

Insightful Visualizations of National Researcher Networking Data

Katy Börner

Cyberinfrastructure for Network Science Center, Director
Information Visualization Laboratory, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu



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VIVO Conference, Washington, D.C.

August 26, 2011



Different Stakeholder Groups and Their Needs

Funding Agencies

- Need to monitor (long-term) money flow and research developments, identify areas for future development, stimulate new research areas, evaluate funding strategies for different programs, decide on project durations, funding patterns.

Scholars

- Want easy access to research results, relevant funding programs and their success rates, potential collaborators, competitors, related projects/publications (**research push**).

Industry

- Is interested in fast and easy access to major results, experts, etc. Influences the direction of research by entering information on needed technologies (**industry-pull**).

Advantages for Publishers

- Need easy to use interfaces to massive amounts of interlinked data. Need to communicate data provenance, quality, and context.

Society

- Needs easy access to scientific knowledge and expertise.

Scholars Have Different Roles/Needs

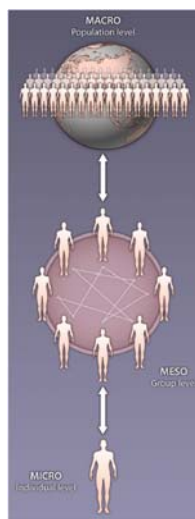
- Researchers and Authors**—need to select promising research topics, students, collaborators, and publication venues to increase their reputation. They benefit from a global view of competencies, reputation and connectivity of scholars; hot and cold research topics and bursts of activity, and funding available per research area.
- Editors**—have to determine editorial board members, assign papers to reviewers, and ultimately accept or reject papers. Editors need to know the position of their journals in the evolving world of science. They need to advertise their journals appropriately and attract high-quality submissions, which will in turn increase the journal’s reputation and lead to higher quality submissions.
- Reviewers**—read, critique, and suggest changes to help improve the quality of papers and funding proposals. They need to identify related works that should be cited or complementary skills that authors might consider when selecting project collaborators.
- Teachers**—teach classes, train doctoral students, and supervise postdoctoral researchers. They need to identify key works, experts, and examples relevant to a topic area and teach them in the context of global science.
- Inventors**—create intellectual property and obtain patents, thus needing to navigate and make sense of research spaces as well as intellectual property spaces.
- Investigators**—scholars acquire funding to support students, hire staff, purchase equipment, or attend conferences. Here, research interests and proposals have to be matched with existing federal and commercial funding opportunities, possible industry collaborators and sponsors.
- Team Leads and Science Administrators**—many scholars direct multiple research projects simultaneously. Some have full-time staff, research scientists, and technicians in their laboratories and centers. Leaders need to evaluate performance and provide references for current or previous members; report the progress of different projects to funding agencies.

Why Use National Researcher Networking Data?

- **Structured data** – Easy to process by computers.
- **Comprehensive** – Not only publication but also funding, teaching, patenting activity is captured.
- **High quality** – faculty record, funding, course data has “touched” money.
- **Linked** to other data silos via Linked Open Data.
- **(Inter)National** – Science is a global enterprise and needs to be studied/understood globally.
- **Open** – Anybody can access detailed data, re-run analysis.

Many NRN instances hold and expose **Thomson Reuters, Elsevier, MEDLINE, NSF, NIH** and other data.

Science of (team) science research and practice requires an interdisciplinary, multi-level, mixed-methods approach.



TEAM SCIENCE

A Multi-Level Systems Perspective for the Science of Team Science

Katy Börner,^{1*} Noshir Contractor,² Holly J. Falk-Krzesinski,³ Stephen M. Fiore,⁴ Kara L. Hall,⁵ Joann Keyton,⁶ Bonnie Spring,⁷ Daniel Stokols,⁸ William Trochim,⁹ Brian Uzzi¹⁰

Published 15 September 2010; Volume 2 Issue 49 49cm24

This Commentary describes recent research progress and professional developments in the study of scientific teamwork, an area of inquiry termed the “science of team science” (SciTS, pronounced “sahyts”). It proposes a systems perspective that incorporates a mixed-methods approach to SciTS that is commensurate with the conceptual, methodological, and translational complexities addressed within the SciTS field. The theoretically grounded and practically useful framework is intended to integrate existing and future lines of SciTS research to facilitate the field’s evolution as it addresses key challenges spanning macro, meso, and micro levels of analysis.



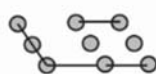
Temporal Levels

Highly dynamic processes (download activity)

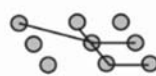
Slow processes (citation activity)

Static structure

Data Types



Co-author network

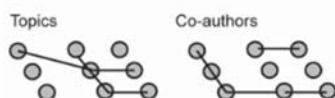


Topic similarity network



Geospatial substrate for a set of authors

Reference Systems



Levels of Aggregation



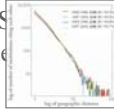
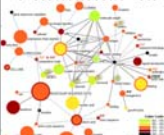


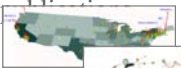
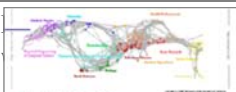
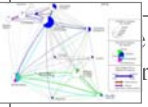


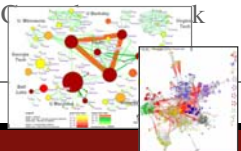
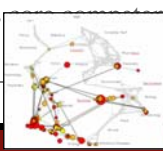
Katy Börner, Kevin W. Boyack, Staša Milojević, Steven Morris. (2011) An introduction to modeling science: Basic model types, key definitions, and a general framework for the comparison of process models. In Scharnhorst, Börner, van den Besselaar (Eds) Models of Science Dynamics. Springer Verlag.



Standard VIVO Visualizations

7

Type of Analysis vs. Level of Analysis

	<i>Micro/Individual</i> (1-100 records)	<i>Meso/Local</i> (101-10,000 records)	<i>Macro/Global</i> (10,000 < records)
Statistical Analysis/Profiling	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF, all of science SA, 
Temporal Analysis (When)	Funding portfolio of one individual	Topic bursts of PNAS 	113 Years of PNAS Research 
Geospatial Analysis (Where)	Career trajectory of one individual	Mapping a scientist's intellectual landscape 	PNAS 
Topical Analysis (What)	 s.	flows in research 	VxOrd/Topic NIH funding 
Network Analysis (With Whom?)	NSF network of one 	NIH network 	NIH's 

University of Florida

How do you want to compare?
by Grants

Who do you want to compare?
Search: X

Records 1 - 10 of 30

Entity Label	Grant Count	Entity Type
<input checked="" type="checkbox"/> Continuing Education	562	UF Department, Agent, Non-Academic Department, Department
<input checked="" type="checkbox"/> Florida Museum of Natural History	203	Museum, Agent
<input checked="" type="checkbox"/> College of Agricultural and Life Sciences	166	Agent, UF College, College
<input checked="" type="checkbox"/> College of Engineering	103	Agent, UF College, College
<input checked="" type="checkbox"/> Evelyn F. and William L. McKnight Brain Institute of the University of Florida	64	UF Center, Agent, Center
<input checked="" type="checkbox"/> International Center	54	UF Department, Agent, Non-Academic Department, Department
<input checked="" type="checkbox"/> Florida Sea Grant	44	UF Center, Agent, Center
<input type="checkbox"/> Whitney Laboratory for Marine Bioscience	42	UF Research Laboratory, Agent, Laboratory, Research Laboratory
<input type="checkbox"/> Water Institute	38	UF Center, Agent, Center
<input type="checkbox"/> College of Dentistry	35	Agent, UF College, College

