Bibliometric-Based Visualizations and Maps for Technology Foresight

A Work in Progress Report

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Euskirchen, Germany

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Acknowledgement

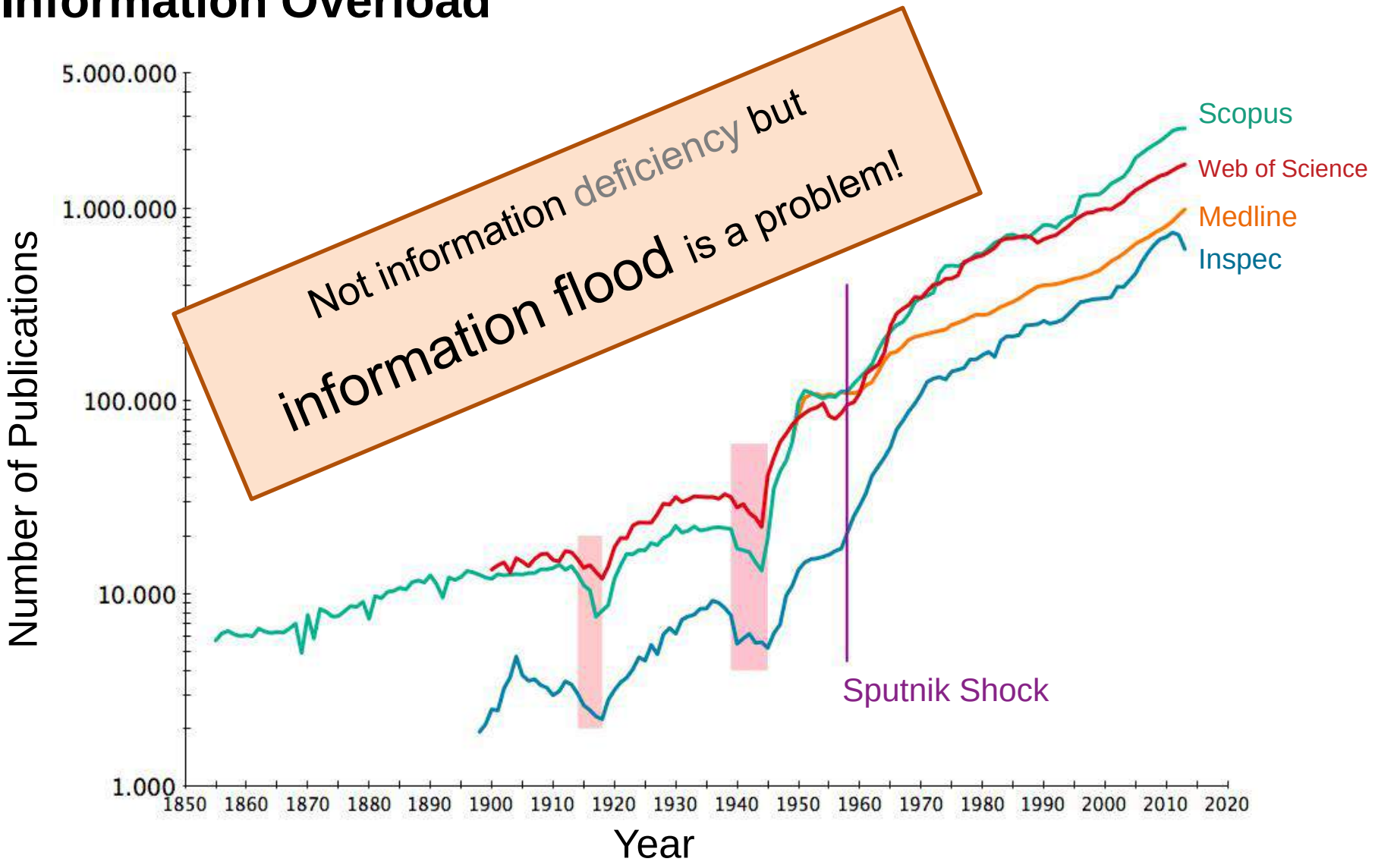

Tomorrow's technology
is based on
today's work
in scientific laboratories.

Technology Foresight

needs to establish a kind of

Science Observatory

Information Overload



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Bibliometrics is …

… quantitatively

eavesdropping

on scientific

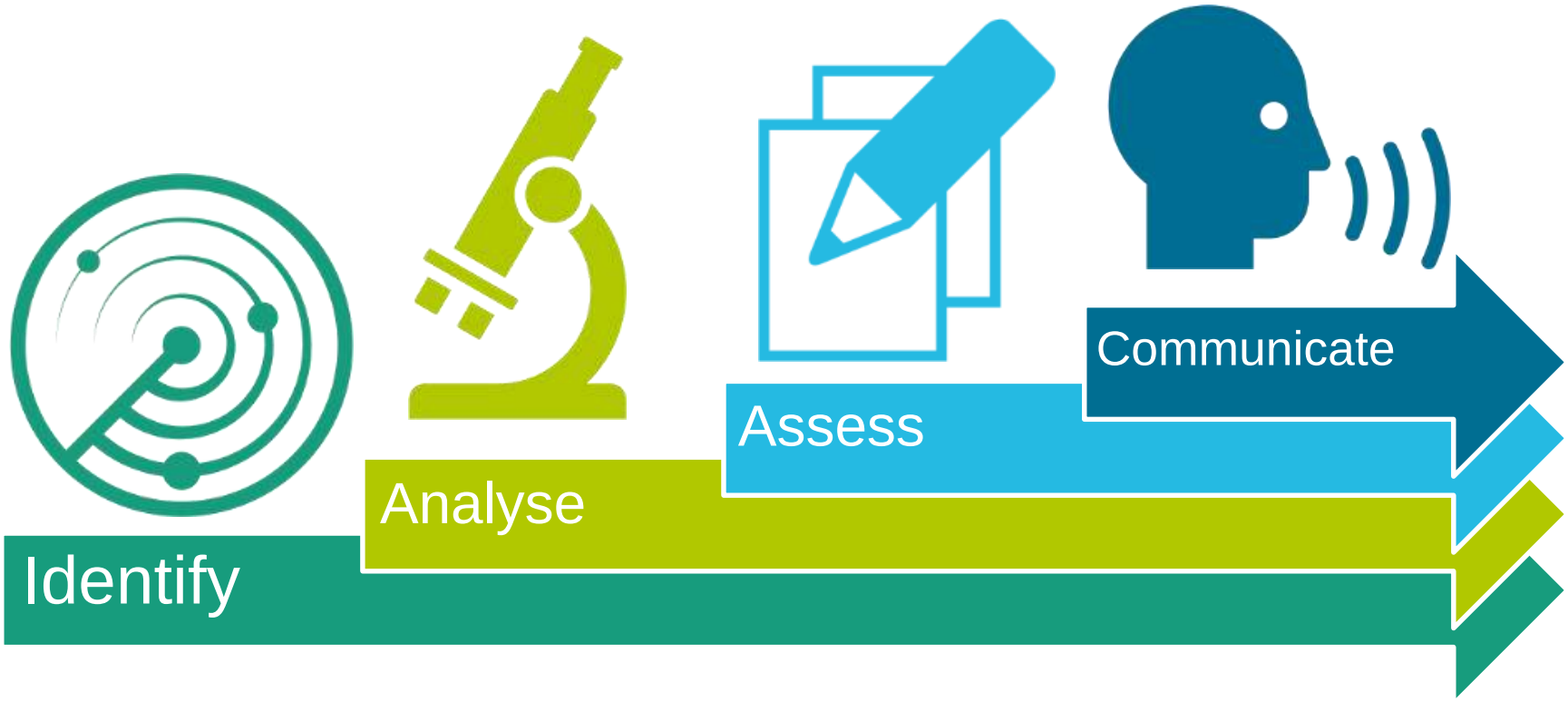
communication.

