

June 4, 2013

DTU, Copenhagen

4th LEONARDO SATELLITE SYMPOSIUM

ORGANIZING COMMITTEE:

Maximilian Schich, Associate Professor, ATEC, The University of Texas at Dallas, U.S.

Roger Malina, Executive Editor at Leonardo Publications, France/U.S.

Isabel Meirelles, Associate Professor, Dept. of Art + Design, Northeastern University, U.S.

Annick Bureaud, Leonardo/OLATS for the Studiolab consortium

SPONSORS:

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ARTS, HUMANITIES, AND COMPLEX NETWORKS 4TH LEONARDO SATELLITE SYMPOSIUM AT NETSCI 2013

Tuesday, June 4, 2013

DTU – Technical University of Denmark, Copenhagen.

We are pleased to announce the fourth Leonardo satellite symposium at NetSci2013 on Arts, Humanities, and Complex Networks. The aim of the symposium is to foster cross-disciplinary research on complex systems within or with the help of arts and humanities.

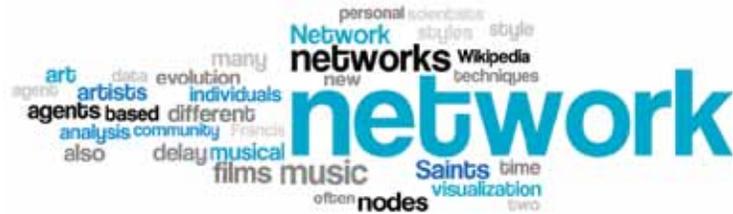
The symposium will highlight arts and humanities as an interesting source of data, where the combined experience of arts, humanities research, and natural science makes a huge difference in overcoming the limitations of artificially segregated communities of practice. Furthermore, the symposium will focus on striking examples, where artists and humanities researchers make an impact within the natural sciences. By bringing together network scientists and specialists from the arts and humanities we strive for a better understanding of networks and their visualizations in general.

The overall mission is to bring together pioneer work, leveraging previously unused potential by developing the right questions, methods, and tools, as well as dealing with problems of information accuracy and incompleteness. Running parallel to the NetSci2013 conference, the symposium will also provide a unique opportunity to mingle with leading researchers and practitioners of complex network science, potentially sparking fruitful collaborations.

As in previous years, selected papers will be published in print, both in a Special Section of *Leonardo Journal* (MIT Press) and a dedicated *Leonardo eBook* (again MIT Press).

- 8:30 Registration & Breakfast**
- 9:00 Roger Malina**
Opening Remarks
- 9:10 Maximilian Schich**
Introduction
- 9:30 Keynote Denny Vrandečić:**
Wikidata: Where Arts and Humanities Meet Graphs
- 10:10 Coffee break**
- 10:40 Doron Goldfarb, M. Arends, J. Frochauer, M. Weingartner, D. Merkl:**
Collectivizing the Barr model
- 11:00 Eموke-Agnes Horvat, A. Spitz:**
A Diverse Menu of Cinematic Delicacies that do not Expire
- 11:20 Marnix van Berchum:**
Linked Sources. A Network Approach to the Repertory of Sixteenth-Century Polyphony
- 11:40 Bruno Mesz, J. P. Pinasco, P. Amster, P. R. Zivic:**
Stylistic Evolution in Networks: Delayed Dynamics in Style Emergence
- 12:00 Lunch (on your own)**
- 13:30 Keynote Scot Gresham-Lancaster**
Computer Network Music
- 14:10 Keynote Paolo Ciuccarelli**
Mind the Graph! A Discussion on the Design of the Network
- 14:50 Coffee break**
- 15:20 Santiago Ortiz:**
Narratives in Network Visualization
- 15:40 Ruth Ahnert:**
Protestant Letter Networks in the Reign of Mary I
- 16:00 Thomas Lombardi**
The Communion of the Saints: Networks and the Study of Iconography.
- 16:20 Francois-Joseph Lapointe**
Hybrids are Hubs: Transdisciplinarity, the Two Cultures and the Special Status of Artscientists
- 16:40 Discussion**
- 17:00 End**
- 19:00 The Data Body on the Dissection Table. Arts, Humanities, Medicine and Complex Network, Medical Museion, Copenhagen**
<http://www.olats.org/studiolab/databody.php>