Save as CSV Clear

Comparing Grants of Organizations in University of Florida

Total Number of Grants

You have selected 7 of a maximum 10 organizations to compare. Clear

- Florida Sea Grant 44
- International Center 54
- Evelyn F. and William L. McKnight Brain Institute of the University of Florida 64
- College of Engineering 103
- College of Agricultural and Life Sciences 166
- Florida Museum of Natural History 203
- Continuing Education 562

Temporal Analysis (When) Temporal visualizations of the number of papers/funding award at the institution, school, department, and people level

VIVO enabling national networking of scientists

Home | People | Organizations | Research | Events

University of Florida

Explore 487 publications activity across 554 scientific sub-disciplines

13 Disciplines | 554 Sub-Disciplines

Search: X

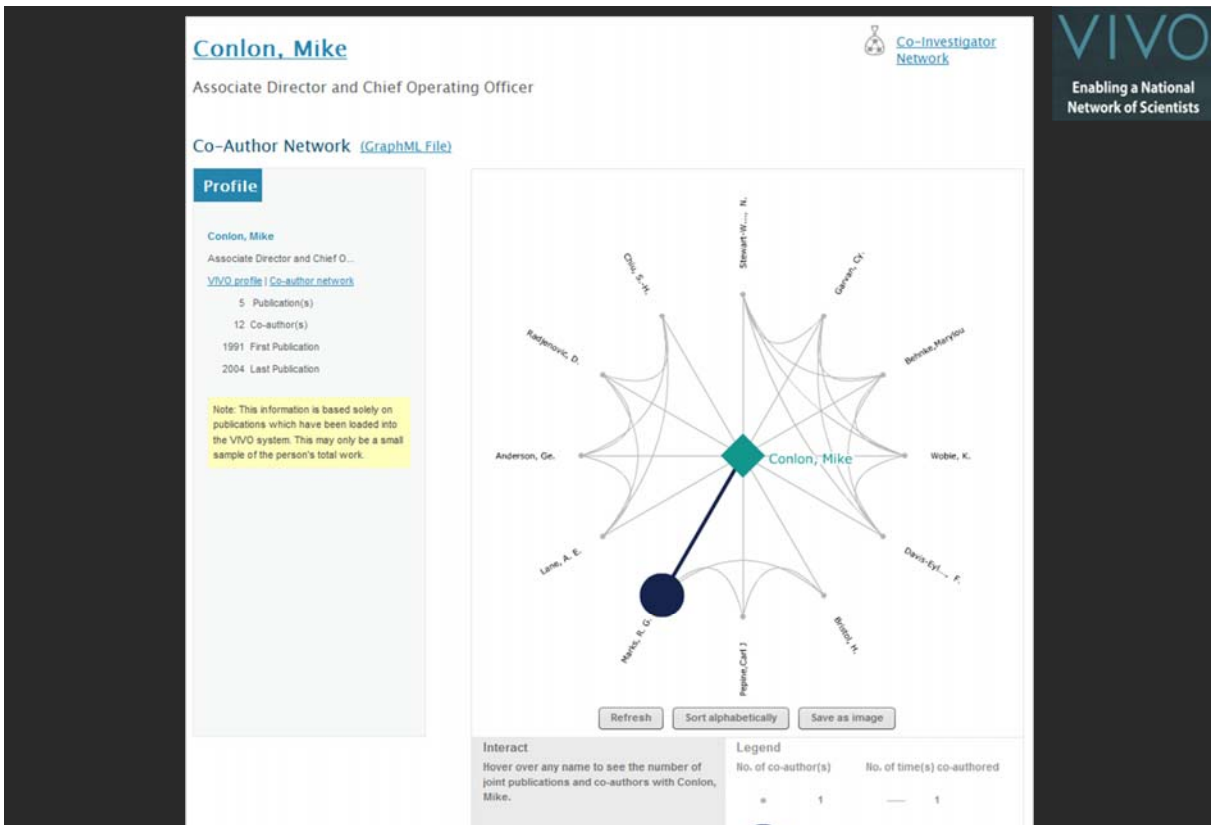
1 - 13 of 554

Sub-Disciplines	# of pubs.	% activity
Pest Management Science	24.2	5.0
Wildlife Research	19.1	3.9
Protein Science	13.1	2.7
Clinical Cancer Research	12.6	2.6
Pain	12.0	2.5
Environmental Contamination	11.2	2.3
Insect Physiology	11.1	2.3
Organic Chemistry	10.9	2.2
Marine Biology	10.3	2.1
Computer Aided Molecular Design	10.2	2.1
BioStatistics	9.0	1.9

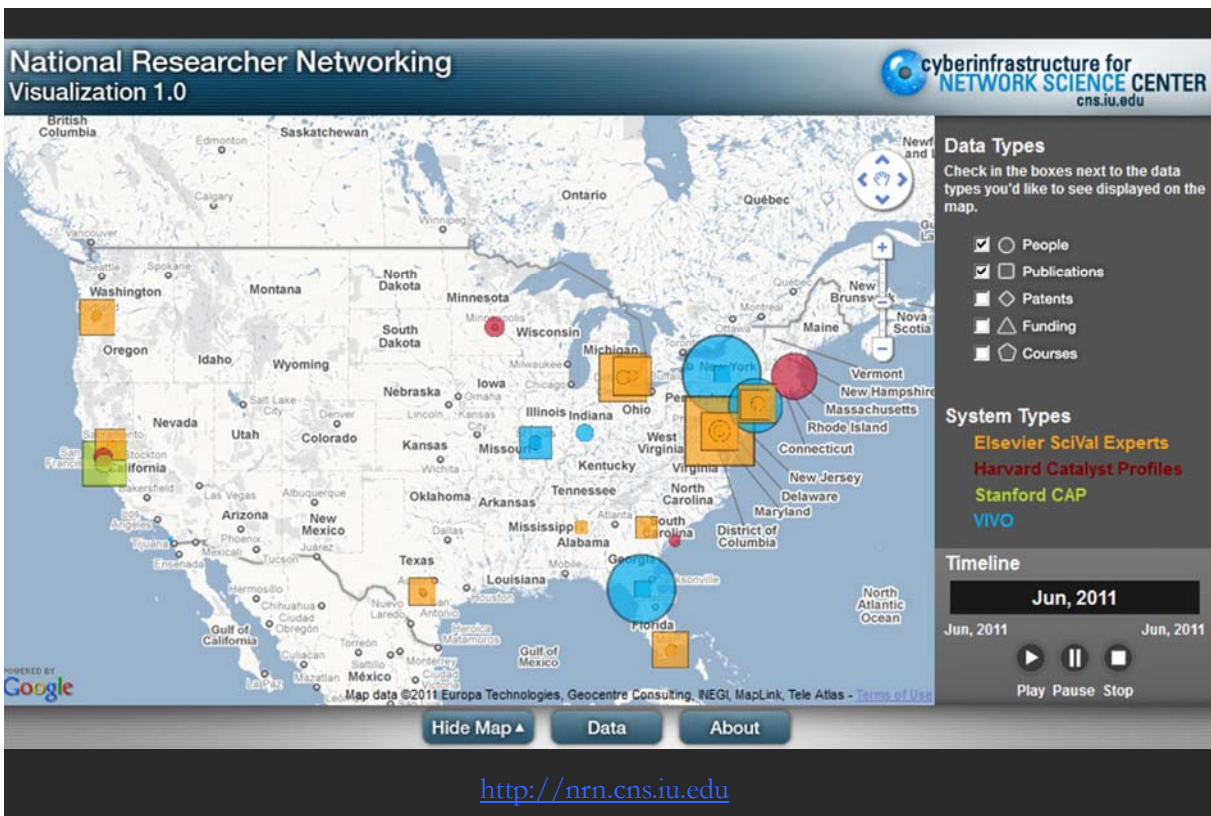
Top 290 disciplines shown

mapped 14.55% of 3,346 publications

Topical Analysis (What) Science map overlays will show where a person, department, or university publishes most in the world of science. (in work)



Network Analysis (With Whom?) Who is co-authoring, co-investigating, co-inventing with whom? What teams are most productive in what projects?



