



Evaluation of Enterprise Technology Competitiveness Based on Technology Topics

Xuemei Yang¹•Xuefeng Wang¹•Jia Li¹•Xinglu Wang¹•Anran Zhu¹

Xuefeng wang

Email:wx5122@bit.edu.cn

1.School of Management and Economics, Beijing Institute of Technology

Xuemei Yang

KMDA

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Background

- Technological knowledge becomes the most attractive resource for enterprises to gain competitive advantage.
- The focus of enterprise technology competition is turning to the competition and control of intellectual property rights.
- Enterprises need to understand their own and competitors' technological positions in formulating technology research and development strategies.



Background

- Based on the technology competitiveness evaluation of patent analysis, its usefulness is hindered by the significant limitations embedded in the patent classification based metric.
- With the development of technologies such as machine learning, many scholars actively explored different methods of patent mining for semantic mining and topic clustering.



Introduction

Competence theory: The technology competitiveness of an enterprise is reflected in its **ability** to technological innovation, coordinate and integrate multiple technology.

Resource theory: The technology competitiveness of enterprises is a unique collection of technological **resources** for enterprises.

The technology competitiveness of enterprise not only comes from the collection of technological resources, but also is the ability of enterprises to gain advantages.



Introduction

- In general, technological resources are highly specialized and difficult to be coded and structured, which are considered to be a highly knowledge-intensive intangible asset.
- The patent as technological resource condensation not only contains rich enterprise technological information, but also the output of the enterprise's technological innovation activities and the input of the next production.



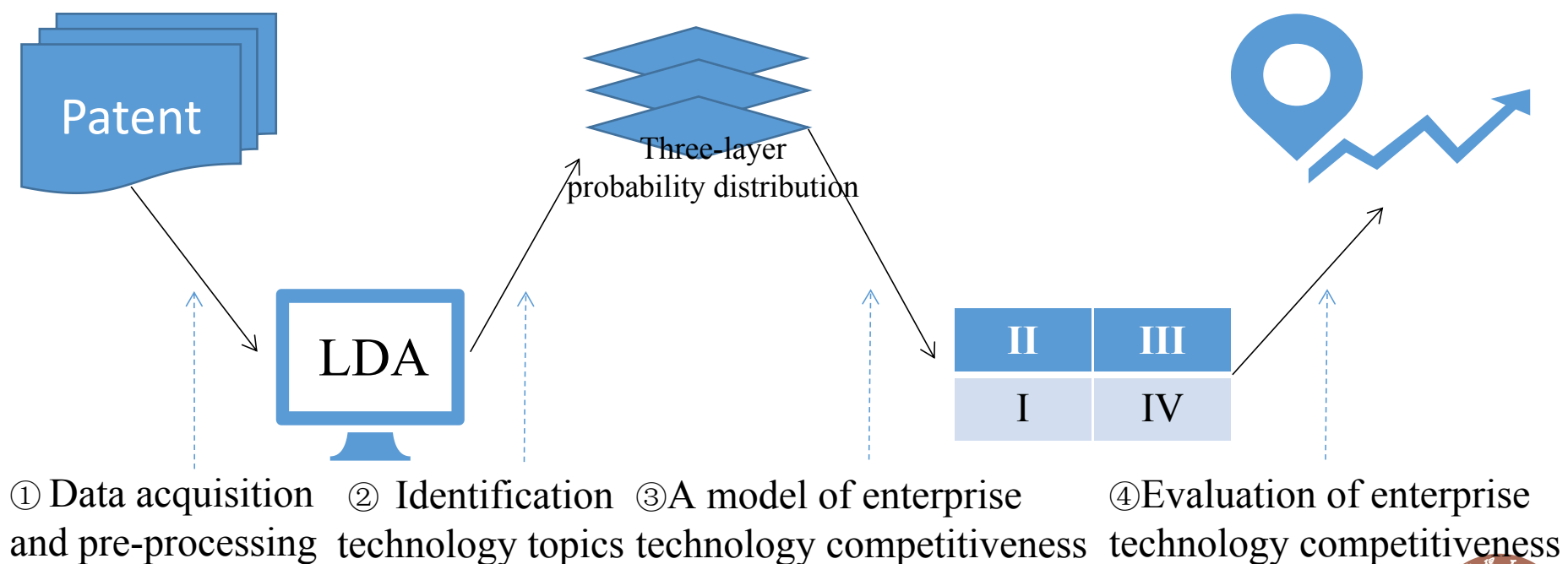
Introduction

At present, the evaluation methods of enterprise technology competitiveness using patent data mainly include: index system evaluation method, patent portfolio analysis method, patent network and matrix evaluation method.