But …

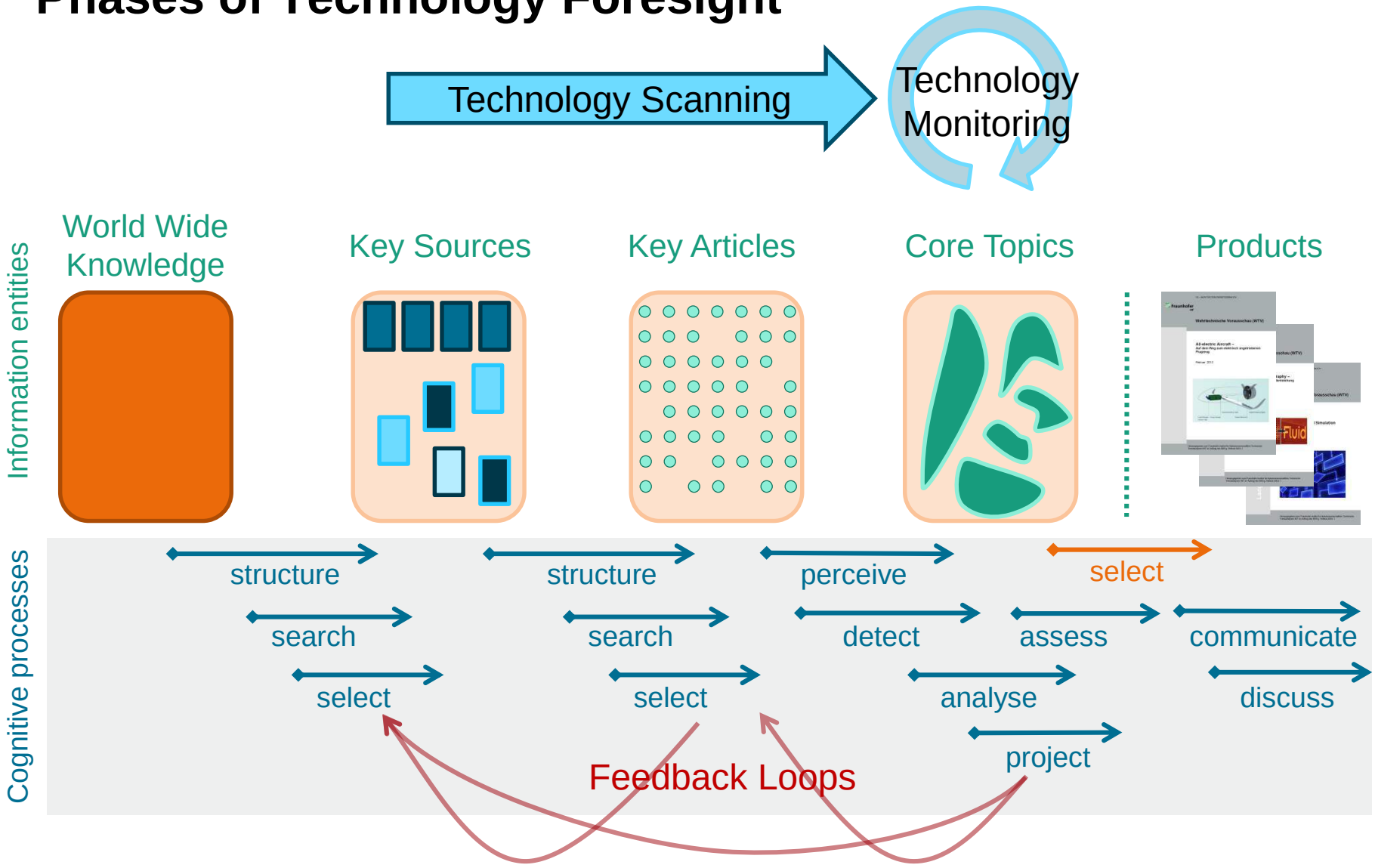
bibliometrics is an inherently

retrospective approach.

Phases of Technology Foresight



Phases of Technology Foresight



Trend Archaeology – The Idea

Historic Scientific Trends

Synoptic Multidimensional Bibliometric Analyses

Trend Archaeology

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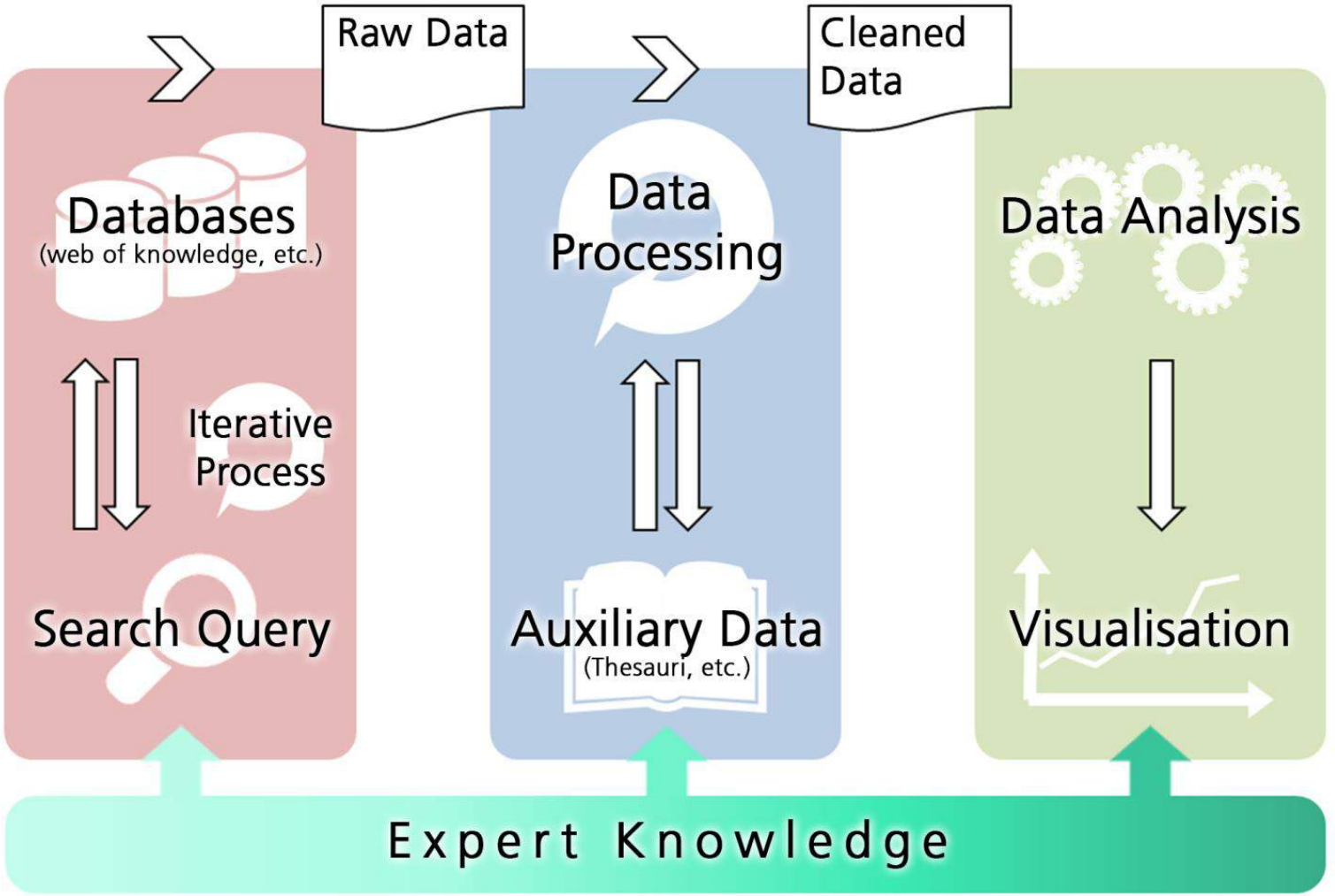
Considered Bibliometric Observables:
- Publication Dynamics
- Publication Activity of Actors
- Document Types
- Cooperation
- Co-Author Network
- …. (continuously extended)