Geospatial Analysis (Where) Where is what science performed by whom? Science is global and needs to be studied globally.

VIVO NRN on the Go

Overview, Interactivity,
Details on Demand
come to
commonly
used devices
and environments



Develop VIVO Visualizations

See also *Visualization in VIVO Workshop on Aug 24, 2011*

<http://wiki.cns.in.edu/display/PRES/VIVO+Presentation>



VIVO Presentation

4 Added by Chin Hua Kong, last edited by Chintan Tank on Aug 24, 2011 (view change)

August, 2011 Workshop

Material

- [Java 1.5 or higher](#) - A programming language and computing platform for developing cross OS softwares.
- [Science of Science tool \(Sci2\)](#) - An desktop application for information analysis and visualization.
- [Gephi](#) - An interactive visualization tool for networks and complex systems, dynamic and hierarchical graphs.
- [VIVO August 2011 workshop data.zip](#) - Hands on workshop data package

Slides

- [Tutorial Slides](#) presented at the VIVO Conference 2011
- [Pre-Questionnaire](#) and [Post-Questionnaire](#)

Demo Links

- [Map of Science Visualization \(dev link\)](#)
- [Temporal Graph Visualization \(dev link\)](#)
- [National Researcher Networking Visualization](#)
- [Word Cloud Visualization dev link](#)

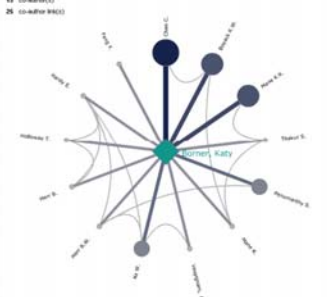
Borner, Katy
Person

This information is based solely on publications which have been loaded into the VIVO system. This may only be a small sample of the person's total work.

General Statistics

36 publication(s) from 2001 to 2010 (.CSV File)
80 co-author(s) from 2001 to 2010 (.CSV File)

Co-Author Network (GraphML File)



Legend

No. of publication(s) 0 2 4 6
No. of (in-c) (co-authored) 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

Tables

Publications per Year (.CSV File)

Year	Count
2001	2
2002	4
2003	2
2004	7
2005	7
2006	3
2007	10
2010	1

Co-author (.CSV File)

Author	Publications with Borner, Katy
Chen C.	5
Boyack K.W.	4
Mane K.K.	4
Ka W.	3
Penumarthy S.	3
Vespignani, Alessandro	2
Herr B.	2
Herr E.	2
Holloway T.	2
Herr D.W.	2
Thakur S.	2
Feng Y.	2
Mane K.	2

Download Data

General Statistics

- 36 publication(s) from 2001 to 2010 (.CSV File)
- 80 co-author(s) from 2001 to 2010 (.CSV File)

Co-Author Network

(GraphML File)

Save as Image (.PNG file)

Tables

- Publications per year (.CSV File)
- Co-authors (.CSV File)

<http://vivo.iu.edu/vis/author-network/person25557>

36 publication(s) from 2001 to 2010 (.CSV File)

80 co-author(s) from 2001 to 2010 (.CSV File)

Year	Count	Co-Author(s)
2001	2	Chen C.
2002	4	Chen C.; McMahon T.; Feng Y.
2003	2	Chen C.; Boyack K.W.
2004	7	Sengupta A.; Penumarthy S.; Thakur S.; Sooriamurthi R.; Maru J.T.; Shiffrin R.M.; Mane K.; Moor K.A.;