Roger Malina,
Maximilian Schich,
Isabel Meirelles



INTRODUCTION

With pleasure we introduce the fourth incarnation of our *Leonardo* satellite symposium on **Arts, Humanities, and Complex Networks** at NetSci2013. Building on the extraordinary experience of our first three symposia at Northeastern University 2010 in Boston, the Ludwig Museum in Budapest 2011, and the Northwestern University campus in Evanston in 2012, we continue our mission to amend arts and humanities to the list of disciplines commonly associated with complex network research, in addition to mathematics, physics, computer science, engineering, biology, and social science. Again, we received an outstanding response to our call that manifests a growing interest and quality of proposals coming from both traditional arts and humanities, as well as established practitioners in complex network science.

This year we have selected eight 15 minute contributions, from 55 submissions. The effective acceptance rate of 14.5% is the lowest so far. Contributors to our symposium were selected using a peer review process with three independent reviewers per paper. Both selected submissions as well as our keynotes complement the topic areas that self-emerged in our previous selections. These topics include networks in art, networks in the humanities, networks in culture, network visualization research as well as art about networks.

Complementing our Special Section in *Leonardo* Journal (MIT-Press), we are also proud to present the third edition of our *Leonardo eBook*, which brings together all previously selected contributions, plus a number of further relevant papers.

Figure: The diagram generated in *Wordle.net* depicts the top 40 words in the abstracts published in this book of abstracts.

Denny Vrandečić
Project director
Wikidata

KEYNOTE

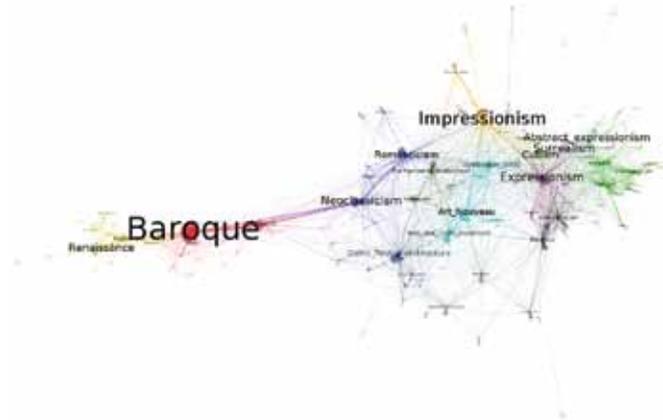


WIKIDATA: WHERE ARTS AND HUMANITIES MEET GRAPHS

Wikidata is creating a free knowledge base about the world that can be read and edited by humans and machines alike. It will provide data in more than 300 languages and allow for the data to be accessed, used, and analyzed by anyone. Wikipedia is using the data already, moving the structured data about its content to a central place from where it can be easily reused and integrated. Wikipedia provides a rich coverage of very different topics of interest, and Wikidata enables ways to analyze and query the data in novel, data-driven ways, thus providing new paths to gain insights and discover connections, explicating the complex networks in arts, humanities, and other areas.

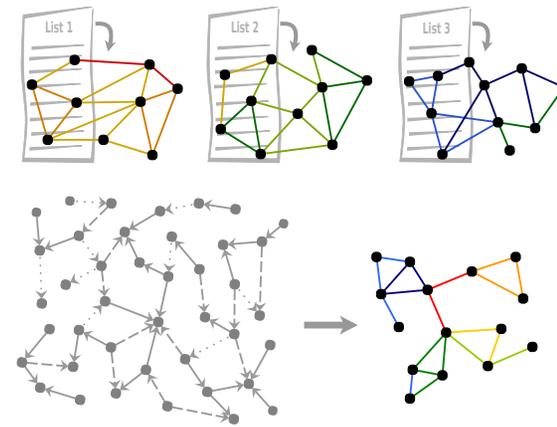
Doron Goldfarb,
Max Arends,
Josef Froschauer,
Martin Weingartner,
Dieter Merkl

Institute of Software
Technology and
Interactive Systems
Vienna University of
Technology, Austria



Emöke-Ágnes Horvát,
Andreas Spitz

Interdisciplinary
Center for Scientific
Computing, University
of Heidelberg,
Germany



