces in the corpus and the next sites they are linking to. The result (figure 1) is a centralized network where hackerspaces (green nodes) appear densely located around two main nodes (dark red nodes), these corresponding to the social networks Facebook and Twitter. We can observe other big nodes located in the centre corresponding to

Google and other services of the social web as Youtube, Instagram, Flickr etc. Also located in the centre, but less important (smaller) are more specific services related to free software as MediaWiki and Gitub. Some hackerspaces escape from the centre to link to small clusters of nodes. Among them, the farther point at left corresponds to the makerspace.de that links to a specific cluster formed around radar.squat.net that shows the relation of this space with the early history of the hacklabs. The analysis will follow eliminating the nodes not corresponding to hackerspaces to see if these share direct links between them. Afterwards, I will proceed to the classification of the nodes accordingly its denomination.

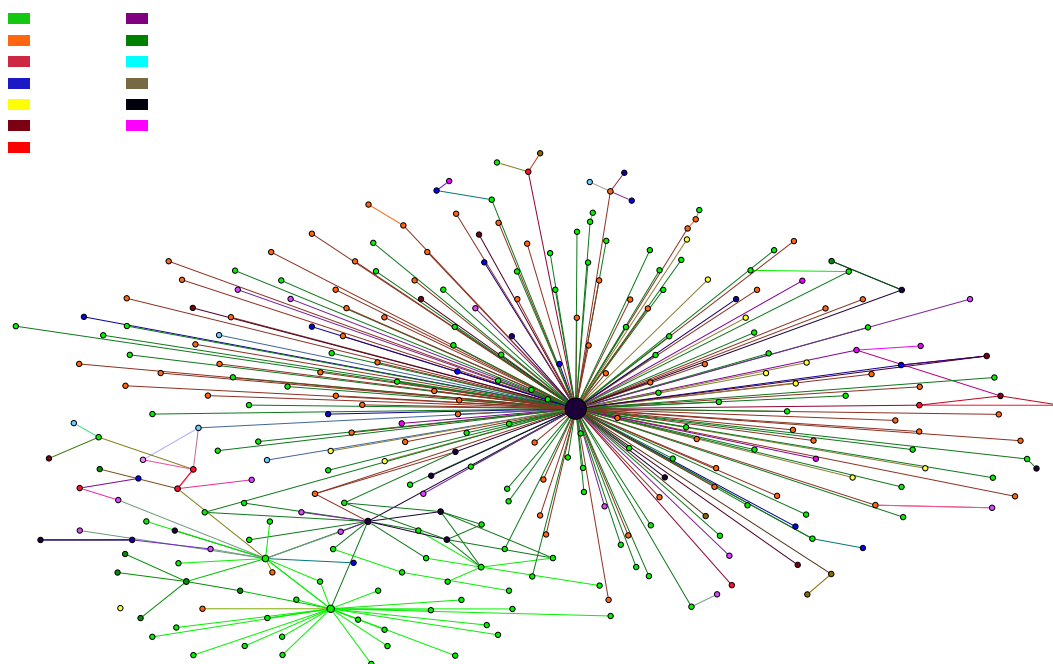


Fig.2 Network of hackerspaces linking to *hackerspaces.org*. Nodes Classified according it's denominations.

The second diagram (figure2) shows the links between hackerspaces, it is shaped as a star centred around the node *hackerspaces.org*. This indicates that hackerspaces are mainly linked across the web *hackerspaces.org*. We find some exceptions, showing hackerspaces that link to the main node and the nodes of other hackerspaces, and hackerspaces that produce their own nets working as a secondary hub. This is the case of the Noisebrige and the Chaos Computer Club.

To discover the diversity of the nodes, they have been coloured accordingly its denomination, this classification has been done attending to how the spaces denominate themselves, not accordingly previous definitions. Between the most usual denominations, we find 'hackerspace' (green colour) followed by 'makerspace' (orange colour). Some fablabs (blue colour) are also linked to *hackerspaces.org*, co-working spaces and startup accelerators (in yellow) are also frequent. Less usual we find spaces