Co-author network (GraphML File)

```

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3 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
4 xsi:schemaLocation="http://graphml.graphdrawing.org/xmlns
5 http://graphml.graphdrawing.org/xmlns/1.0/graphml.xsd">
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7 <key id="number_of_authored_works" for="node" attr.name="number_of_authored_works" attr.type="int" />
8 <key id="num_unknown_publication" for="node" attr.name="num_unknown_publication" attr.type="int" />
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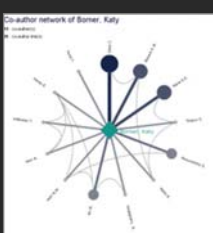
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Save as Image (.PNG file)

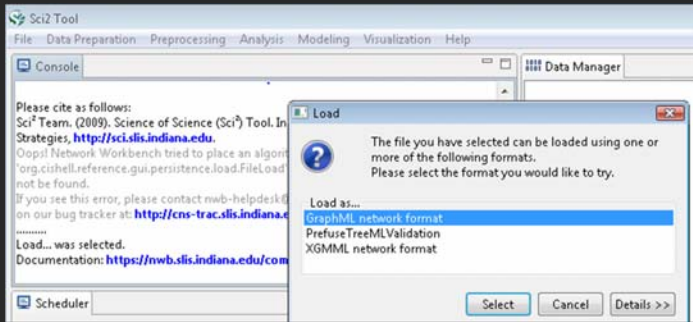
Publications per year (.CSV File), see top file.

Co-authors (.CSV File)

Co-Author	Count
Andrienko G.	1
Andrienko N.	1
Ben-Miled Z.	1
Blackwell A.	1
Boyack K.W.	4
Bozicevic M.	1
Brodbeck D.	1
Burkhard R.A.	1
Chen C.	5



Run Sci2 Tool and Load Co-Author Network ([GraphML File](#))



Network Analysis Toolkit
Nodes: 81
Edges: 390

Visualize the file using Radial Graph layout.



Click on node to focus on it.
Hover over a node to highlight its co-authors.

Code and tutorials are linked from <http://sci2.wiki.cns.edu>

Network Analysis Toolkit (NAT) was selected.

Nodes: 109

Isolated nodes: 0

Node attributes present: label, number_of_authored_works, num_unknown_publication, num_latest_publication, latest_publication, profile_url, num_earliest_publication, earliest_publication, url
Edges: 731

No self loops were discovered.

No parallel edges were discovered.

Average degree: 13.4128

This graph is weakly connected.

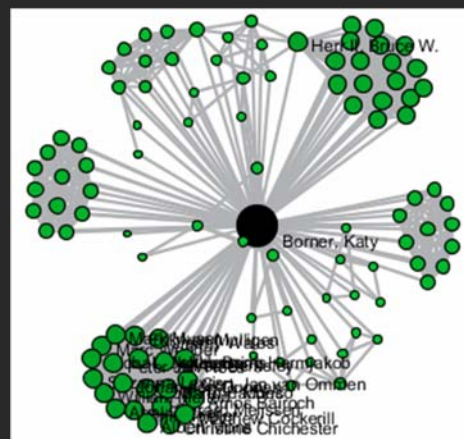
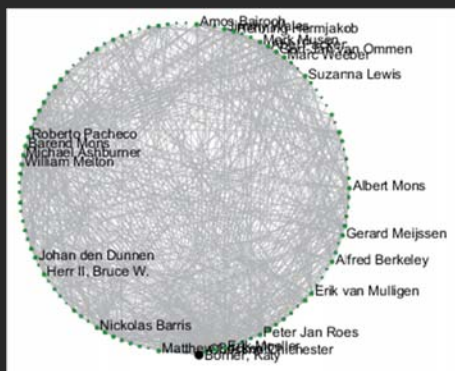
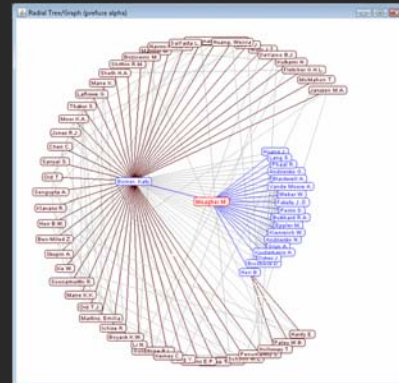
There are 1 weakly connected components. (0 isolates)

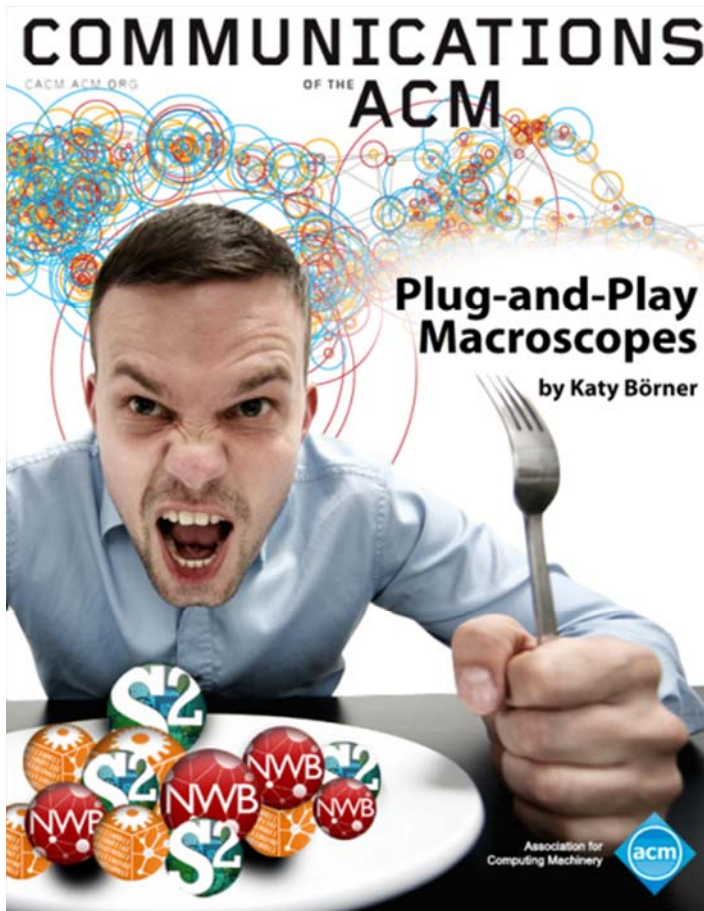
The largest connected component consists of 109 nodes.

Density (disregarding weights): 0.1242

.....

Node Degree was selected.





Börner, Katy. (March 2011).
Plug-and-Play Macroscopes.
Communications of the ACM,
54(3), 60-69.

Video and paper are at
<http://www.scivee.tv/node/27704>

21



Plug-and-Play Macroscopes

While **microscopes** and **telescopes** are physical instruments, **macroscopes** resemble continuously changing bundles of software plug-ins.

Sharing algorithm components, tools, or novel interfaces becomes as easy as sharing images on Flickr or videos on YouTube. Assembling custom tools is as quick as compiling your custom music collection.

They provide a **common standard** for

- the design of **modular, compatible algorithm and tool plug-ins**
