Structural Feature Analysis and Spatial Modeling of Knowledge System Based on Interdisciplinary Integration

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Abstract—Figuring out the structural features and internal logic of knowledge system from an interdisciplinary perspective under the action of knowledge flow and revealing the changes in the spatial structure and pattern of the knowledge systems of different disciplines are meaningful works for both the theoretical and practical research on the utilization and expansion of interdisciplinary knowledge. For this reason, this paper built a spatial model for the interdisciplinary knowledge system and analyze its structural features. At first, key features of the interdisciplinary knowledge system were mined, and a knowledge system was built based on the coupling of knowledge and discipline. Then, the relationship between technical knowledge and discipline was discussed, and the complex spatial features of the interdisciplinary knowledge system were mined. After that, this paper built an evolutionary dynamics model for knowledge stickiness, and used it to study the main influencing factors of the knowledge stickiness of interdisciplinary knowledge system based on dynamics and figure out its action mechanisms on the performance of knowledge utilization and expansion. At last, experimental results verified the effectiveness of the constructed model and the proposed algorithm.

Keywords—interdisciplinary integration, knowledge system, structural feature analysis, spatial correlation analysis

1 Introduction

Now the knowledge innovation has become the mainstream of the development of the times [1–7]. New concepts, methods and technologies brought about by the intersection and integration of various disciplines can join their forces to solve major science problems in different fields [8–10]. In the knowledge systems of modern disciplines, the exchange between disciplines becomes increasingly frequent, so it's necessary to organize and manage the interdisciplinary knowledge in an effective way [11–15]. After reviewing relevant literatures, it's found that existing studies about interdisciplinary integration generally discussed the problem of knowledge system construction from the linear temporal dimension perspective, and few of them explored the problem of the structural features and evolution laws of interdisciplinary knowledge system from the overall spatial dimension perspective [16–23]. However, re-interpreting the structural features and internal logic of knowledge system from an interdisciplinary perspective under the action of knowledge flow and revealing the changes in the spatial structure and pattern of the knowledge systems of different disciplines are meaningful works for both the theoretical and practical research on the utilization and expansion of interdisciplinary knowledge.

Wang et al. [24] pointed out that current research has turned into the direction of investigating interdisciplinary knowledge integration and measuring the degree of interdisciplinarity. The authors introduced a new analytical framework and used content, citation position, and citation to describe the integration of interdisciplinary knowledge. They summarized seven knowledge categories, including research subject, theory, methodology, technology, human entity, data, and others, and used them to classify the integrated knowledge phrases. Delina [25] summarized the discussions made in a workshop aiming to build an inter- and multi-disciplinary knowledge community on the critical study of geoengineering in Southeast Asia. Drotianko et al. [26] elaborated on the philosophical reflection of social and cultural consequences of the mutual effects of high technologies and interdisciplinary studies in the context of information society. The increasing phenomenon of interdisciplinary science mainly exhibit as the fusion of technology and society and the human-machine hybrids, which has raised serious anthropological and sociocultural problems, bringing new challenges to professional epistemologists, and requiring the public to know about the influence of high technologies on people and society and its consequences. Díaz-Nafría et al. [27] introduced the glossaLAB international project and described it as a contribution to respond to the urgent requirement of knowledge integration framework, in the paper, the authors discussed the main components of the project and the solutions to achieve the desired goals in three different aspects.

Although field scholars have conducted a lot of research work on interdisciplinary integration, still, the research in aspects such as the structural feature analysis of knowledge system and the construction of spatial model is yet to be further improved. Therefore, this paper carried out the related research. The second chapter of the paper mined the key features of interdisciplinary knowledge system; the third chapter built a knowledge system based on the coupling of knowledge and discipline; the fourth chapter discussed the relationship between technical knowledge and discipline, and mined the complex spatial features of the interdisciplinary knowledge system; the fifth chapter built an evolutionary dynamics model for knowledge stickiness, studied the main influencing factors of the knowledge stickiness of interdisciplinary knowledge system based on dynamics, and explored its action mechanisms on the performance of knowledge utilization and expansion. At last, experimental results verified the effectiveness of the constructed model and the proposed algorithm.

2 Mining of key features of knowledge system structure based on interdisciplinary integration

The interdisciplinary knowledge system usually exhibits a special structural effect, that is, between the knowledge communities of a same discipline, there're close and tight relationships. Such community structure of interdisciplinary knowledge system can reflect the mutual relationships between the knowledge communities of a same discipline, and it's often used to describe the scattering and clustering characteristics of the relationships between knowledge nodes in the interdisciplinary knowledge system. This paper mined the said structural features of knowledge communities based on the *Girvan-Newman* algorithm, a method for detection and analysis of community structure, and verified whether there're scattering or clustering features in the interdisciplinary knowledge system.