Primary objective:

Reduce the complexity of the scientific landscape

Trend Archaeology - Bibliometric Workflow



Trend Archaeology - The Matrix of Topics

Fullerene

- Discovered 1985
- 0-dimensional carbon allotrope
- Nobel Price Chemistry 1996

Nanotubes

- Discovered 1991
- 1-dimensional carbon allotrope
- No Nobel Price

Graphene

- Discovered 2004
- 2-dimensional carbon allotrope
- Nobel Price Physics 2010

Bulk Metallic Glasses

- Amorphous metals created by very fast cooling
- Exhibit interesting properties

High-Temperature Superconductors

- Discovered 1986
- Nobel Prize Physics 1987

Cold Fusion

- Claimed observation in 1989
- Prototypical example of pathological science.

Human Enhancement

- Current hype theme
- Comprises a bundle of techniques

Transcranial Electric Stimulation

- Form of neurostimulation
- Useful for therapy and possibly enhancement

Cochlear Implant

- Commercialised hearing prosthesis

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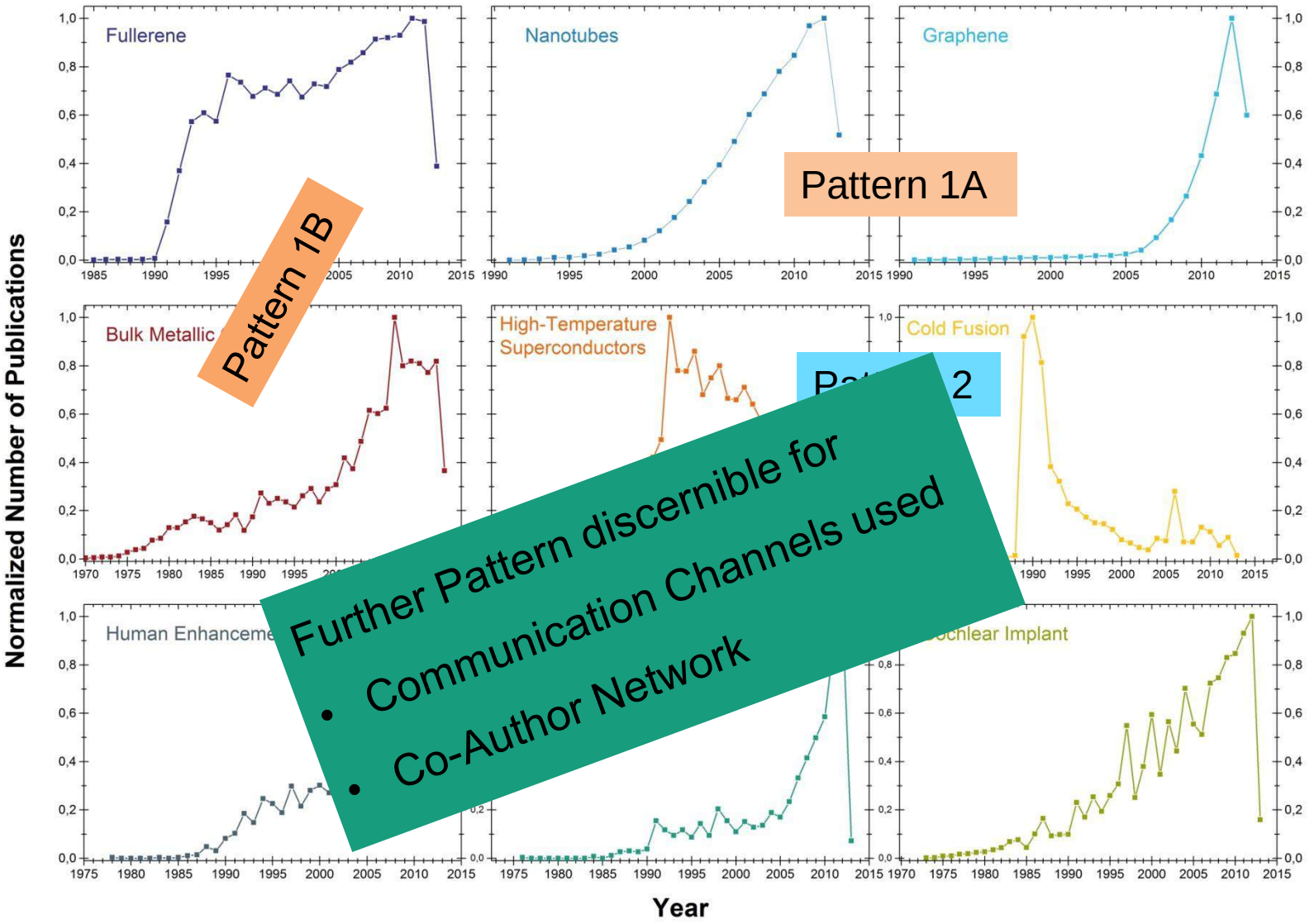
Trend Archaeology – Publication Dynamics