COLLECTIVIZING THE BARR MODEL

When Alfred Barr designed his famous diagram for the MoMA *Cubism & Abstract Art* exhibition of 1936, he drew up upon his extensive art historical knowledge in order to visualize the evolution of modern art based on the relationships between various modern art movements. Relatively few featured artist names reflect a shift of perception of the developments of the arts away from interactions between individual geniuses to interactions between art collectives. The choice of these “isms” was, however, highly selective: Barr left out a number of movements that did not fit into his evolutionary model (Astrit Schmidt-Burkhardt: *Stamm bäume der Kunst. Zur Genealogie der Avantgarde*, Berlin: Akademie Verlag 2005). Thus, his diagram was highly acclaimed for its educational value, but also criticized for its selective point of view. The recent growth in availability of publicly available digital resources dedicated to art history makes it possible to address such criticism by again shifting the focus: Away from the interpretation of cultural developments through individuals to their collective interpretation through a large group of people. One source of collectively accumulated art historical knowledge is Wikipedia. Although, of course, not comparable to the work of dedicated scholars, it has been shown that this collectively edited encyclopedia features accurate factual information to a high degree. Based on previous work (Doron Goldfarb et al.: *Art History on Wikipedia, a Macroscopic Observation*, in Proc. WebSci, 2012), we therefore construct a bipartite network of links between Wikipedia articles about artists and about art movements. The underlying idea is that each movement is comprised of its members and that ties between movements are based on individuals acting as bridges between them. The resulting network shows the relationships between art movements as present on Wikipedia, connected by the many individuals who determined their historical evolution and based on the contributions by the many individuals who participated in the creation of this collective knowledge base.

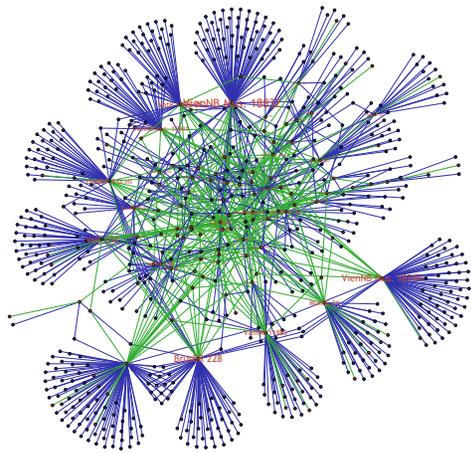
A DIVERSE MENU OF CINEMATIC DELICACIES THAT DO NOT EXPIRE

The film industry knows several recipes for guaranteed blockbusters, but as is the case with real fast-food, these recipes also result in a limited diet where every serving tastes the same. The commonly available personal favorite lists of filmgoers all around the world indicate this cinematic malnutrition. Connoisseurs and critics on the other hand often have a very specific taste, which results in exotic and specialized menus of films, tailored to an appetite only few can stomach. Either kind of list is prone to contain films with common traits and thus reveals more about the list’s creator than about our film heritage. In a novel approach to this problem, we suggest an objective way of putting together a more diverse selection of films that is based on long-lasting cinematic influences instead of personal tastes. We derive a list of the most influential films not from the insights of a handful of experts or fans, but from a large-scale network that contains different types of film references and reflects the viewpoint of the filmmakers themselves. As a result, the obtained list is no longer subject to personal taste. Instead, it consists of films that incorporate a wide palette of cinematic tools and elements of style: the films that taught cinema its best tricks and the delicacies which no aspiring filmmaker could resist referencing. For a network-based comparison, we transform top lists of films into multiplex networks by connecting films that share common traits such as genre, cast, crew, language or period of release. We analyze the proposed objective list in relation to various existing top lists to point out structural differences between them. Our results show that personal taste is too narrow to account for the full range of different flavours in world cinema.

Figure: Multiplex film networks generated from classic top lists of films (a) are less diverse in both topology and the number of distinct relations when compared to a network of top films extracted from a network of film references (b).