The evaluation method based on patent portfolio analysis can select a certain patent index from different evaluation levels to conduct multi-dimensional comparison, which can identify competitors and analyze technology competition.



Methodology



Methodology

Step1:Data acquisition and pre-processing

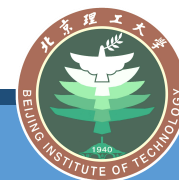
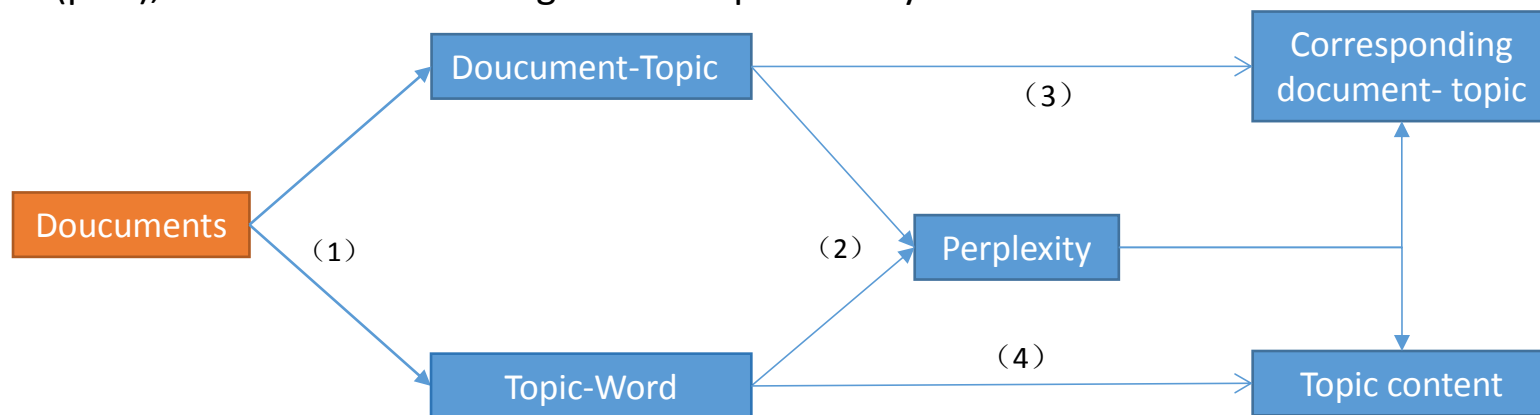


Documents	P1	keyword1	keyword2	...
	P2	keyword2	keyword4	...
	P3	keyword1	keyword5	...
	P3	keyword3	keyword4	...