This method takes the modular index as the criterion to identify the optimal community structure of the knowledge system. Assuming: X_{ij} represents the adjacency matrix; l_i and l_j represent the degrees of two knowledge nodes; then for a given set of knowledge nodes D, the following formula gives the expression of community intensity:

$$\sum_{i\in D,\ j\in D} X_{ij} - l_i l_j / 2n \tag{1}$$

Assuming: the structure of an interdisciplinary knowledge system is divided into l communities, $\xi(i,j)$ represents the exponential function, after standardization, the difference (W) between the number of connecting edges of actual knowledge nodes in the community and the random expected relation number could be attained, the specific calculation formula is:

$$W = \frac{1}{2n}\sum_{k=1}^{l}\left(\sum_{i\in D, j\in D} X_{ij} - \frac{l_i \times l_j}{2n}\right)\cdot \xi(i,j) \tag{2}$$

$$N_Y = \sum_{r=1}^{M_N}\left\{\frac{\sum_{i\neq j\in r} D_{ij}}{\sum_x n_x(n_x-1)} - \frac{\sum_{i\neq j\in r} o_i o_j}{\left(\sum_x n_x\right)^2}\right\} \tag{3}$$

When W is not equal to 0, namely the number of connecting edges of actual knowledge nodes in the community is greater than the random expected relation number, the clustering of all knowledge nodes in the interdisciplinary knowledge system exhibits a community structure to a certain extent. If knowledge nodes i and j are from a same community, then the value of $\xi(i, j)$ is 1; if they are from different communities, then the value is 0. The value range of W is [–1, 1], the larger the value, the more obvious the community structure of the interdisciplinary knowledge system, and the better the community division effect. Figure 1 shows an example of the effect of community division.