Marnix van Berchum

Utrecht University,
Netherlands



LINKED SOURCES. A NETWORK APPROACH TO THE REPERTORY OF SIXTEENTH-CENTURY POLYPHONY

Scattered over the many libraries and archives of Europe, lie the remnants of past musical cultures. Musical manuscripts and prints provide us with glimpses of the repertoires that were circulated, collected and performed. From its beginnings in the 19th century musicology has been involved with the study of these musical repertoires. Sources have been studied from codicological viewpoints, the compositions these sources contain from stylistic angles. My current research approaches the repertoire of sixteenth-century music from the perspective of network theory. Musical compositions are regarded as cultural artefacts, contextualized within the transmission of music and broader socio-economic conditions of a defined historical period. This approach exploits the characteristics of musical sources and their content as networked entities, providing a more formalized view of the term 'repertory'. In the proposed paper I will introduce the above described research project. I will talk about the problems of approaching a distinct historical period – in this case from the history of music – from the viewpoint of network theory. What are the characteristics of such a network? How did the network evolve over time? What musicological question can be answered? My choice for the sixteenth century will be explained, including the characteristics of the transmission of music from this period and the consequences they have on viewing a musical repertoire as a type of formal network. The above will be illustrated by a case study on one of the most famous sets of musical manuscripts from the early decades of the sixteenth century. These manuscripts were produced by the *scriptorium* of Petrus Alamire and were mainly created for the Habsburg-Burgundian court. This case study will demonstrate that 'repertory' is not merely a collection of compositions in a specific place or time, but a strong interconnected network of compositions, composers and dedicatees.

Figure: A visualization of the network of the Alamire manuscripts, their music and composers showing the centrality of the composer Pierre de La Rue and the isolation of the incomplete source OxfBA 831. [Data: CMME database (www.cmme.org); visualized in Gephi]

Bruno Mesz,

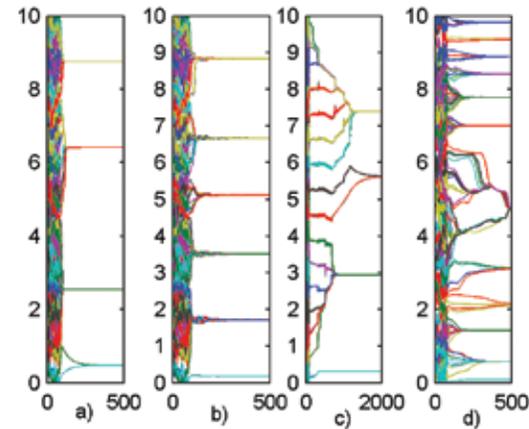
LAPSO, Universidad
Nacional de Quilmes,
Argentina

Juan Pablo Pinasco,

Pablo Amster,
Depto. Matematica,
FCEN-UBA IMAS,
CONICET, Argentina

Pablo Rodriguez Zivic

Depto. Computacion,
FCEN-UBA, Argentina



STYLISTIC EVOLUTION IN NETWORKS: DELAYED DYNAMICS IN STYLE EMERGENCE

We simulate the evolution of styles in a system of interacting agents. Our motivation is to study the emergence of popular music genres such as tango or jazz. In our model, style is represented by a real number in the range 0–10. We assume that given a network of interacting agents, each agent assimilates features from their neighbors' styles. We will say that two agents are neighbors when their styles are similar (numerically close to each other). Observe that the network structure itself evolves as the agent styles change. The interplay between musicians in the Americas in the second half of the XIX century was strongly dependent on their physical interaction, due to the lack of sheet music and recording devices, specially among non-reading musicians. We focus in a crucial aspect of interaction, a temporal delay. This delay arises when musicians playing together assimilate features not just of the present style of the others but also of their past style or their tradition; delay can be also caused by slow speed of information transmission, or due to technological limitations. The style of each agent is initialized by a real number in the range 0–10 assigned randomly with uniform distribution. The values of the agents are allowed to evolve randomly and independently during a certain time before the beginning of interactions. After that lapse, their evolution is similar to opinion dynamics models, where each agent replaces its own style with some weighted average of the styles of their neighbors. Numerical simulations show the effects of the delay, which produces slower convergence to more different styles (several clusters of fully connected agents) in comparison with non delayed interactions, in which only the present styles of agents have influence and not their past. Moreover, we consider the effect of heterophily (when the intensity of interaction is greater for agents that are dissimilar in style) and of popularity, where a second evolving network, simulating the public, establishes a ranking of the agents according to how much public is in their neighborhood; the rank of an agent determines the strength and the extent of its influence.