Methodology

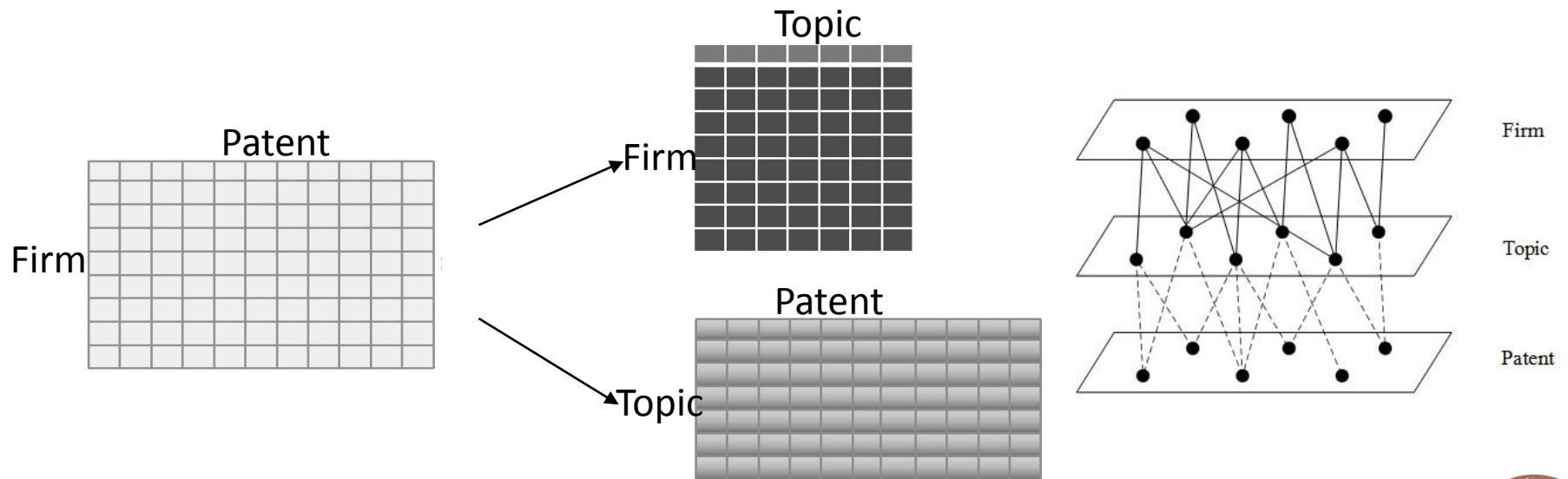
Step2: Identification technology topics using LDA model

LDA (Latent Dirichlet Allocation) topic model proposed by Blei in 2003 (Blei et al., 2003), is a three-layer Bayesian probability model extended on probabilistic Latent Semantic Indexing (pLSI), which is a document generation probability model.