Lesson 1

Trend Archaeology for Technology Foresight

Complexity reduction of trend archaeology works

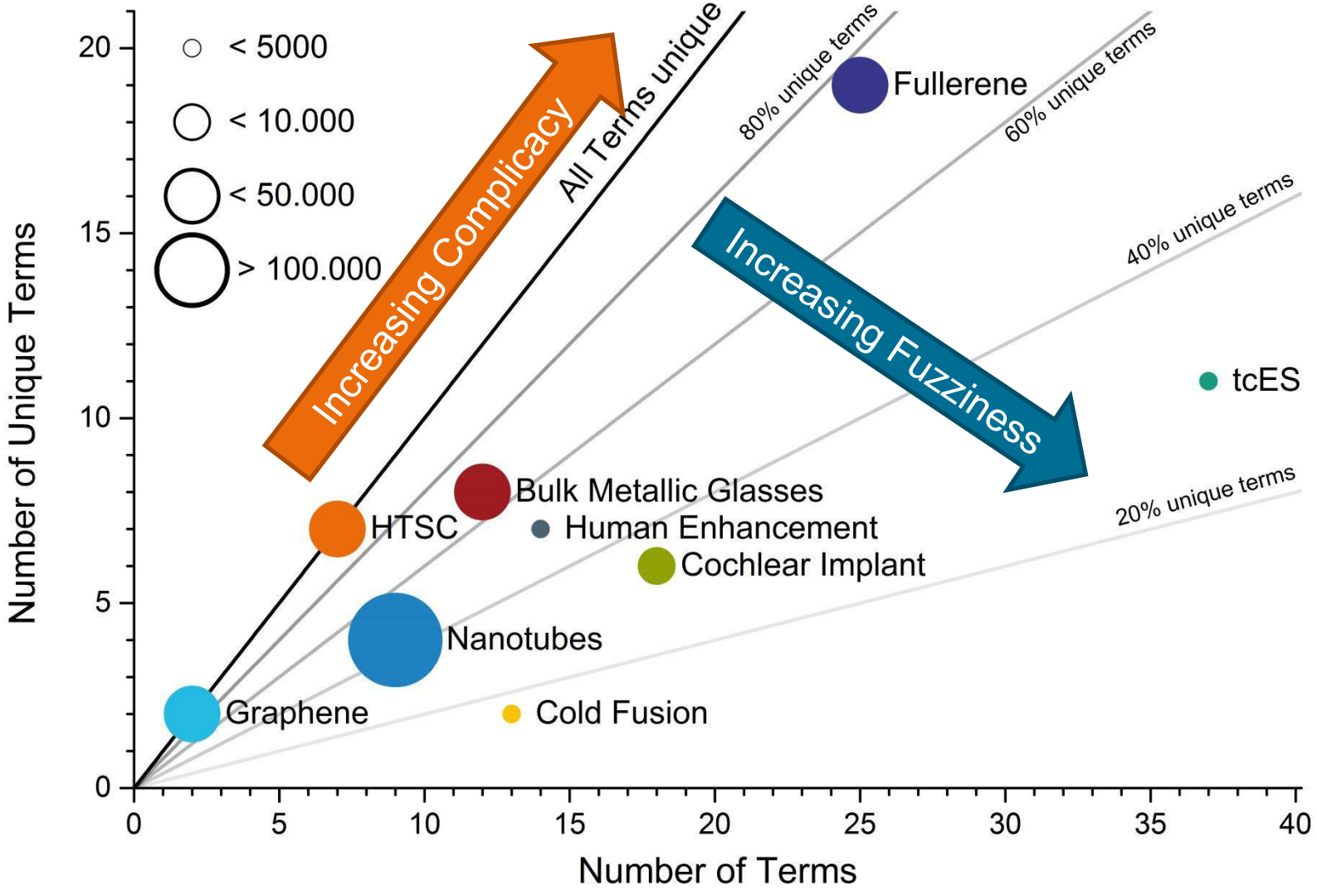
➔ Different patterns discernable for

- Publication dynamics ➔ Hotness of a topic
- Densification of co-author network ➔ Establishment of a topic
- Communication channels used ➔ Process of this establishment

Temporal evolution of scientific themes seem to follow different patterns

➔ Regularities might reveal predictive information for technology foresight!

The Art of a Search Query



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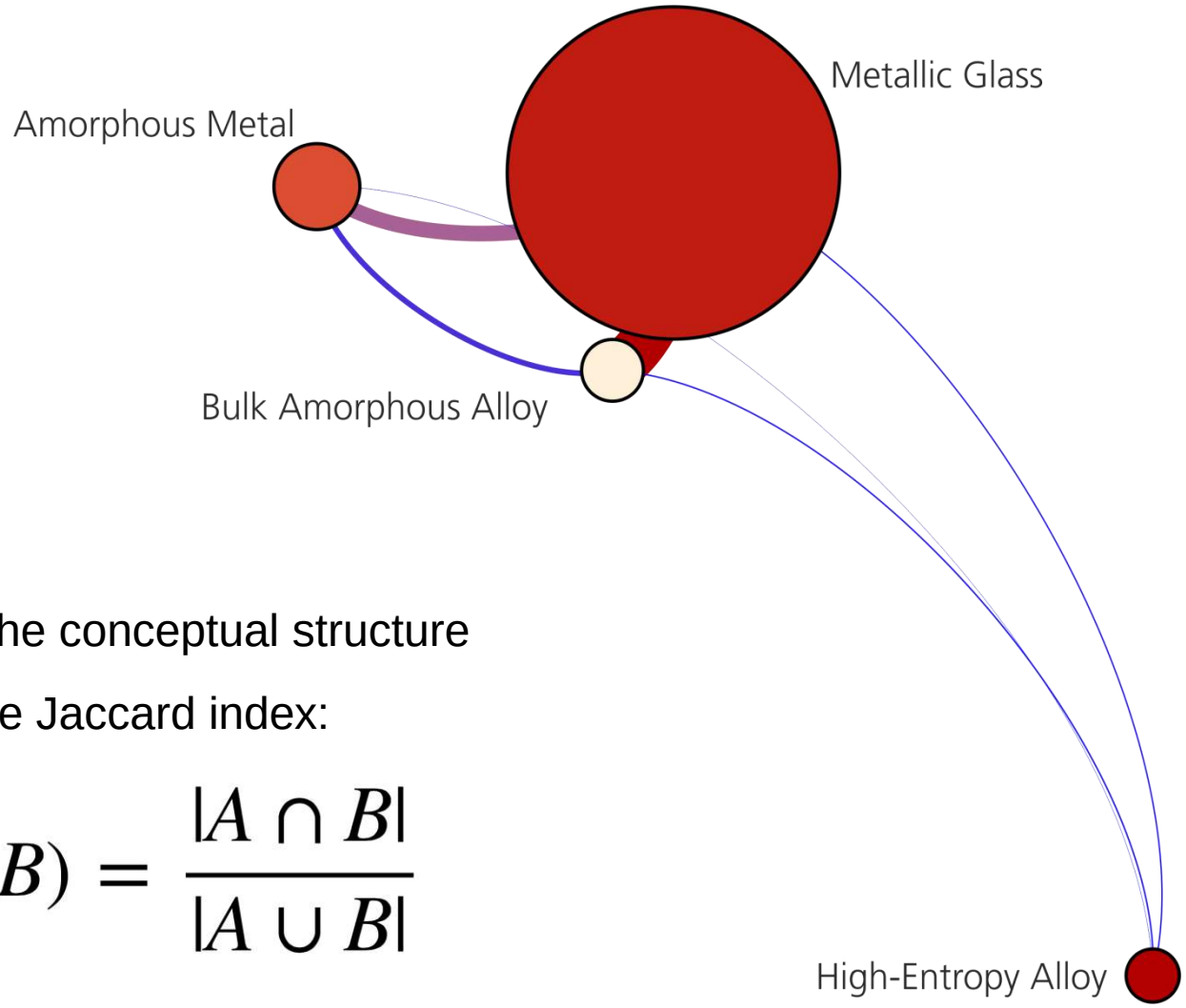
Conceptual Structure of a Search Query