Figure: Style emergence in agent networks. Self-organized dynamics a) without delay; b) with delay; c) with delay and heterophily; d) with delay and popularity effect.

13:30–14:10

**Scot Gresham-
Lancaster**

Arts and Technology
Program, The University
of Texas at Dallas, U.S.

KEYNOTE



COMPUTER NETWORK MUSIC

Computer Network Music is a new genre of music practice that grew directly out of the advance in personal computer technology and networking. Since the early 1980's there has been an enclave of experimental composer/performers who have worked consistently to use the latest breakthroughs in musical hardware and software advances. They make new work using only their impromptu interaction with the nodes and flows of heterogeneous ad-hoc networks as the sole source of structure and determinism in the creation of music. Aesthetically aligned with the utopian visions of machine vitality and cooperative synergy of John Cage and Buckminster Fuller, this work arises from a necessity to directly express the state of network interaction as sound. Starting with a shared memory space, the techniques evolved to be structured like the classic network model of node and flow. Finally, the architecture of network music practice has come to more closely resemble the structured and semantic context found in many complex networks, where process and procedure are semiotically bound to fixed functions, that pass information in expected ways locally, but create unexpected and complex expressions not present in any other musical practice. The future of computer network music promises to be even more entwined with process and dynamic interaction. The ubiquity of homogenous "laptop" orchestras in the curriculum of many graduate music schools begs the question regarding the more heterogeneous techniques of the early work in this field and whether this is a musical necessity or simply a convenience. The direct and interactive sonification of network flows demonstrate the clear value that is present in the direct use of networks in the Arts and Humanities in general.

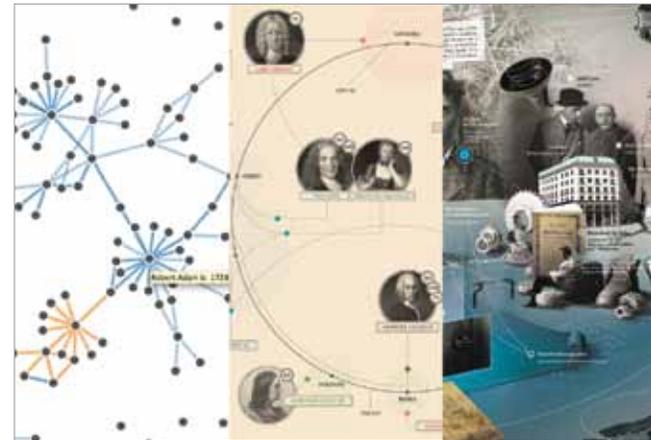
Figure: The HUB performing at the REDCAT concert hall in Los Angeles in 2010
(Photo by Phil Althouse)

14:10–14:50

Paolo Ciuccarelli

Scientific Director,
DensityDesign
Research Lab &
Associate Professor,
Politecnico di Milano,
Italy

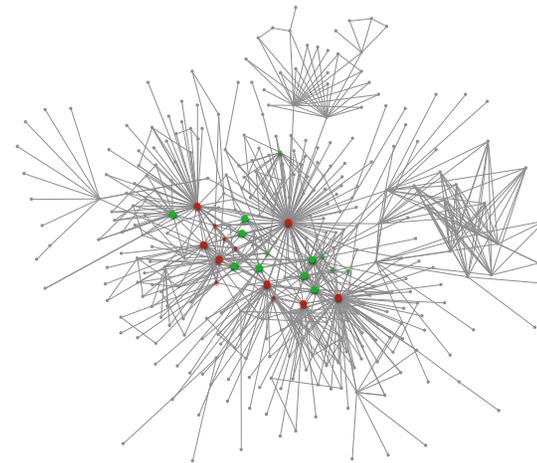
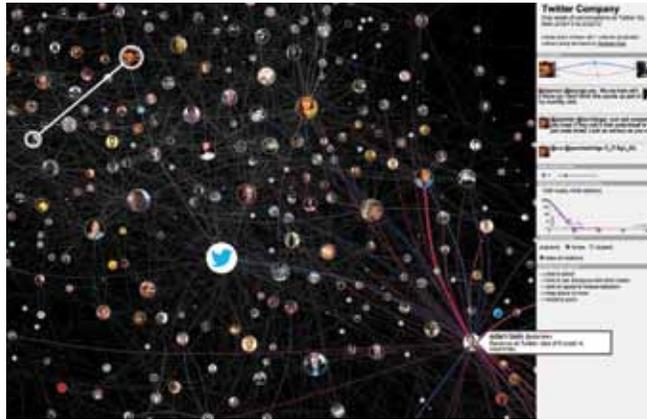
KEYNOTE