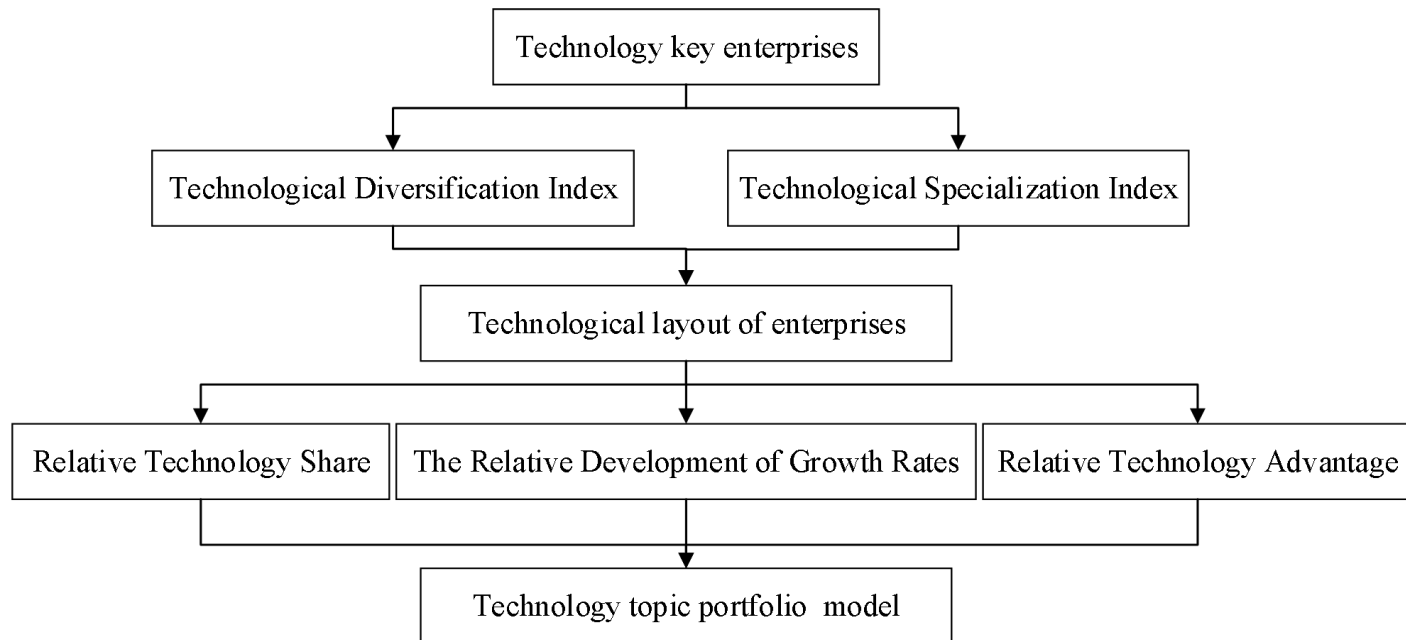
Methodology

Step2: Identification technology topics using LDA model



Methodology

Step3: Constructing a model of technology competitiveness



Methodology

Step3: Constructing a model of technology competitiveness

Technological layout

-from the perspective of enterprise technology distribution

$$TD = 1 - \sum_{i=1}^n \left(\frac{f_i}{f} \right)^2$$

$$TS = \frac{\sum (f_i \times f_j \times \cos(t_i \times t_j))}{\sum (f_i \times f_j)}$$

where t_i and t_j indicates that the patents relate to the category of the topic, $\cos(t_i \times t_j)$ indicates the degree of association between the category t_j and the category t_i



Methodology

Step3: Constructing a model of technology competitiveness

Evaluation of technical competitiveness based on patent portfolio

Relative technology share

$$RTP = \frac{P_{ij}}{P_{iB}}$$

The relative development of growth rates $RDGR = \frac{\text{Growth rate of patent grants for a single technology}}{\text{Growth rate of patent grants for all technologies}}$

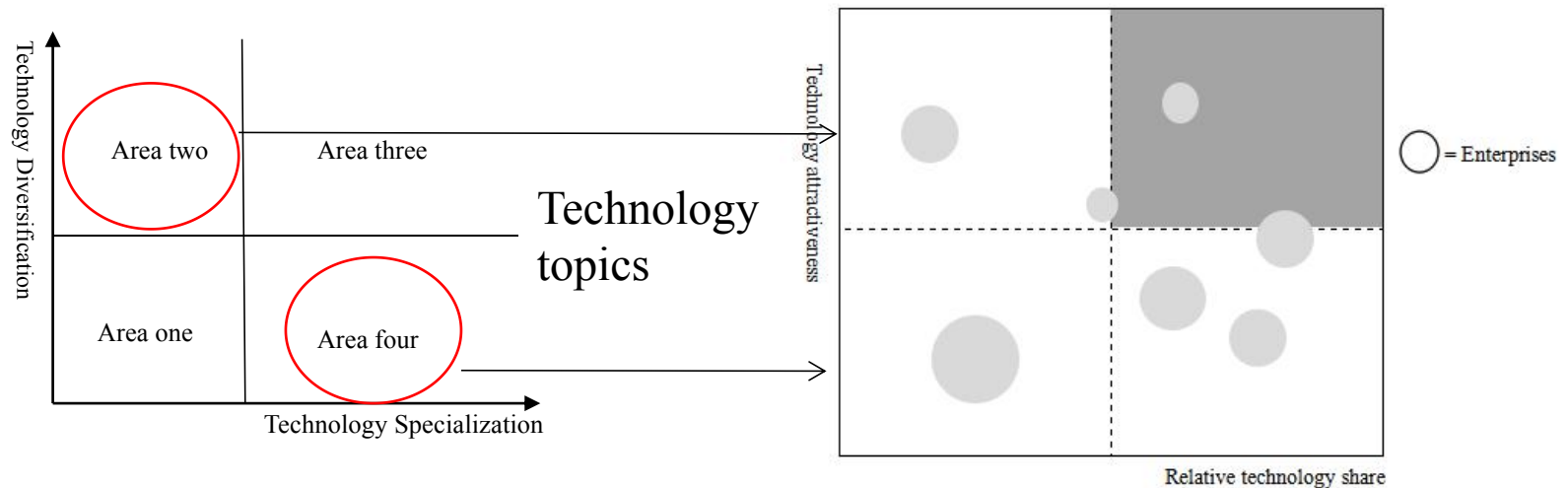
Relative technological advantage

$$RTA_{ij} = \frac{p_{ij} / \sum_j p_{ij}}{\sum_j p_{ij} / \sum_{ij} p_{ij}}$$



Methodology

Step4: Evaluation of enterprise technology competitiveness



Case Study

Selection of research subjects

- The technology field: Intelligent Connected Vehicle(ICV)
- Database: Derwent Innovation
- Date: 1998.01.01-2017.12.31