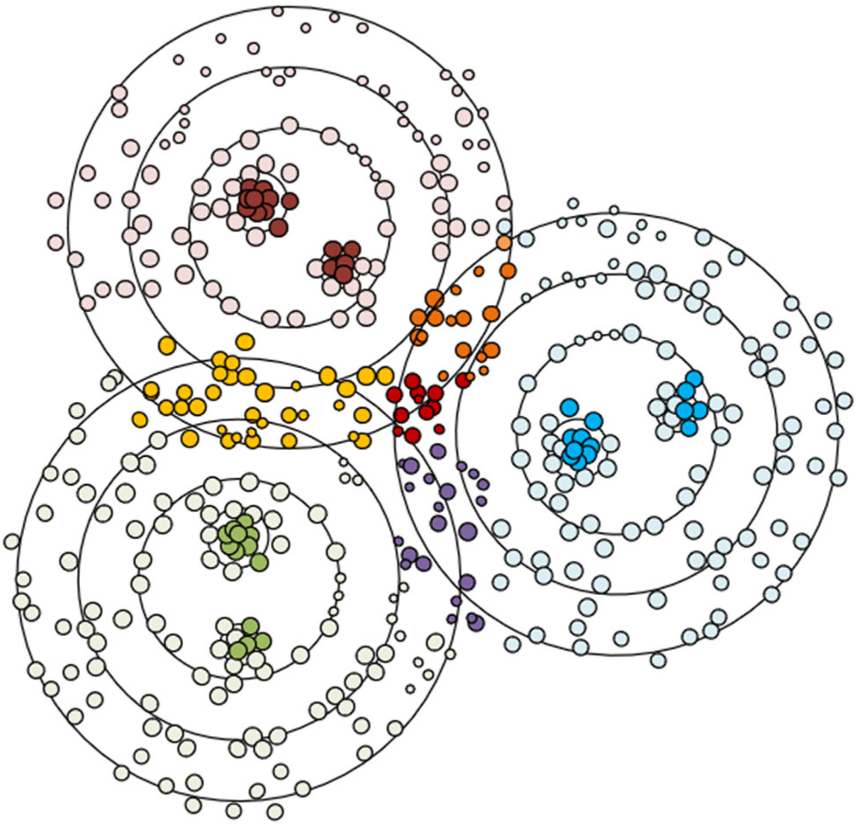

Fig. 1. An example of community division effect

3 Construction of knowledge system based on knowledge-discipline coupling

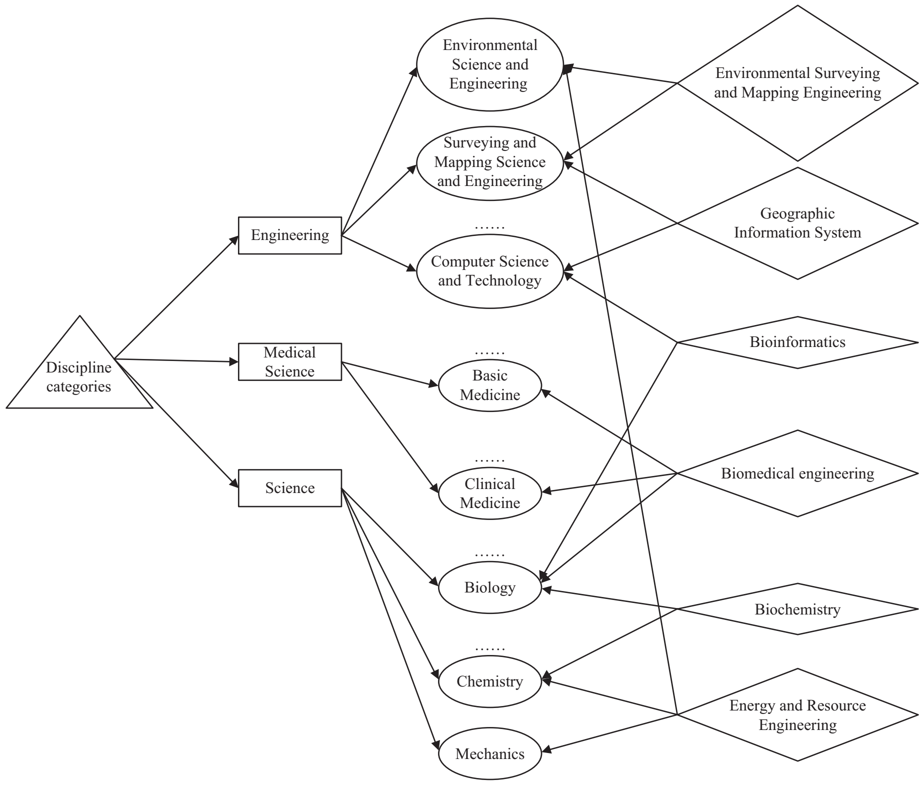

Fig. 2. The cross-relationships between disciplines

Figure 2 gives a diagram showing the cross-relationships between disciplines. For two disciplines, if the types of technical knowledge contained in the knowledge systems of the two are of high consistency, then it's considered that there's a cross relationship between the knowledge systems of the two disciplines. This paper comprehensively considered the types of technical knowledge involved in the two disciplines and their spatial distribution features in the interdisciplinary knowledge system. Assuming: L represents the set of different types of technical knowledge jointly involved in two disciplines i and j; $r_{i,l}$ and $r_{j,l}$ represent the number of technical knowledge type l involved in disciplines i and j; D represents the total number of disciplines covered in the interdisciplinary knowledge system; d_l represents the number of disciplines in which the technical knowledge type l is involved; then, the degree of correlation of the two disciplines established based on the public knowledge nodes (w) can be calculated by the following formula:

$$w = \sum_l \frac{(r_{i,l} + r_{j,l}) / \sum_o r_{o,l}}{log(D / d_l + 1) + 1} \tag{4}$$

In the coupling relationship between the knowledge systems of multiple disciplines, there're correlations between the knowledge node attributes and the connecting edges. In order to study the complex interdisciplinary knowledge system and its applications, this paper calculated the correlation degree and coupling degree of the knowledge systems of multiple disciplines based on the complex network analysis method. Assuming: $s_{ab}(i)$ represents the correlation coefficient between the potential integrated knowledge system A and the actual integrated knowledge system B of discipline i; $a_i(j)$ represents the knowledge integration relationship that may exists between discipline i and discipline j; $b_i(j)$ represents the coupling relationship that exists actually; σ represents the identification coefficient, then the following formula gives the calculation formula of the correlation degree:

$$s_{ab}(i) = \frac{a_i^{min}(j) b_i^{min}(j) | a_i(j) - b_i(j) | + \sigma a_i^{max}(j) b_i^{max}(j) | a_i(j) - b_i(j) |}{| a_i(j) - b_i(j) | + \sigma a_i^{max}(j) b_i^{max}(j) | a_i(j) - b_i(j) |} \tag{5}$$

The formula for calculating the coupling degree δ between A and B is:

$$\delta = \frac{1}{l} \sum_{j=1}^{l} s_{ab}(i) \tag{6}$$

The value range of coupling degree is [0, 1], and the larger its value, the greater the coupling degree of the two. If $\xi\delta = 1$, then it indicates that the knowledge systems of two discipline are completely coupled.