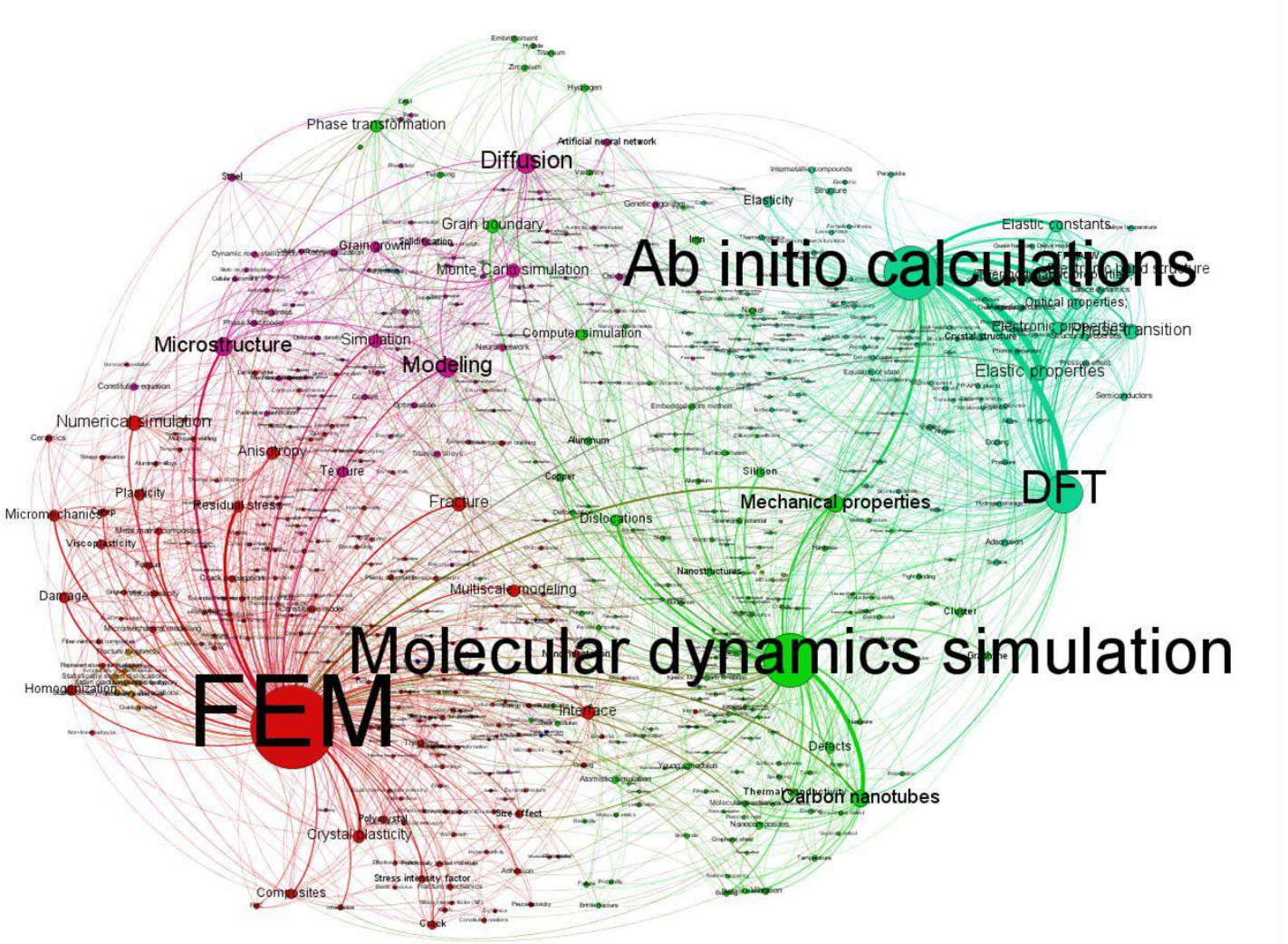


Mapping the conceptual structure utilizing the Jaccard index:

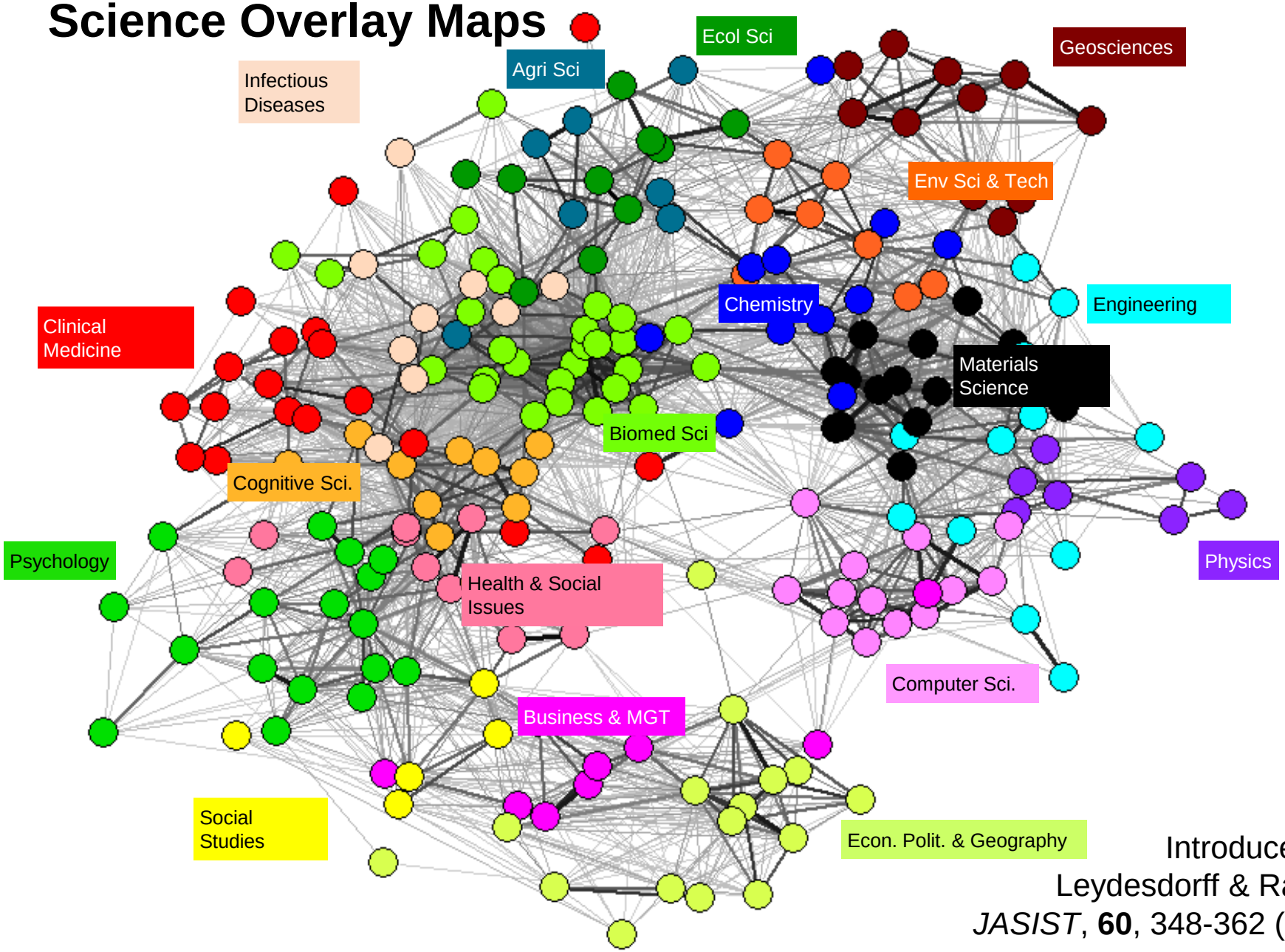
$$J(A,B) = \frac{|A \cap B|}{|A \cup B|}$$