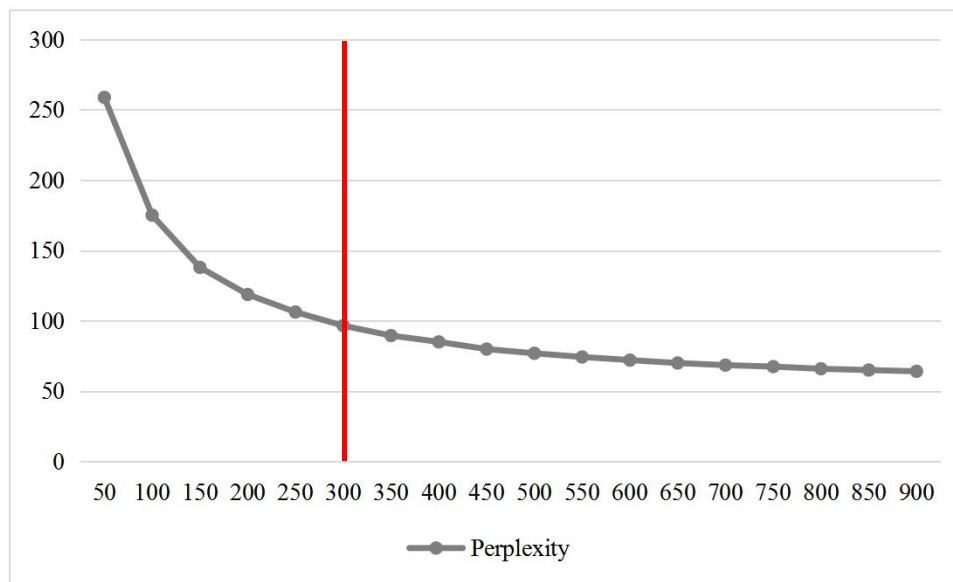
Firm	Patents	Firm	Patents	Firm	Patents	Firm	Patents
GENK	655	HYMO	177	NSMO	90	FUJH	48
HYMR	328	FORD	154	HOND	77	ITLC	47
GLDS	269	MVLL	137	DAIM	69	CHRA	47
TOYT	208	NPDE	109	BOSC	67	AISW	46
GOOG	183	SMSU	95	VOLS	67	MITQ	45



