GALEX:
Exploring the evolution and intersection of disciplines

Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE

Presented by:
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Source From Fig. 1 of "Galex: Exploring the Evolution and Intersection of Disciplines", Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
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What, How, Why

- **Marks**: Predefined Points, lines
- **Channels**: Color hue and saturation, location
- **ROI**: domains, fields, subfields
- **Task Abstractions**: analyzing, comparing, zooming and filtering,...
Previous tools:

- Lacks interactivity
- Evolution of topics
- Semantic relevance among topics
- Showing the structure of science
Related Work: Science mapping

The paper claims that the main difference between them and the precedent work is being Algorithm-based. Mapping topics into a 2D plane (compared to representing topics in only one dimension: rivers) 2D space is more intuitive and effective in capturing topic relationships.
The new tool:

Advantages:

- Evolution of hotspots from the viewpoints of an investor (To find the potential fields).
- Inspecting the relationship to others fields from the perspective of relevance.
- PhD candidates who want to have a macro background.
- For Students want to choose supervisors.
Source From Fig. 2 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Data hierarchy

- **Discipline level**
- **Area level:** origin, growth, fusion, separation, decline
- **Institution level:** academics Popularity of topics and phrases that are involved in Galex, including phrases, institutions, and authors.
Who could use it?

- Students
- Decision-makers
- Professors
- Analysts
- Investors
The video

https://vimeo.com/360154945
Effectiveness

- Design and implementation of a hierarchical and integrated visual analysis framework that allows analysts to understand a scientific field from macro- to micro-perspective;

- Design of a flexible time brush and a context-aware spotlight, they empower analysts to quickly grasp the semantics of region of interest in any time slice. We also design a synchronous spotlight which enables the comparison of sets of document collections;

- Design of a topic tree metaphor which enables analysts to review topic evolution intuitively and to find representative papers of each topic and potential inter-topical papers expediently;

- Provision of a set of networks revealing the backbone of a field, as a complementary to the structure captured by text data.
Visual Exploration of the Intersections among Scientific Fields

Examples: co-occurrence topical words, Showing citation

Chunag->mapped the topic similarity between areas

Pivot slice

CiteVis2, CiteMatrix
Literature Visualization Software

Cite space -> literature review, scientific paradigms identification, topic evolution detection.

VOS viewer -> focuses on creating bibliometric networks. Journals, papers, authors and phrases (heatmaps).

CitNet Explorer -> aims the development of research topics.

Action science explorer -> integrates reference management and network analysis.

GALEX: illustrates a hierarchical understanding of discipline from macro to micro.
Requirements analysis

Use Cases:
1. Disciplinary planning
2. Daily research
3. Career planning

R1 - Comprehension of the overview of one field, inspection of the relationship between its sub-fields, and rapid determination of key entities, such as phrases, institutions, and authors, of any part of the field;

R2 - Perception of hotspots and their evolution, detection of the emergence, rise, decline, fusion, and separation of a field, and inspection of changes in key entities across time;

R3 - Checking the influence scope of a field and exploration of its intersection with other fields;

R4 - Comparison of the academic performances and topic distributions among institutions;

R5 - Detection of top scholars and institutions in a field and assessment of the cooperation among them.
Design, details, interface considerations

Fig. 4: The main overlap zone between the AI (contour line) and CV area (points) located at the upper right side of the latter. Spotlight indicates the top scholars, institutions (arcs), and phrases inside the covered region. Contour line of CV indicates that most papers are distributed across three groups and Group 2 owns most of the papers, forming two cores. Paper will be re-colored by its predominant topic after clicking the icons.

Source From Fig 4 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE.
Time Slices Creator

Source From Fig.5 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Small snapshots and entity lists

Source From Fig. 6 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Cumulative time Slice

Area layer.

tSNE+LDA

Source From Fig.7,8 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Institution Level Multiple Spotlights

Synchronous interactions
Line Charts
Comparing between two institutions
Time brush: differences in different disciplines

Source From Fig.10 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Source From Fig.11 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Network Panel:

Three entity networks provided in the network panel:

- Phrase co-occurrence,
- author cooperation,
- institution cooperation networks

The networks help analysts to deepen the understanding of the structure of research areas from different perspectives,
Case 1: focus on the Computer Vision.

Topic-driven shift and Technique-driven shift

Source From Fig.14 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Case 1: focus on the Computer Vision.

Source From Fig.12,13 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Case 2: Focus on Visualization

Source From Fig. 15 of “Galex: Exploring the Evolution and Intersection of Disciplines”, Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE
Case 2: Focus on the entire Computer Science}

Source: From Fig. 16 of "Galex: Exploring the Evolution and Intersection of Disciplines", Zeyu Li, Changhong Zhang, Shichao Jia, and Jiawan Zhang, Senior Member, IEEE.
Discussion: User Feedback

Finally, we collected their feedback informally. They all agreed that Galex is comprehensive and well-designed, enabling them to gain new insights into a discipline from multiple perspectives quickly and effectively. They favored the interaction components for their natural, flexible, and easy-to-use characteristics. They also pointed out some weaknesses, such as the weak logical association of the last layer with the first two, and the newly added papers in topic trees are not explicitly highlighted. They also put forward several suggestions, such as implementing panning and zooming in the area layer and replacing the uncommon interaction: triggering an action by hovering over the element for 1 s. Finally, all the professors are willing to use our system in their daily research.
Scalability

Limitations

Generalizability

Data Quality
**Strengths**

- Showing a comprehensive overview with different scales
- Interactivity and User friendly
- Basic Design!
- Comparison between areas, institution, phrases, ...

**Weaknesses**

- Vague labels and details
- Not really explaining the algorithm
- Marks, Basic Design
- Overlap in Clustering
Thank You