MIND THE GRAPH! A DISCUSSION ON THE DESIGN OF THE NETWORK

As communication designers we are often asked to bring complex scientific issues in the hands of non-expert stakeholders: people that are neither expert of the domain of interest nor familiar with the very nature, the structure and the dynamics of complexity. It's the case of Controversy Mapping in Social Studies, where the aim is to preserve the richness of the controversy and, at the same time, to represent it in an understandable way for the public(s). From one side, network visualization seems to be the natural device to put Actor-Network Theory in action; on the other, the limits of network visualizations suddenly emerge in engaging the public: a graph can be scary, impenetrable and repulsive. Even though the solution is not obvious, it is a communication problem, and, as such, can be solved.

A deeper issue emerges, even with experts and highly motivated users. Network visualizations have become a powerful conceptual and cognitive research tool for many disciplines, including, more recently, those soft sciences that embraced digital technologies. Digital Humanities is one of these domains trying to exploit the heuristic potential of network visualizations, often importing and "practicing" the quantitative methodology —network analysis— embedded in the visualization pattern. If we accept that humanistic inquiry is based on the recognition of knowledge production as a constructive process, where 'making' is a fundamental step and interpretation —not truth— is the goal, visualization is more a matter of creation than representation; it's about building the pattern, not just finding it. Data and graphs are not objective representations of pre-existing facts: they are the generative, qualitative and uncertain processes that allow scholars to craft out novel interpretations from tacit knowledge spaces. That is where a fruitful and tight collaboration between designers, (soft) sciences scholars and experts may be established.



NARRATIVES IN NETWORK VISUALIZATION

Interest in networks visualization continues to grow, as new uses and tools emerge. Among the networks that are more interesting and useful to visualize are the ones coming from humanities and cultural contexts, since these contexts have a tradition of working with relational logics and information (rather than quantitative ones). The metaphor of culture and humanities as networks precedes by far the practice of visualizing them. In this young field, however, there are many common problems and unsolved challenges, such as the fact that network visualizations tend to be good at displaying overall and abstract patterns, or helping identifying very local facts, but are poor building structured narratives. There exist two main visualization strategies: the global one, that often reproduces a shape known as hairball, in which relations are unreadable; and the local one, that gives rich information about specific relations yet losing the context.

I propose a series of advanced interactive techniques that connect the local view and the global view, and that build narratives out of subsets of nodes: partial linearities out of the non-linearity. My techniques, based on graph theory and geometrical algorithms, include the use of interactive back and forth transitions between local and global views, simulations and stimulations that help to understand the spread of influences among nodes, and the use of the “reenactment mode” in which dynamical and temporal behaviors are reproduced in a way new stories are created. By using these techniques the interactor has a complete experience of exploration and obtains insight from local, global and intermediate scales. Cultural networks often come from very dynamic realities such as creative dialogues, influences and co-operations that lay extended in time, the reenactment strategy reconstructs and visualizes these processes, and thus conveys these dynamic human realities.

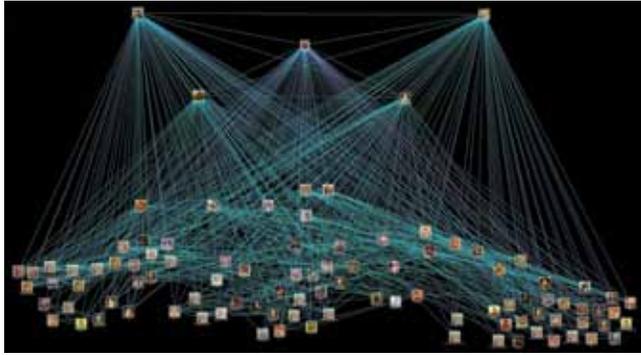
PROTESTANT LETTER NETWORKS IN THE REIGN OF MARY I