Case Study

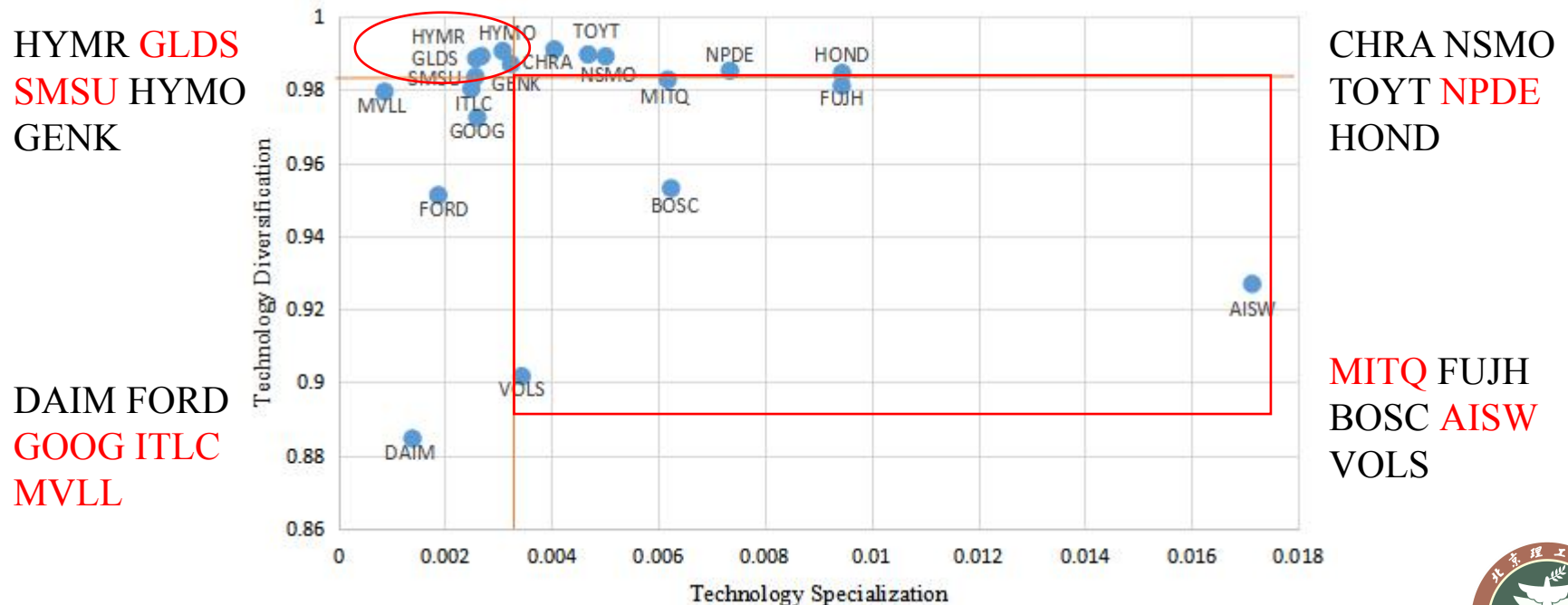
Determination of technology topics

This paper selects 300 technology topics where the perplexity curve is smoother.