- that can be **easily combined into scientific workflows**, and
- **packaged as custom tools**.

Anyone can map. Anyone can replicate or advance workflows.

Sci² Tool
A tool for science of science research & practice

Email Address

Password

Login

Forgot your password?
To recover your account password, please visit our [password recovery page](#).

Not registered yet?
[Register now](#)

Tutorials
Katy Börner (2010) Science of Science Research and Tools (12 Tutorials). Reporting Branch, Office of Extramural Research/Office of the Director, National Institutes of Health, Bethesda, MD.

- Tutorial #01: [Science of Science Research](#)
- Tutorial #02: [Network Science / Information Visualization](#)
- Tutorial #03: [CIShell Powered Tools: Network Workbench and Science of Science Tool](#)
- Tutorial #04: [Temporal Analysis—Burst Detection](#)
- Tutorial #05: [Geospatial Analysis and Mapping](#)
- Tutorial #06: [Topical Analysis & Mapping](#)
- Tutorial #07: [Tree Analysis and Visualization](#)
- Tutorial #08: [Network Analysis and Visualization](#)
- Tutorial #09: [Large Network Analysis and Visualization](#)
- Tutorial #10: [Using the Scholarly Database at IU](#)
- Tutorial #11: [VIVO National Researcher Networking](#)
- Tutorial #12: [Future Developments](#)

Geetha Senthil (2010). [Multidisciplinary Nature of Work With Reference to PIs and ICs Within a Portfolio](#). PA Group at NIH.

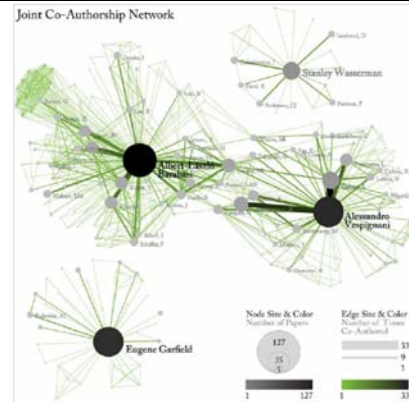
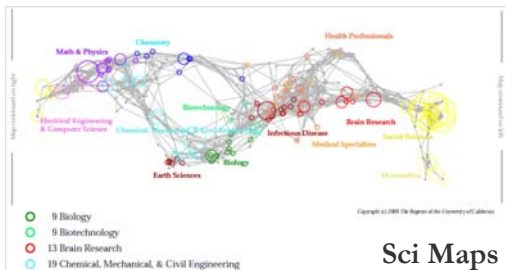
NIH Office of Extramural Research and Katy Börner (2010) [Network Visualizations Using SPIRES Data and the Sci2 Tool](#). Office of Extramural Research at NIH.

<http://sci2.cns.iu.edu>
<http://sci2.wiki.cns.iu.edu>



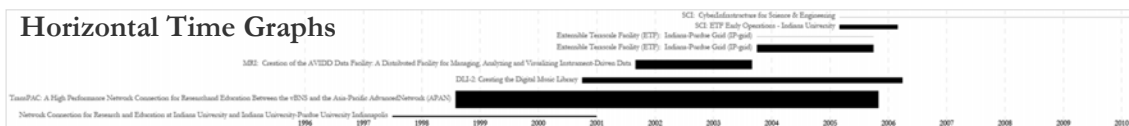
Sci² Tool – “Open Code for S&T Assessment” to run replicable workflows

OSGi/CIShell powered tool, see <http://cishell.org>
<http://sci2.cns.iu.edu> | <http://sci2.wiki.cns.iu.edu>

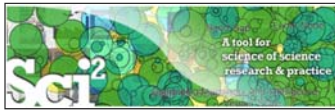


GUESS Network Vis

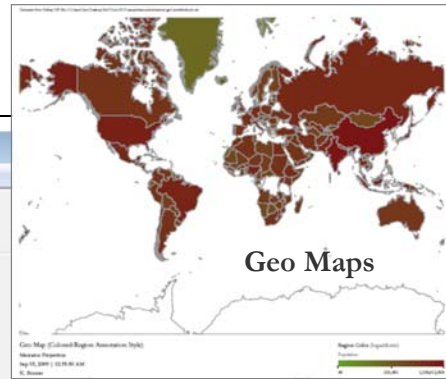
Horizontal Time Graphs



Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micab, Dubon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2009). *ReTe-Netzwerk-Red: Analyzing and Visualizing Scholarly Networks Using the Scholarly Database and the Network Workbench Tool*. *Proceedings of IS²I 2009: 12th International Conference on Scientometrics and Informetrics, Rio de Janeiro, Brazil, July 14-17*. Vol. 2, pp. 619-630.



Sci² Tool



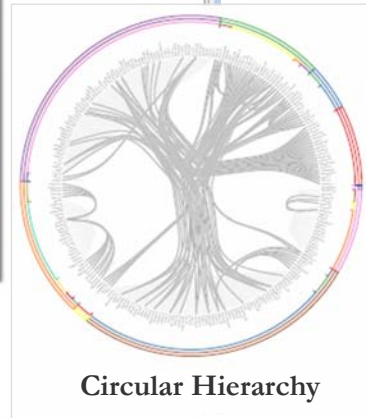
Sci² Tool
File Preprocessing Modeling Analysis Visualization Scientometrics Help

Console