Conceptual Space of a Topic

Keyword Analysis of *Computational Materials Science*



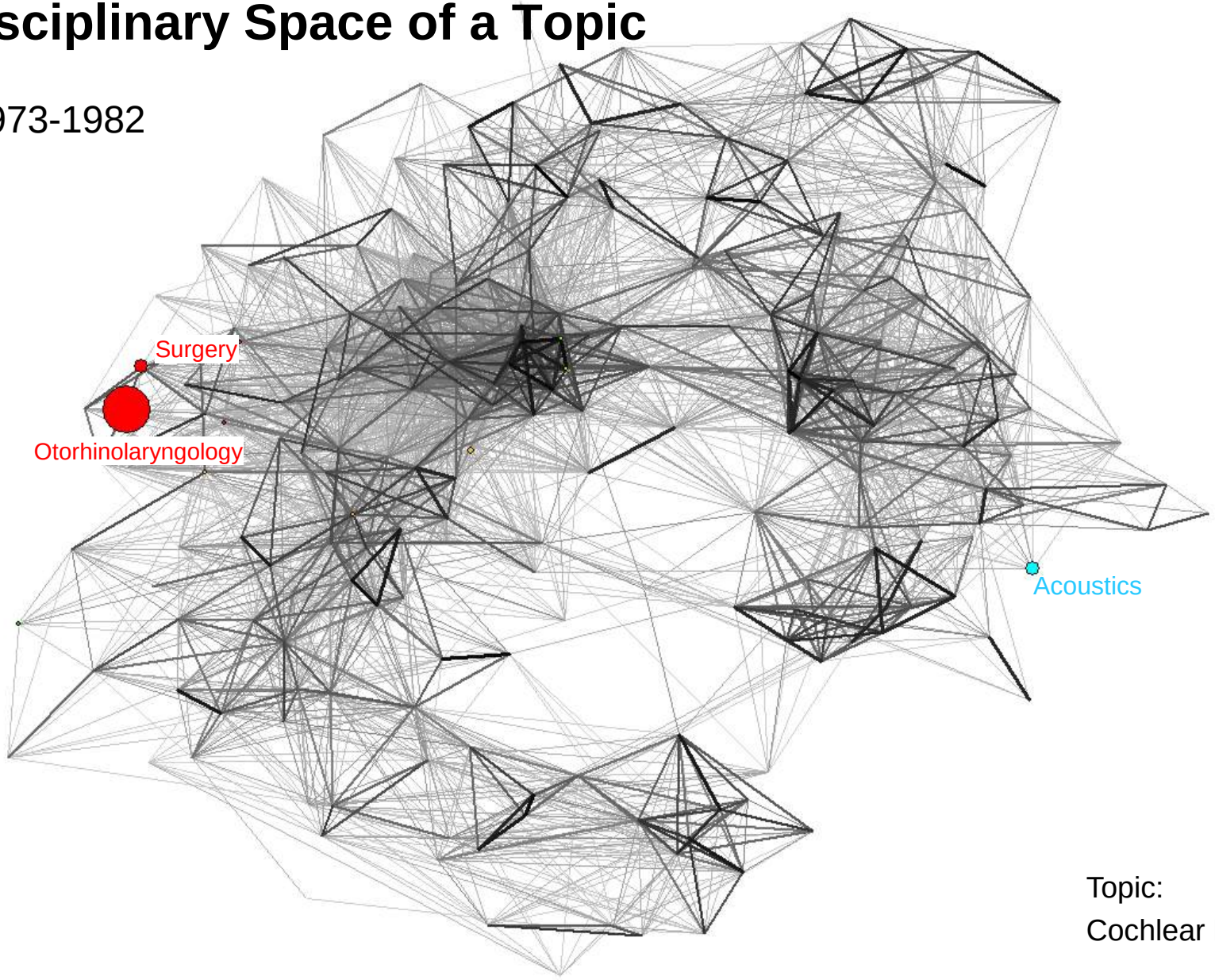
Science Overlay Maps



Introduced by
Leydesdorff & Rafols,
JASIST, **60**, 348-362 (2009)