Case Study

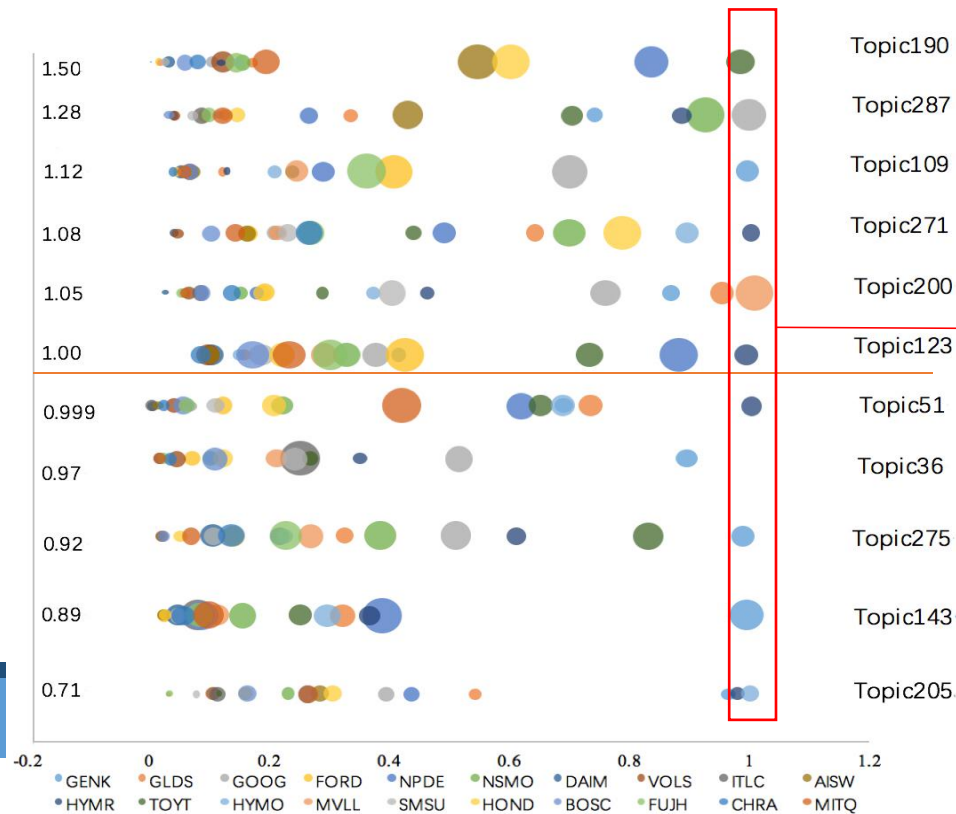
Technological layout of the enterprise



Case Study

Development of different enterprises in the same technology topic

MITQ NPDE
FUJH HOND
TOYT AISW

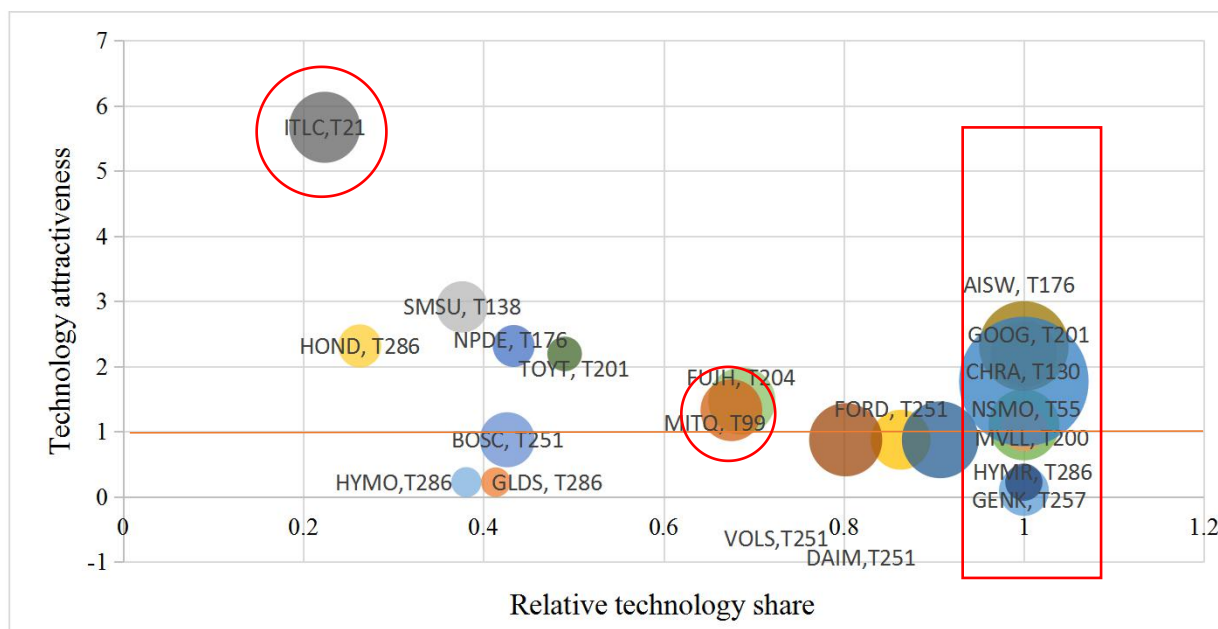


GENK HYMR
HYMO GOOG



Case Study

Competitiveness of key technology topic of different enterprises

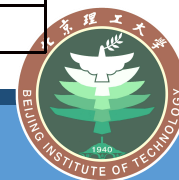


AISW **GOOG**
CHRA **NSMO**
MVLL **HYMR**
GENK

Case Study

Competitiveness of key technology topic of different enterprises

Topic	Enterprises	Specific technology content
21	ITLC	V2X information fusion technology
55	NSMO	Car image sensor chip
99	MITQ	Millimeter wave radar chip
130	CHRA	Lane departure warning system
138	SMSU	Collaborative control system
176	NPDE、HOND、AISW	Path planning system
200	MVLL	Telematics system
201	TOYT、GOOG	Vehicle information topological stream interaction
204	FUJH	Obstacle detection, surrounding environmental warning
251	FORD、DAIM、BOSC、VOLS	Adaptive cruise system
257	GENK	Vehicle interconnection terminal
286	HYMR、GLDS、HYMO	Night vision system



Conclusion

This paper has used LDA topic model to perform topic clustering, which avoids the cumbersome manual classification and solves the problem of coarse and lack of timeliness of coding classification. Based on the three-layer probability distribution of the enterprises-technology topics-patent text, we analyze the technology competitiveness of 20 enterprises in the field of intelligent connected vehicle.

This paper indirectly constructs the three-layer probability distribution of the enterprises-technology topics-patent text by matching the enterprise and its patents. In the following research, the Author-Topic model can be used to directly construct the three-layer probability distribution.



Thank you!

Xuemei Yang
Email:18222951779@163.com