that use the old denomination hacklab (in dark red), medialabs (red colour) and spaces dedicated to art and technology that use diverse denominations as community, workshop or association (pink colour). Finally, we find hackerspaces located in educational institutions (dark orange), DIY workshops (brown) free software developer's communities (dark blue), the hackerspaces associated to the Chaos Computer Club (dark green) and diverse cultural associations (light blue). A closer navigation into these spaces unveils that the difference of names not always is linked to different activities. Inside the big groups as hackerspaces and Makerspaces we find places dedicated to diverse activities as working with electronics, the development of free and open software, media critique, or really specific endeavours inspired by science fiction, such the production of replicas of the Star Wars robots. Inside the group 'art and technology' we also find a diversity of spaces some of them working specifically in art and technology but also there are spaces working in bio hacking and other that considers art as a hobby to enjoy in a group. Inside local networks, the spaces that link between them, with the exception of the hackerspaces linked to the ccc.de, we can find also a diversity of denominations and activities. That makes difficult to have a real classification and demonstrates that this is a diverse phenomenon.

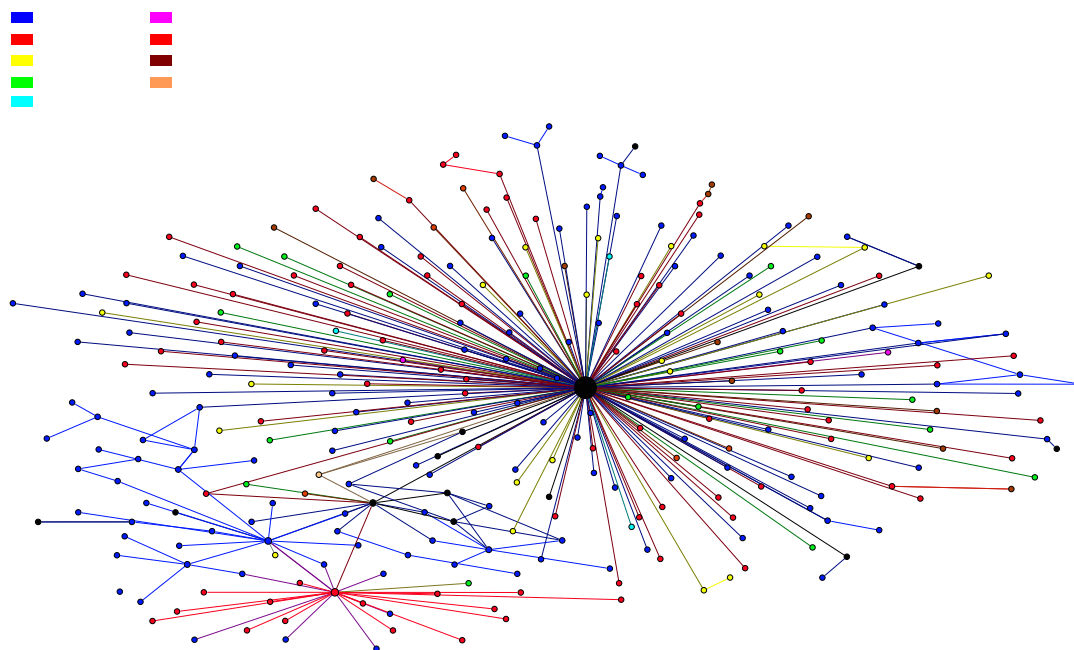
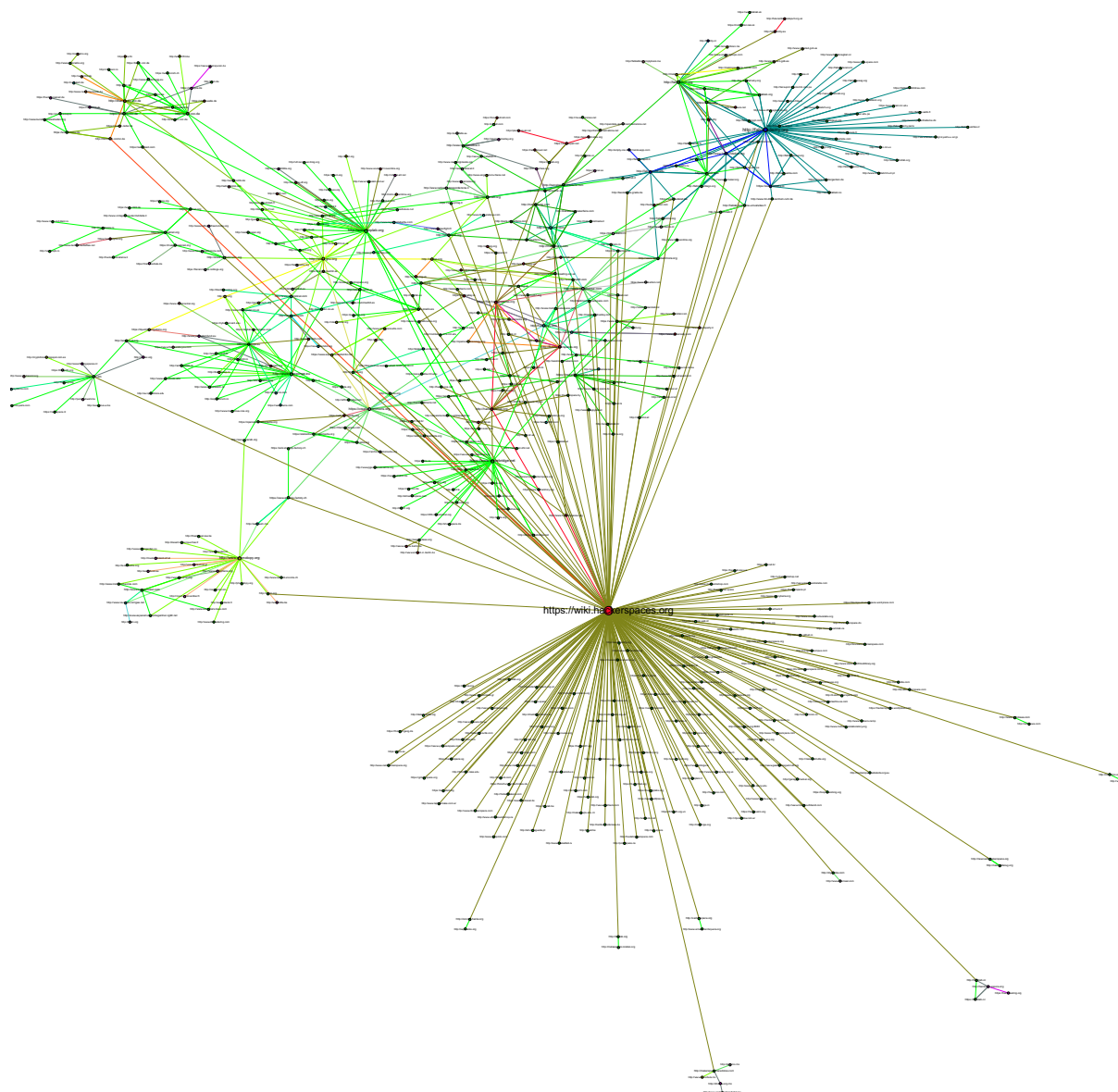