Welcome to the Science of Science Tool (Sci²). The development of this tool is supported in Network Science center and the School of Li Indiana University, the National Science Foundation and IIS-0715303, and the James S. McDonnell Cyberinfrastructure portal (<http://sci.slis.indiana.edu>).
The primary investigators are Katy Börner, In SciTech Strategies Inc. The Sci² tool was developed by J. Duhon, Patrick A. Phillips, Chintan Tank, a Cyberinfrastructure Shell (<http://cishell.org>) for Network Science Center (<http://cns.slis.indiana.edu>). Many algorithm plugins were derived from the Network Science Center (<http://nwb.slis.indiana.edu>).
Please cite as follows:
Sci² Team. (2009). Science of Science Tool. In Sci² Strategies Inc., <http://sci.slis.indiana.edu>.
.....

Scheduler
Remove From List Remove completed

!	Algorithm Name	Date	Time	% Con
<input checked="" type="checkbox"/>	Extract Co-Author Network	09/03/2009	00:15:20 AM	100%
<input checked="" type="checkbox"/>	Load and Clean ISI File	09/03/2009	00:15:05 AM	100%

Visualization menu items:
GUESS
GnuPlot
Radial Tree/Graph (prefuse alpha)
Radial Tree/Graph with Annotation (prefuse beta)
Tree View (prefuse beta)
Tree Map (prefuse beta)
Force Directed with Annotation (prefuse beta)
Fruchterman-Reingold with Annotation (prefuse beta)
DrL (VxOrd)
Specified (prefuse beta)
Horizontal Line Graph
Circular Hierarchy
Geo Map (circle annotations)
Geo Map (region coloring annotations)
Image Viewer
RefMapper



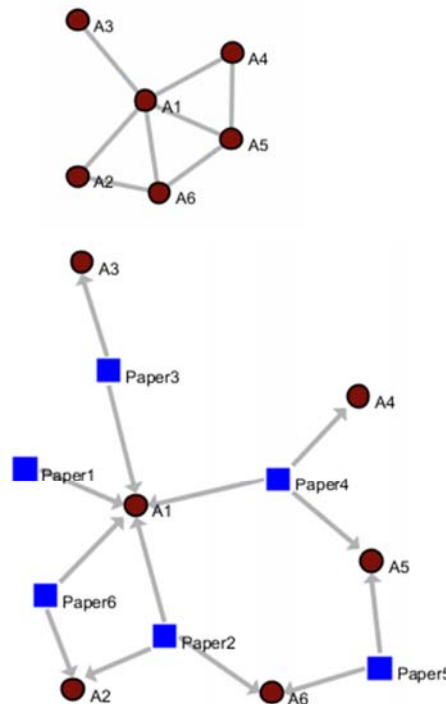
Network Extraction: Examples

Author co-occurrence network

	A	B
1	Publication	Authors
2	Paper1	A1
3	Paper2	A1;A2;A6
4	Paper3	A1;A3
5	Paper4	A1;A4;A5
6	Paper5	A5;A6
7	Paper6	A1;A2

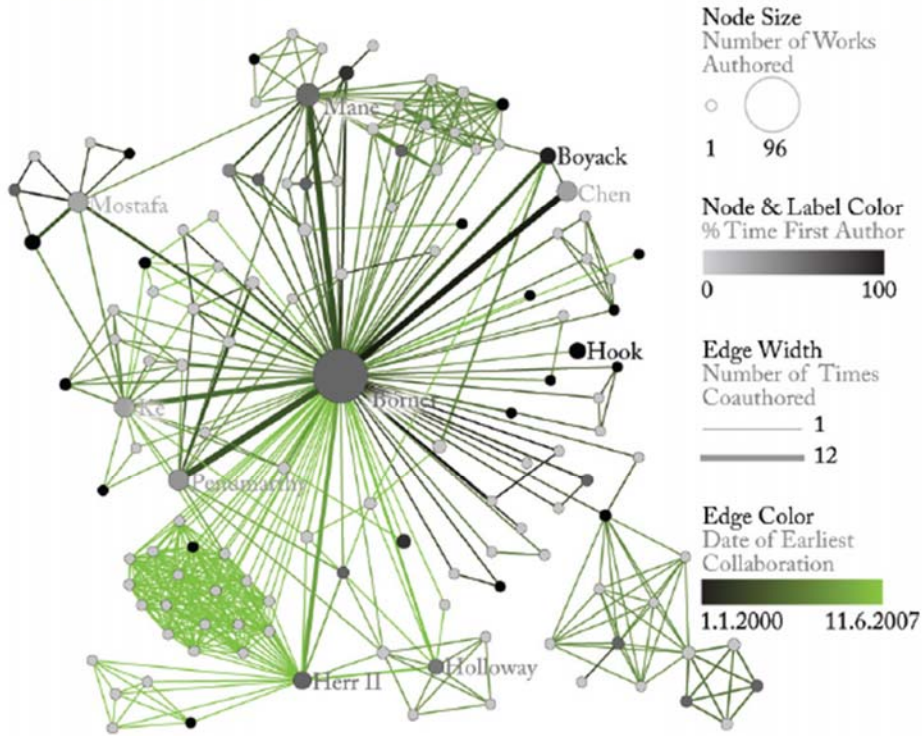
Extract Network from Table
Extracts a network from a delimited table
Column Name: Authors
Text Delimiter: ;

Extract Bipartite Network
Extract a bipartite network from two columns in the table. If the column values may list multiple entries, enter the special text which delimits them.
First column: Publication
Second column: Authors
Text Delimiter: ;

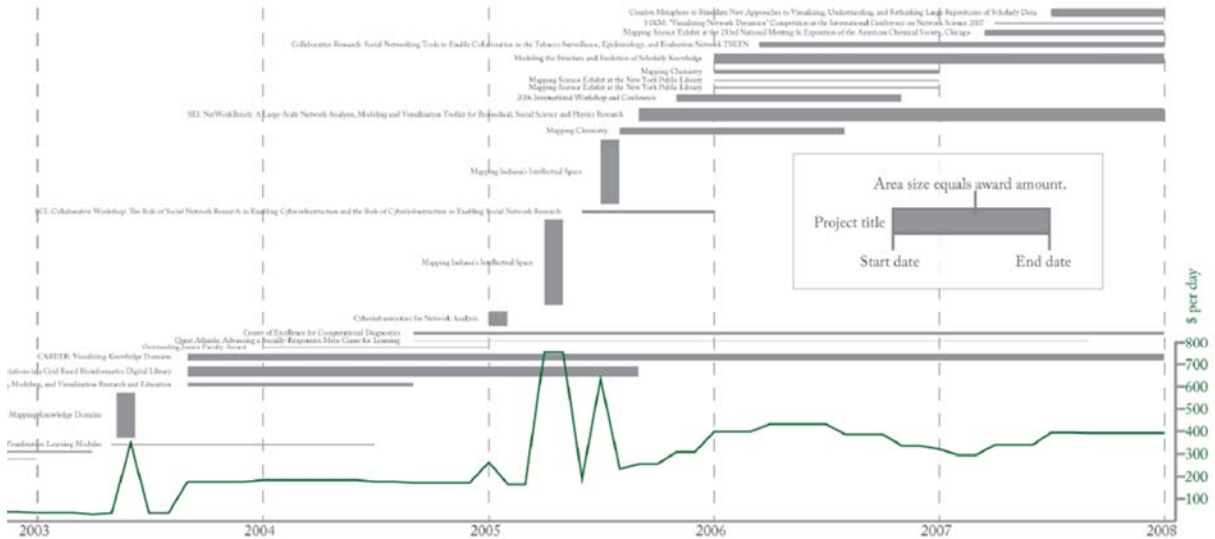


Paper-author 2-mode network

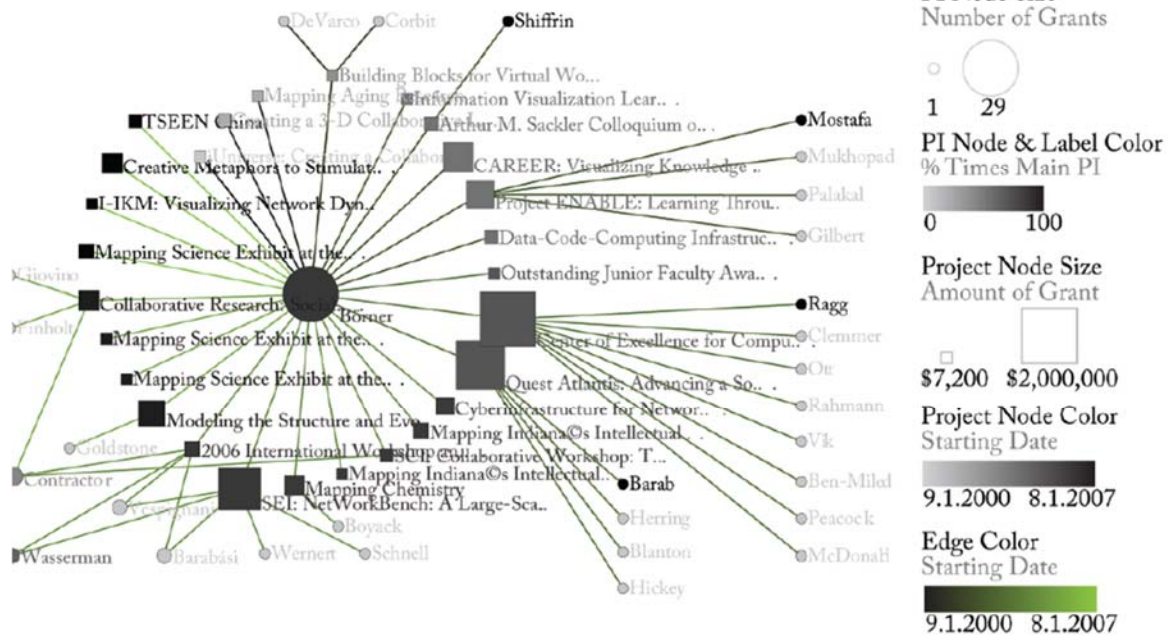
Coauthor Network



Project Timeline



Investigator-Project Network



Learn how to run custom VIVO data queries and visualize results

See also *Visualization in VIVO Workshop on Aug 24, 2011*

<http://wiki.cns.in.edu/display/PRES/VIVO+Presentation>



VIVO Presentation

4 Added by Chin Hua Kong, last edited by Chintan Tank on Aug 24, 2011 (view change)

August, 2011 Workshop

Material

- Java 1.5 or higher - A programming language and computing platform for developing cross OS softwares.