A letter is, necessarily, a mark of a relationship between sender and recipient. Bodies of letters, where they survive, can tell us about communities. One such example is the large collection of Protestant martyrs’ letters dating from the reign of Mary I of England at the British Library and Emmanuel College Library, Cambridge, England. The martyrologist John Foxe and his colleague Henry Bull published many of these letters during the 1560s in the famous ‘Book of Martyrs’ and the lesser known ‘Letters of the Martyrs’. However, these printed versions often edit out personal greetings and commendations, which point to a much larger network, as well as sometimes obscuring the true identities of the recipients. The original manuscripts therefore point to a much larger active community of Protestants who were practicing their faith in England during the reign of Mary I than Foxe and Bull’s publications show. I reconstruct this network in collaboration with Dr Sebastian Ahnert (Department of Physics, University of Cambridge) from evidence in the letters and show that through statistical measures and visualization, network analysis allows us to identify key Protestants who do not feature prominently in Foxe and Bull’s publications. Many of these individuals are important sustainers of the community infrastructure, providing monetary, moral, and logistical support to the martyrs during their persecution (Figure). It also allows us to understand just how important individual martyrs were in maintaining a community beyond the prison and beyond their own lifetimes. This paper will also seek to answer why Foxe and Bull’s depiction of the underground Protestant community in England failed to conform to this reality.

Figure: Giant component of the letter network of Protestant martyrs during the reign of Mary I of England. Prominent martyrs are shown in red, prominent sustainers –identified through network analysis– in green.

Thomas Lombardi

Washington &
Jefferson College,
Washington, PA, U.S.



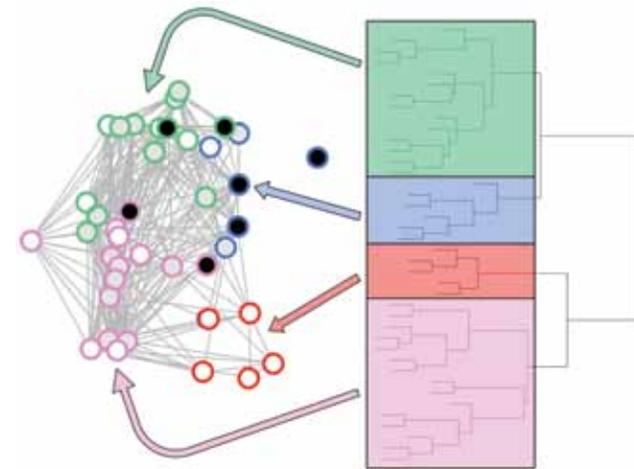
THE COMMUNION OF THE SAINTS: NETWORKS AND THE STUDY OF ICONOGRAPHY

The Communion of the Saints presents a view of the Christian community that spans space, time, life, and death. Medieval iconography captures the evolution of the Communion by integrating new Saints into established iconographic imagery. The co-occurrences of Saints in medieval paintings provide a basis for modeling the development of iconography as a network. This study adapts techniques for analyzing groups of people in digital images to the images of Saints in medieval paintings. In the development of the iconography of St. Francis in the Thirteenth and Fourteenth Centuries artists and their patrons exerted great effort to connect St. Francis to the rich iconographic tradition of the Middle Ages. The network of early images of St. Francis exhibits characteristics consistent with networks that develop by preferential attachment whereby the network evolves by attaching new nodes (recently canonized Saints) to those nodes with high degree. Accordingly, Christ, Mary, and Francis are hubs with high degree, and the degree distribution of the nodes fits that of a power-law distribution. The evolution of this structure, driven by the imagery of intercession, creates a dense network of closed triads arranged hierarchically from Christ to Mary to Francis to the broader community of Saints. By examining the evolution of the network, researchers can analyze and visualize the changing structure of the Communion of the Saints and its associated iconographic traditions.