Fig.3 Network of hackerspaces linking to hackerspaces.org. Nodes Classified according it's geographical locations.

In the same diagram, I proceed to colour the nodes accordingly to their location (figure3). Hackerspaces are distributed all over the world, the diagram showing a bigger presence in Europe (blue colour) and the United States and Canada (red and orange colour). There are followed by hackerspaces located in Central and South America (yellow), and less numerous are spaces located in Australia, Asia, Africa, Russia and the

Middle East. Regarding Asia, although the presence on the diagram of Asiatic spaces is scarce, the Hackerspaces are a big phenomenon in China supported by governmental institutions and spread in culture houses and universities all over the country. The reason they are not listed in the wiki of *hackerspaces.org* is that Chinese webs rarely link to abroad websites [Álvaro, 2015]. The diagram also shows that most of the spaces that link between them are located in the same region with the exception of some heavily connected nodes as the Noisebridge, which are connected internationally.



The last diagram (figure 4) answers the questions: What links hackerspaces between them? and which are the local and global networks they mesh?

This visualization includes all the nodes in the corpus after the first layer of the web, constituted by websites as Facebook and Twitter, have been eliminated. This allows focusing in the webs specifically relating to hackerspaces.

This is a more complex diagram it shows a first cluster below of hackerspaces linked to the hackerspaces.org wiki which are not related among them, but above the node

*hackerspaces.org*, we find sites linked to different global hubs and local networks. Among the global hubs, we find webs related to the development of free software as *gnu.org* and the critique of copyright as *creativecommons.com*, as well as tools as *makerboot* and *Thingiverse* and the *RepRap* project. In addition, the hackerspaces are also linked through events as the *Hackaday* and the maker fairs and publications as the *Makezine*. In the right superior corner we find the network that links the fablab community, it including the MIT, the *fablab.io* - a list of operative fablabs-, the *fabfoundation* and the *fabacademy* - a repository of educational materials that are shared among fablabs and other spaces.