- Science of Science tool (Sci2) - An desktop application for information analysis and visualization.
- Gephi - An interactive visualization tool for networks and complex systems, dynamic and hierarchical graphs.
- VIVO August 2011 workshop data.zip - Hands on workshop data package

Slides

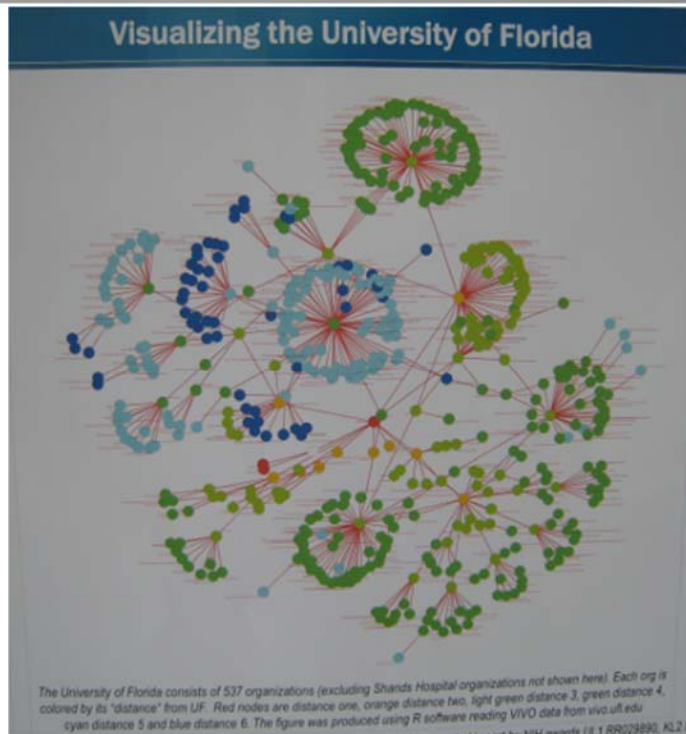
- Tutorial Slides presented at the VIVO Conference 2011
- Pre-Questionnaire and Post-Questionnaire

Demo Links

- Map of Science Visualization (dev link)
- Temporal Graph Visualization (dev link)
- National Researcher Networking Visualization
- Word Cloud Visualization dev link

Attributes to Org Charts: Using R and VIVO for Visualization of Research Activity

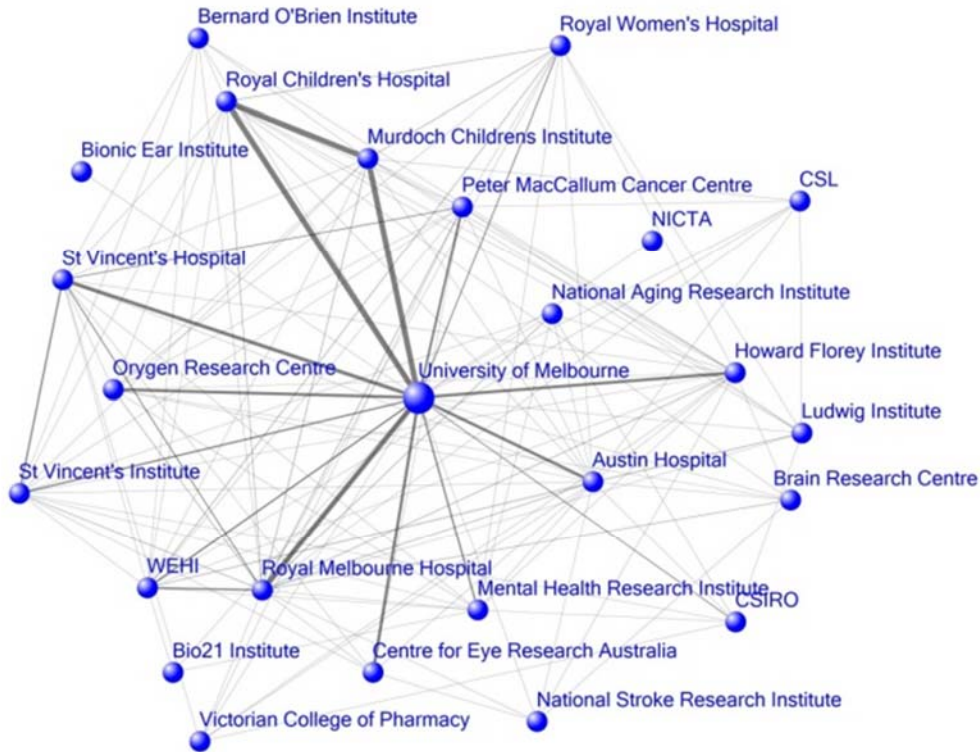
Mike Conlon, UF Clinical and Translational Science Institute, Gainesville, Florida



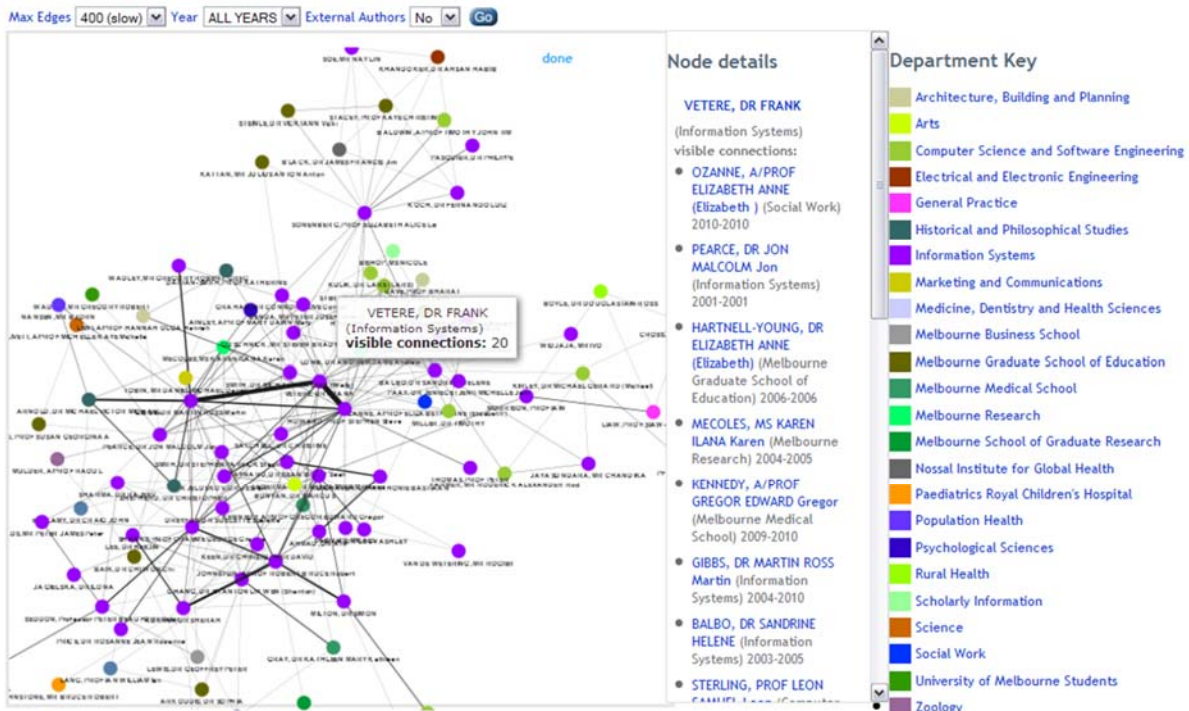
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Custom NRN Visualizations

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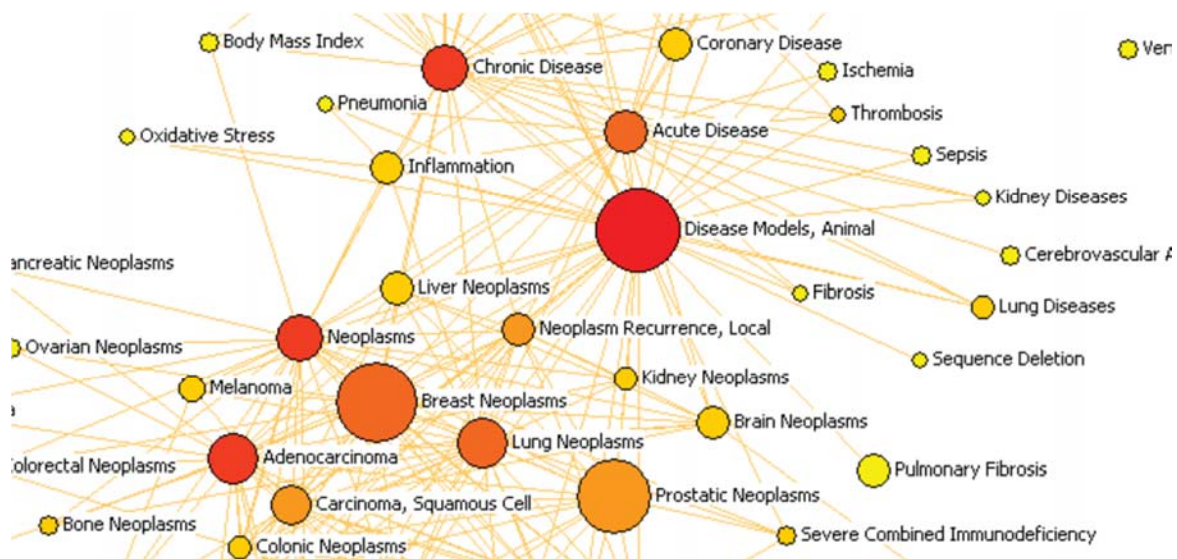


2008 collaboration patterns for medical institutions located close to Melbourne University
 Source: Web of Science co authorship information. Compiled by Simon Porter



Co-authorship network for the department of Information Systems

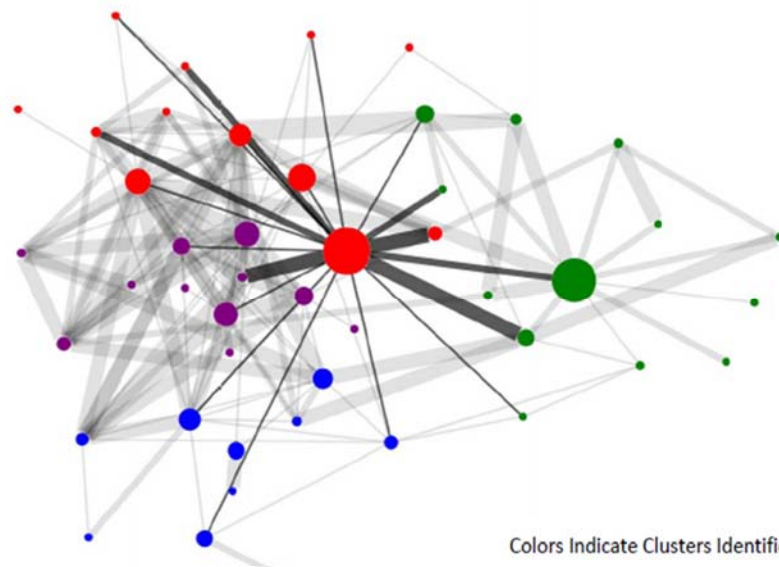
Source: Melbourne Research Windows. Contact Simon Porter simon.porter@unimelb.edu.au



Top MeSH Disease Concepts Appearing in PubMed Publications by the University of Michigan Medical School. Links connect concepts where 100+ authors published about both concepts within the span of their careers.

This visualization revealed that animal disease models were central to disease research at U-M which encouraged additional thought and attention to animal husbandry, animal expenses, and core/shared services overall.

Contact: Jeffrey Horon, J.Horon@elsevier.com

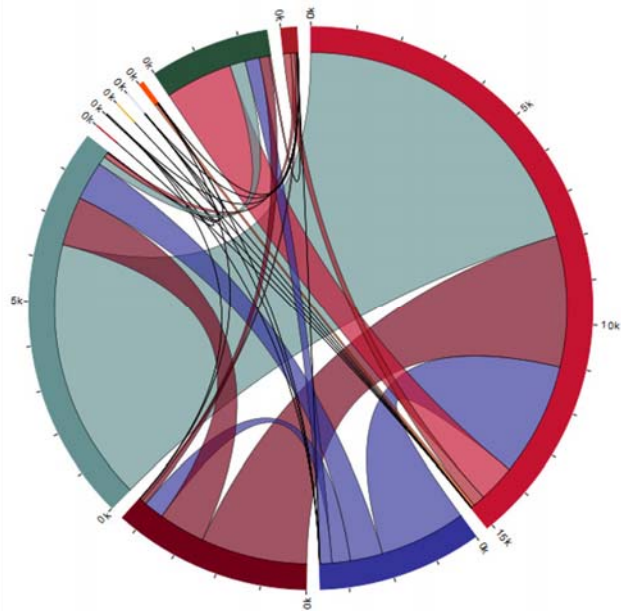


Colors Indicate Clusters Identified by Algorithm

Key
 ● Researcher
 — Co-Authorship — Co-Participation on Sponsored Project — Co-Authorship and Co-Participation on Sponsored Project
 ●●● Increasing 'Betweenness Centrality' (Bridging Effect on Network)

P30 Member Collaborations – Sponsored Project Co-Participation and Co-Authorship Network. Used in **successful!** P30 funding application. Shows the PI's relationships with various P30 members, conveying that the PI was not only the formal center of the group but also the informal center and the person who exhibited the highest betweenness centrality. Contact: Jeffrey Horon, J.Horon@elsevier.com

Institutions	