Disciplinary Space of a Topic

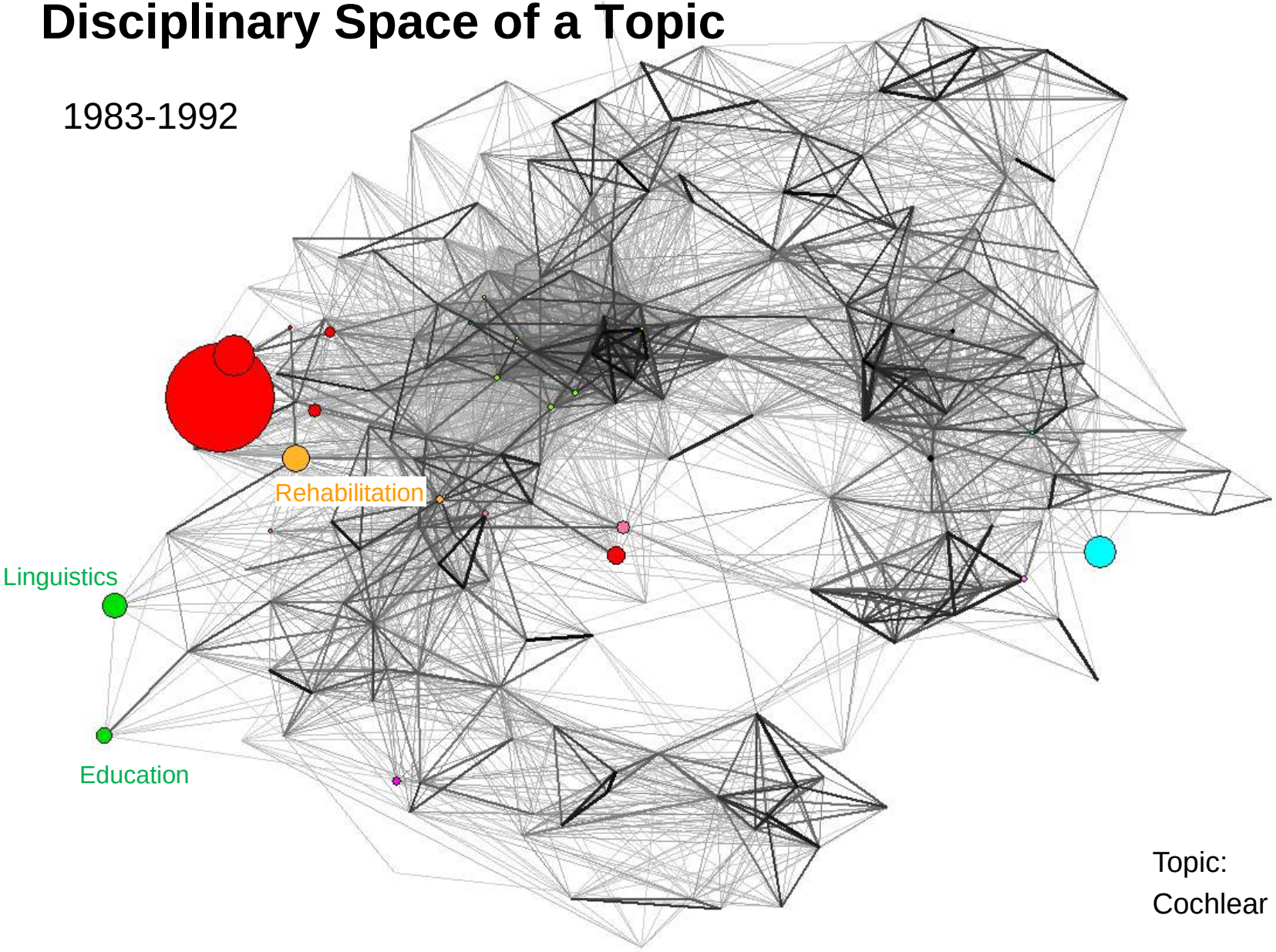
1973-1982



Topic:
Cochlear Implant

Disciplinary Space of a Topic

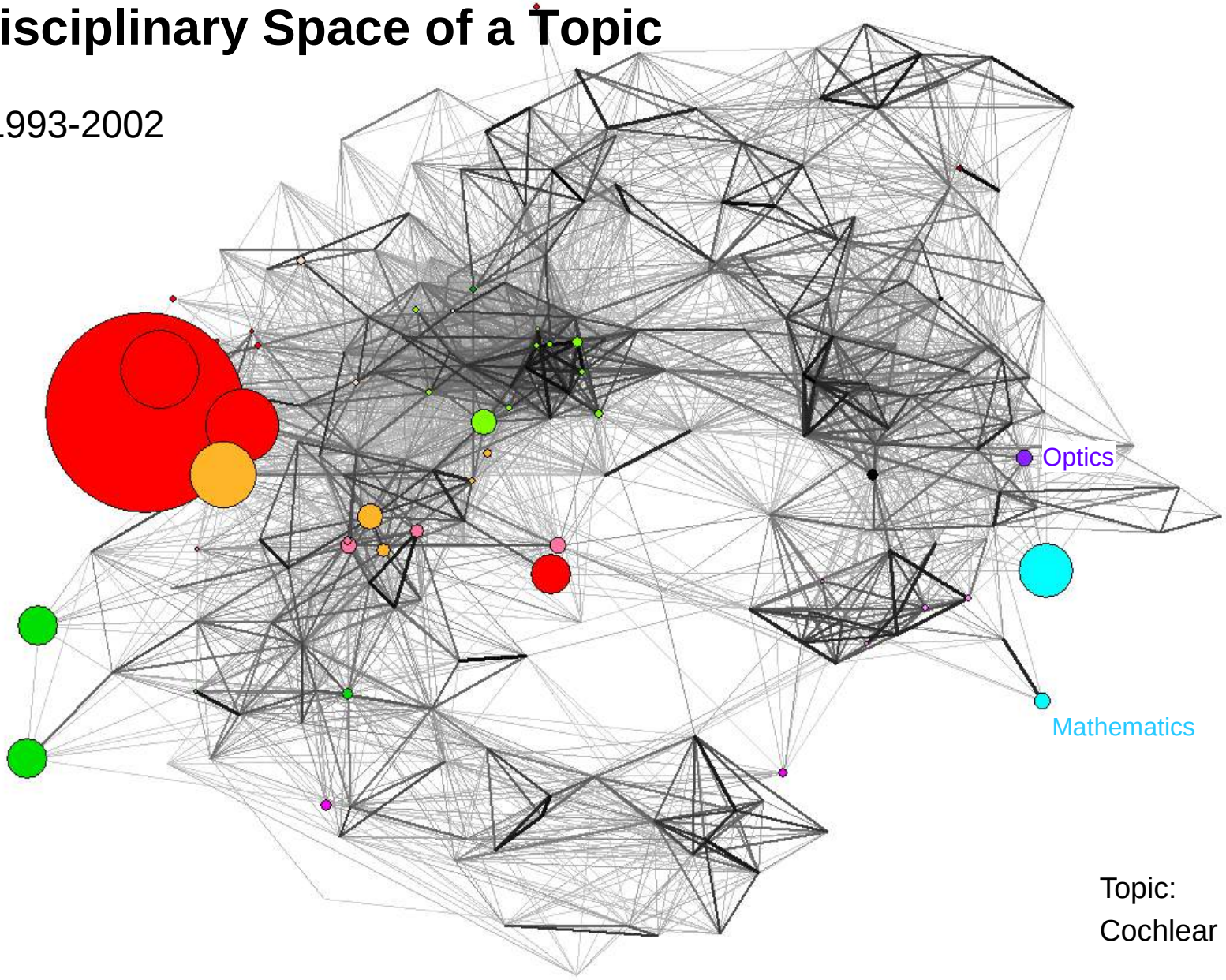
1983-1992



Topic:
Cochlear Implant

Disciplinary Space of a Topic

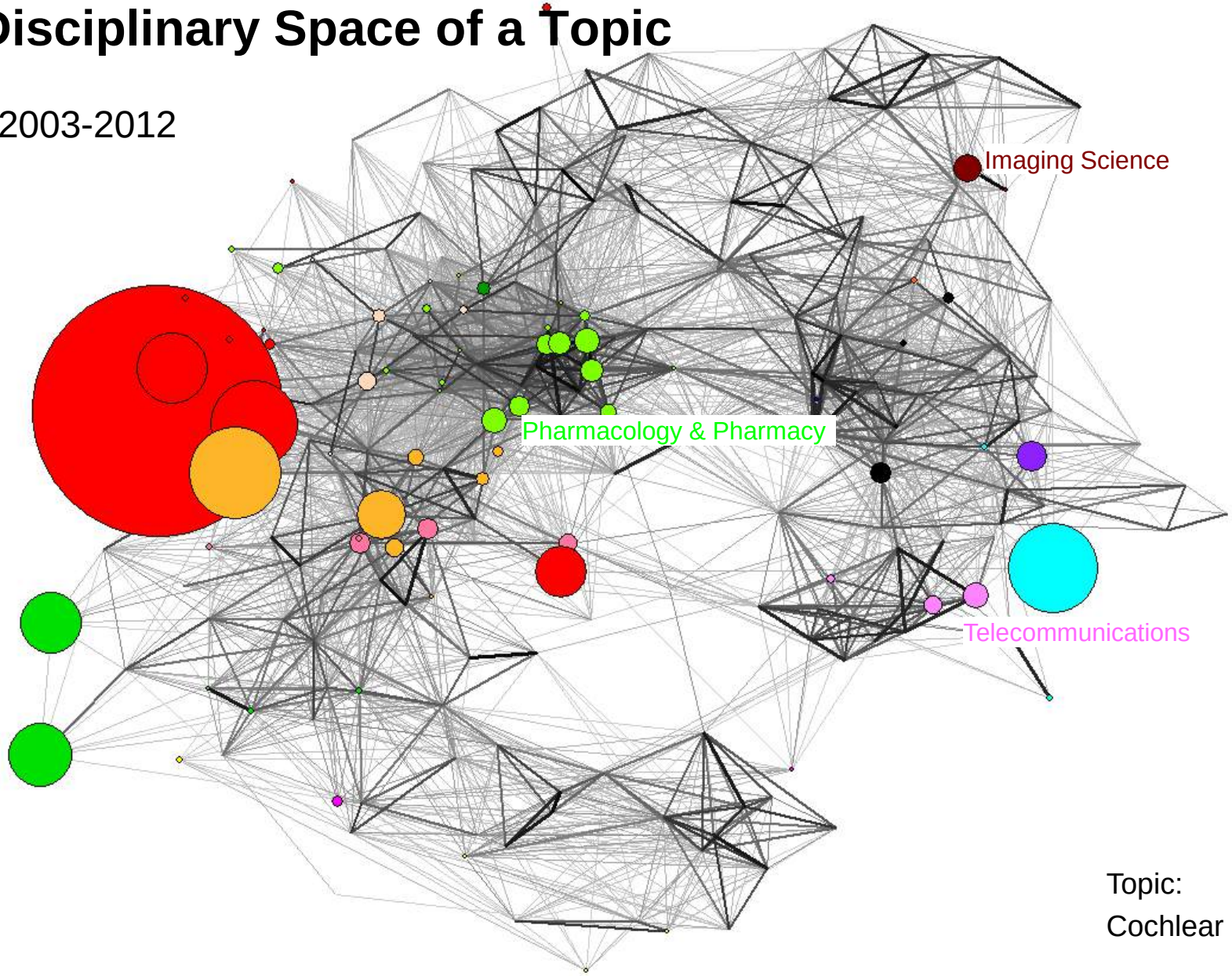
1993-2002



Topic:
Cochlear Implant

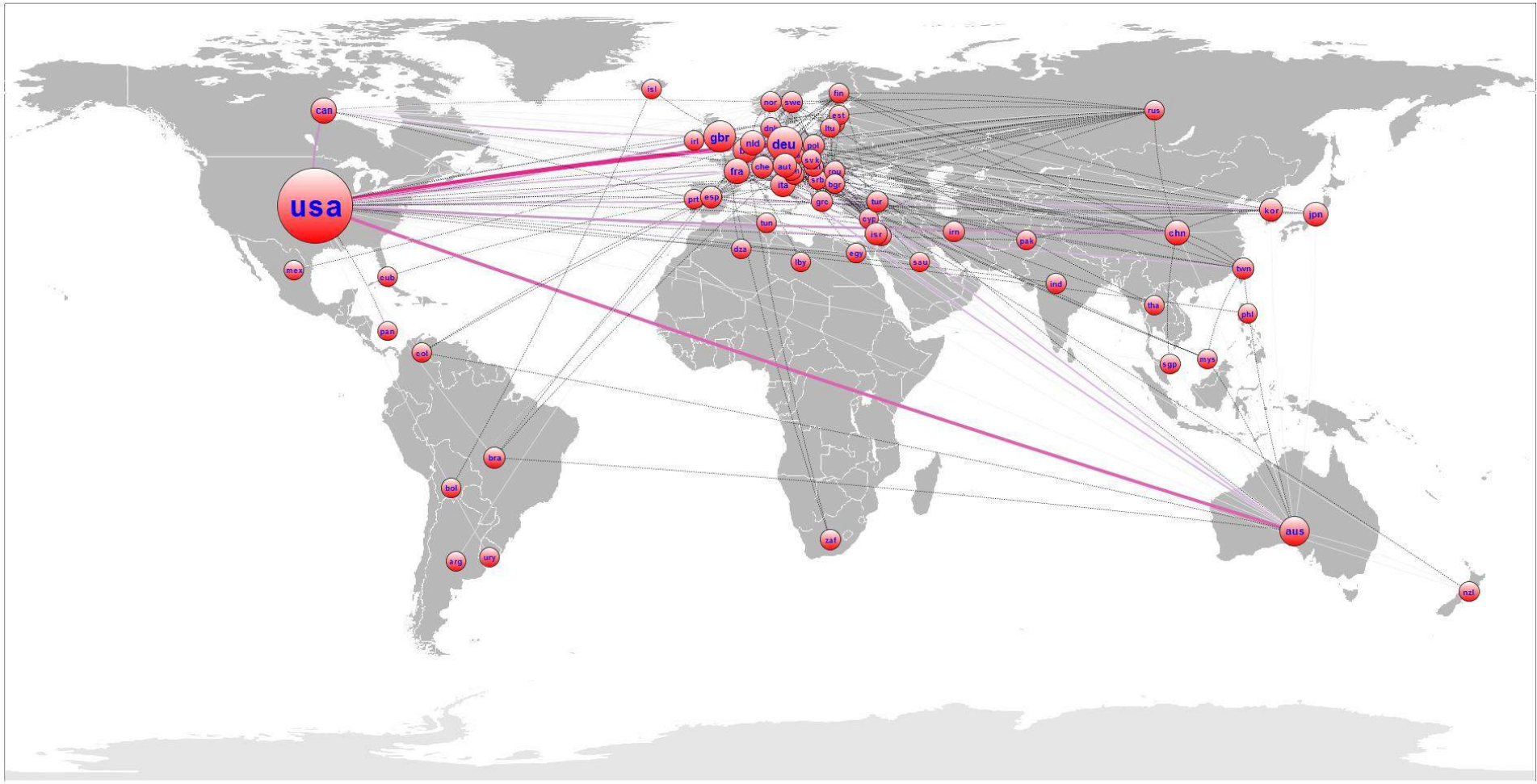
Disciplinary Space of a Topic

2003-2012



Topic:
Cochlear Implant

Seeing is Believing



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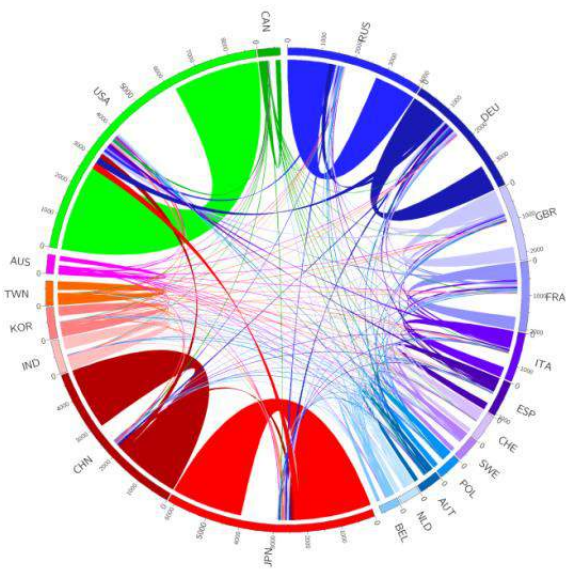
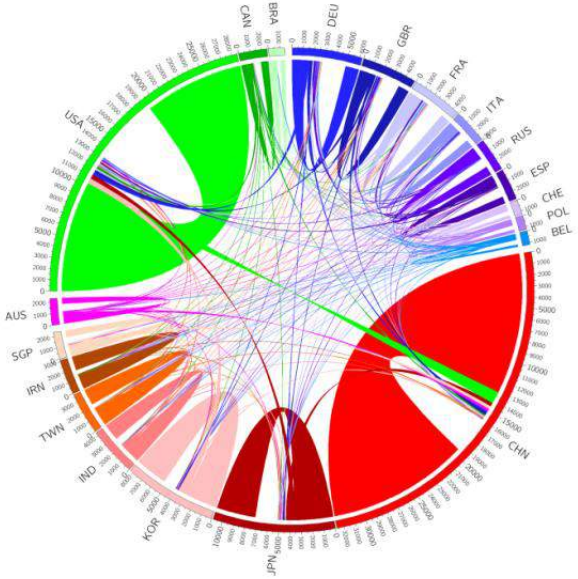
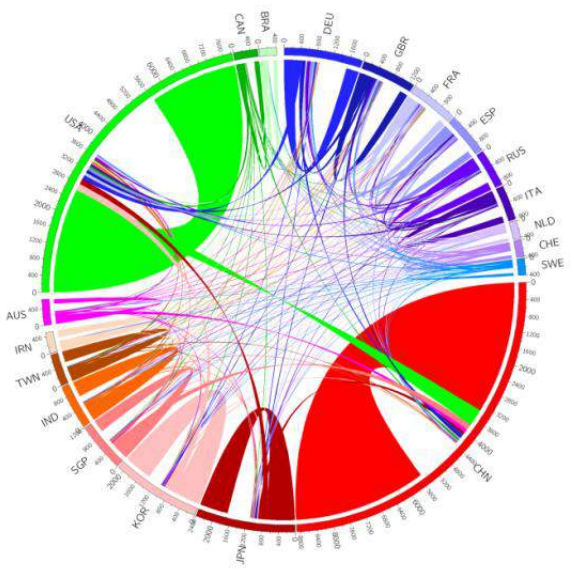
Seeing is Believing – A more compact visualization



Fullerene



Nanotubes



Graphene

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Lesson 2

Utilizing Bibliometrics for Visualization

Lesson 2.1

Visualization is crucial for revealing pattern and confirming notions.

Lesson 2.2

Visualization is useful for communicating results.

→ Ongoing efforts for improving visualization techniques.

Conclusion
Bibliometrics for Technology Foresight

Conclusion 1

Bibliometrics expands the methodological portfolio of technology foresight.

Conclusion 2

Bibliometrics delivers predictive information.

→ Broadening of the necessary basis of an *experience based* projection of current developments onto the future.

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