In the local networks, we find clusters of hackerspaces that link with online communities, cultural and civic associations, local institutions and projects related to their main activities. Among them, the *Sponge* is a media lab aimed to research and intervention on the media ecosystem. The activities carried towards this purpose link this space with associations and foundations of journalists, governmental institutions, and the mass media, which have been monitored. *Fo.am* is a space dedicated to art and technology that links with exhibition spaces, art projects and international conferences about this subject as the *xcoax*. *Freaknet.org* links with its main project, related to media archaeology, the *Museum de la Informatica Fundacione*, with local hackerspaces, and clubs and associations related to computer vintage, as well as other international conferences as the *Transmediale*. The *Chaos Computer Club* links with other hackerspaces and to a network of radio sites formed around the *Chaos Radio*. *Medialab Prado* a citylab engaged in citizens empowerment connect with governmental institutions, neighbours' associations, projects as *Interactivos* and *Experimentadistrito*, open data initiatives and local fablabs as *Madlab*. The *Fablab Barcelona* is connected to the global network through the *fabacademy* and the maker fair *Barcelona*, but at the same time links to local projects and local and international events as the *Sonar*, and the *Smart City Expo*, other local fablabs, as the *fablabcity* and *kids fablabbcn*, institutions and exhibition spaces as the *Science Museum of Barcelona*, as well as to open-data initiatives. These local networks show how beyond its denomination Hackerspaces are densely connected by means of projects and with spaces related to its main purposes and activities, as well as, with projects and institutions sited in its local surroundings.

This analysis is not exhaustive, not all the existent hackerspaces are listed in the hackerspaces wiki, and not all the spaces in the corpus has been browsed with the same depth. The corpus count with 290 spaces added after cleaning the users-maintained list that is hosted at the wiki of *hackerspaces.org*. The spaces in the corpus had been browsed accordingly the interest of their links, to add new nodes to the corpus. Among these nodes had being erased general nodes and nodes of commercial webs -on-line shops-. After these nodes had been added, the list of community workshops has increased, especially after adding the fablabs that do not link directly to *hackerspaces.org*, but that link with multiple hackerspaces listed on the platform. From this first analysis, we can conclude that hackerspaces, makerspaces and other collective workshops are diverse spaces interchanging a noisy communication inherited from its complex history, which vestiges can be found in the activities they realize as radio transmission, open software development and media critique. In these spaces different people meet to do ludic, pedagogical, artistic and social projects, conduct research addressing social issues and teach and learn together. With their activities, they contribute to the elaboration of resources that are shared globally, at the same time that

maintains local projects, contribute to online communities and local associations and link with the cultural and social institutions in the places they are sited. All this identifies these spaces as Spaces of Transformation, points of interference where the noise and difference encounter collectives of human and non-humans participating in the production of new things and knowledge.

### **Conclusion: embodied information. The poetics and pragmatics of spaces of transformation**

An object is a false thing, that hides their potentialities and the multiple connections from where it is produced. The *Space of Transformation* substitutes the essentialist conception of things based on metaphysical transcendence and logical identity by making apparent the complex spatiotemporal meshworks from where things are produced. The *Spaces of Transformation* are points of interference between systems where can emerge the noise or the infinite potentialities of the virtual. In these spaces, things become considered as assemblages, that emerge from the transductions occurring in the bosom of collectives of human and non-human agents and that always have an embodied existence by virtue of which they have affects that allow them to take part in the formation of new assemblages. This movement defines the poetics of matter, the openness and capacity that assemblages have for forming new relations towards the actualization of all their potentialities. This poetic capacity gives to hackerspaces it's potential for empowering the people involved in their activities to participate in the formation of their social and cultural environment. Interacting with technology to produce new things the hackerspaces' participants engage in a speculative activity that produces knowledge about the functioning of the techno-social system. A further analysis of these spaces must focus in its offline relations, the 'close reading' or ethnographic exploration of the network of relations produced around a hackerspace must show how this knowledge is produced in a situated and embodied manner confronting site-specific issues and building participative communities. Also the capacity of these spaces to include difference as a source of new problematics and creation.

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