Figure: Co-occurrence Network of Saints in Early Images of St. Francis

Francois-Joseph Lapointe

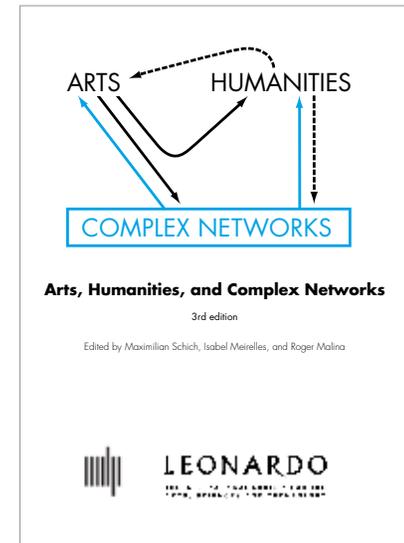
Département de sciences biologiques
Université de
Montréal, Canada



HYBRIDS ARE HUBS: TRANSDISCIPLINARITY, THE TWO CULTURES AND THE SPECIAL STATUS OF ARTSCIENTISTS

Much as been said and written about the “two cultures” separating the world between artists and scientists. On one side of this debate are those who accept and celebrate this cultural art/science divide. On the other side are those who reject it altogether to promote a better integration of arts/science practices. In this paper, I present a network analysis of 40 papers submitted to the SEAD Network for Science, Engineering, Arts and Design. I intended to look at the two cultures from an objective standpoint, testing the hypothesis that texts authored by artists/scientists would be separated in a network representation of intertextual distances. To my great surprise, this is not what the data said. As a matter of fact, all analyses and statistical evaluation of network indices associated with the different categories of papers revealed an integration of artists and scientists in overlapping clusters. As such, these results seem to falsify the art/science paradigm altogether. In terms of intertextual distances at least, it is not possible to distinguish papers authored by scientists from those authored by artists. From a different perspective, however, the network analysis tells an even more interesting story than the non-separation of the two cultures. The statistical analysis of graph-based indices exhibited the special status of artscientists, a transdisciplinary group of individuals different from that of artists and scientists. These hybrid individuals act as hubs in the corresponding networks, i.e., nodes (papers) with more connections than expected by chance alone. This implies that artscientists are probably better at collaborating with each other, but more importantly, that they could also collaborate with artists and scientists at the same time, bridging the gap between the two cultures.

Figure: Joint representation of the clustering and network analysis of the 40 Papers submitted to the SEAD Network based on intertextual distances. The different colors associated with the four clusters defined on the dendrogram are used to identify the corresponding nodes in the network. The three categories of papers are also identified on the graph by nodes labeled in white (artists), black (scientists) or grey (artscientists).



This book is a first anthology of articles to foster the emerging convergence of arts, humanities, and complex networks in *Leonardo* journal. It brings together a selection of articles from four symposia, three on *Arts, Humanities, and Complex Networks* and one on *High Throughput Humanities*. The former is an ongoing satellite series at NetSci – the International School and Conference on Network Science, with articles selected from events that took place in Boston 2010, Budapest, Hungary 2011, and Evanston 2012. The latter was a satellite event at the European Conference on Complex Systems 2010 in Lisbon, Portugal. Further articles were selected from direct submissions to *Leonardo Transactions*.

Produced in partnership with *Leonardo*, the International Society for the Arts, Sciences and Technology, and the MIT Press, this anthology includes 35 articles loosely organized in a number of self-emerging groups, including Networks in Culture, Networks in Art, Networks in the Humanities, Art About Networks, and Research in Network Visualizations. The groups overlap and combine a great variety of perspectives. The articles cover a kaleidoscope of different approaches, ranging from vigorous humanistic inquiry and pure natural science to free artistic expression. Our goal is to provide a useful overview of a large variety of specializations as well as new and interesting collaborations. As we approach the common goal to measure, visualize, and understand complex networks in the arts and humanities, we look forward to document the further growth of this diversity of approaches in future incarnations of this book.

The third edition of our pioneering article collection on **Arts, Humanities, and Complex Networks** from **Leonardo** for the Kindle is available for only \$7.99 from the Amazon Kindle Store: <http://amzn.to/leonardokindle>

For an evolving summary of our activity on Arts, Humanities, and Complex Networks including additional videos, check the eBook web companion at: www.AHCNcompanion.info

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Northeastern

College of Arts, Media and Design
Center for Complex Network Research



Technical University
of Denmark

LEONARDO
THE INTERNATIONAL SOCIETY FOR THE
ARTS, SCIENCES AND TECHNOLOGY

ARTS, HUMANITIES, AND COMPLEX NETWORKS
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