<input checked="" type="checkbox"/> Harvard Med School	(15124)
<input checked="" type="checkbox"/> Northwestern Med School	(3630)
<input checked="" type="checkbox"/> U. of Minnesota	(4388)
<input checked="" type="checkbox"/> U. California at San Fran	(8874)
<input checked="" type="checkbox"/> Cornell	(1)
<input checked="" type="checkbox"/> Cornell Medical	(32)
<input checked="" type="checkbox"/> Ponce School of Med	(3)
<input checked="" type="checkbox"/> Scripps Research Institute	(22)
<input checked="" type="checkbox"/> Univ. of Florida	(100)
<input checked="" type="checkbox"/> Washington U at St. Louis	(2635)
<input checked="" type="checkbox"/> Mendeley	(352)



Inter-Institutional Collaboration Explorer

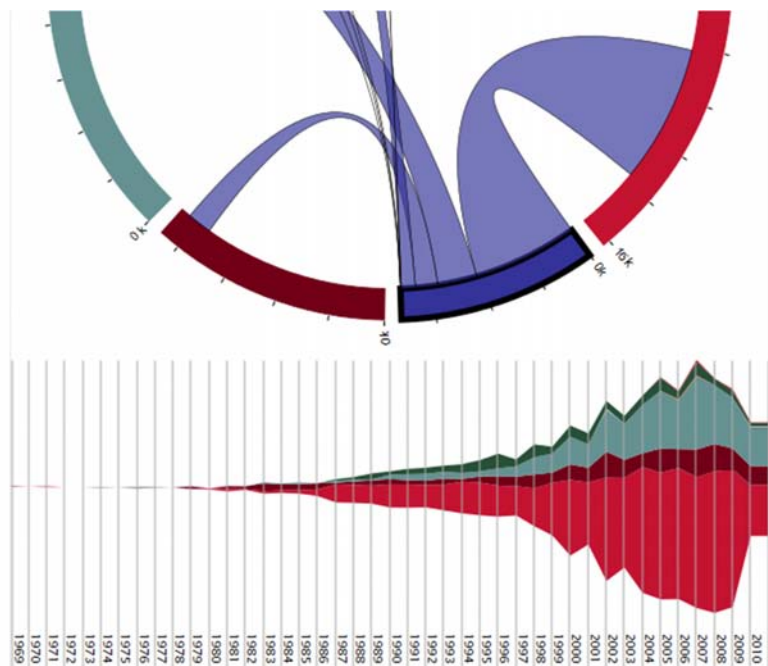
This visualization shows information about “collaborative publications” found at 2 or more Researcher Networking websites.

The idea that institutions don't work together and that biomedical research is conducted in silos is not true. Researchers, even when separated by great distances, are in fact willing to work together, and this visualization demonstrates that they often do.

Contact: Nick Benik (nbenik@gmail.com), Harvard Medical School, Boston, MA.

URL: <http://xcite.hackerceo.org/VIVOviz>

Institutions	
<input checked="" type="checkbox"/> Harvard Med School	(1813)
<input checked="" type="checkbox"/> Northwestern Med School	(3630)
<input checked="" type="checkbox"/> U. of Minnesota	(396)



Inter-Institutional Collaboration Explorer

The outer solid colored arcs represent the 11 institutions. The size of the arc is proportional to the number of collaborative publications found on the site. The inner colored bands represent the number of collaborative publications found between the two institutions that each band connects. Clicking an institution's arc will hide any bands not connected to that institution and will display a timeline of when that institution's collaborative publications were written.

References

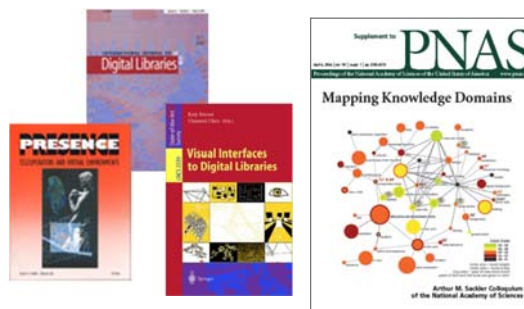
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http://www.pnas.org/content/vol101/suppl_1/

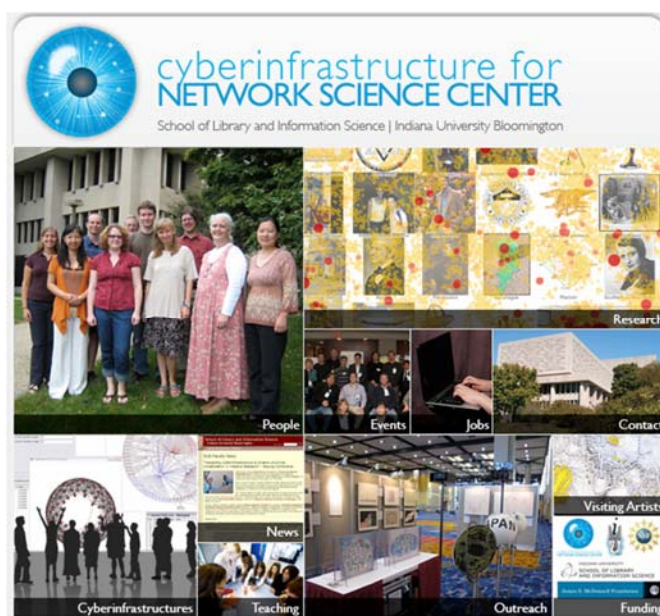
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Scharnhorst, Andrea, Börner, Katy, van den Besselaar, Peter (2011) **Models of Science Dynamics**. Springer Verlag.



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All papers, maps, tools, talks, press are linked from <http://cns.iu.edu>

CNS Facebook: <http://www.facebook.com/cnscenter>

Mapping Science Exhibit Facebook: <http://www.facebook.com/mappingscience>

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