4 Knowledge complexity measurement and spatial correlation

When the distribution of a technical knowledge can be used by more disciplines, it means that this knowledge is less complicated and innovative, and it is a basic knowledge in the fields of these disciplines. On the contrary, when the distribution of a technical knowledge in the distribution space of the interdisciplinary knowledge system is relatively concentrated, then it means that this knowledge is heterogeneous and professional, and it can only be used by less disciplines. Based on the above analysis and the structure of the interdisciplinary knowledge system, this paper explored the relationship between technical knowledge and the disciplines, and mined the complex spatial features of discipline knowledge in the interdisciplinary knowledge system.

Based on knowledge-discipline coupling, the interdisciplinary knowledge system can be regarded as a $m\times 1$ dual-module matrix denoted as $N = (N_{d,i})$. For technical knowledge i, $N_{d,j}$ represents whether discipline d has the attribute of utilizing or expanding this technical knowledge. The discipline knowledge complexity index determines the complexity of the knowledge by calculating which technical knowledge in the interdisciplinary knowledge system has the utilization or expansion advantages (*UEA*) based on knowledge-discipline coupling, if $UEA^{o}_{d,i} = 1$ is to be satisfied, then there is:

$$\frac{knowledge^{o}_{d,i} / \sum_{i} knowledge^{o}_{d,i}}{\sum_{d} knowledge^{o}_{d,i} / \sum_{d}\sum_{i} knowledge^{o}_{d,i}} \geq 1 \tag{7}$$

Discipline knowledge complexity *DKC* has two aspects: knowledge diversity and knowledge universality. The calculation of knowledge diversity and knowledge universality is related to the degree of centrality of the interdisciplinary knowledge system. Assuming D represents the discipline, O represents the technical knowledge, then there are:

$$\begin{aligned} L_{D,0} &= \sum_{O} N_{DO} \\ L_{O,0} &= \sum_{D} N_{DO} \end{aligned} \tag{8}$$

Disciplines and technical knowledge could form an interdisciplinary knowledge system based on the coupling of knowledge and discipline, then based on this system, the complexity of utilizing or expanding the knowledge of different disciplines and the difference in the degree of innovation could be reflected, these two indexes could be attained from iterative calculations:

$$DKC_{sub} = L_{d,m} = \frac{1}{L_{d,0}} \sum_{i} N_{d,i} L_{i,m-1} \tag{9}$$

$$DKC_{kno} = L_{i,m} = \frac{1}{L_{i,0}} \sum_{i} N_{d,i} L_{d,m-1} \tag{10}$$

To further analyze the complexity of discipline knowledge and the spatial features of the interdisciplinary knowledge system, this paper used spatial statistical analysis method to analyze the spatial self-correlation of the interdisciplinary knowledge system based on the complexity of discipline knowledge, and the selected statistical indexes are the global and local Moran's I (the spatial self-correlation index). Assuming: a_i and a_j represent the values of the complexity of discipline knowledge at positions i and j in the interdisciplinary knowledge system; $a^* = 1/m\sum_{i=1}^{m} a_i$ represents the average value of the complexity of discipline knowledge at all positions in the space; $R^2 = 1/m\sum_i (a_i - a^*)^2$ represents the variance of the values of the discipline knowledge complexity; q_{ij} represents the spatial weight matrix, then the calculation formula of the global Moran's I is:

$$I = \frac{m\sum_{i=1}^{m}\sum_{j=1}^{m} q_{ij}(a_i - a^*)(a_j - a^*)}{\sum_{i=1}^{m}\sum_{j=1}^{m} q_{ij}(a_i - a^*)^2} = \frac{\sum_{i=1}^{m}\sum_{j=1}^{m} q_{ij}(a_i - a^*)(a_j - a^*)}{R^2 \sum_{i=1}^{m}\sum_{j \neq i}^{m} q_{ij}} \tag{11}$$

The local Moran's I can be calculated as follows:

$$I_i = \frac{(a_i - a^*)}{R^2}\sum_j q_{ij}(a_j - a^*) \tag{12}$$

Assuming: c_i' and c_j' are observed values standardized by the standard deviation, and they are used to measure the degree to which the discipline knowledge complexity deviates from the average value, then there is:

$$I_i = \frac{m(a_i - a^*)\sum_j q_{ij}(a_j - a^*)}{\sum_i (a_i - a^*)^2} = \frac{mc_i \sum_j q_{ij} c_j}{c^O c} = c_i' \sum_j q_{ij} c_j' \tag{13}$$

5 Construction of evolution dynamics model of knowledge stickiness

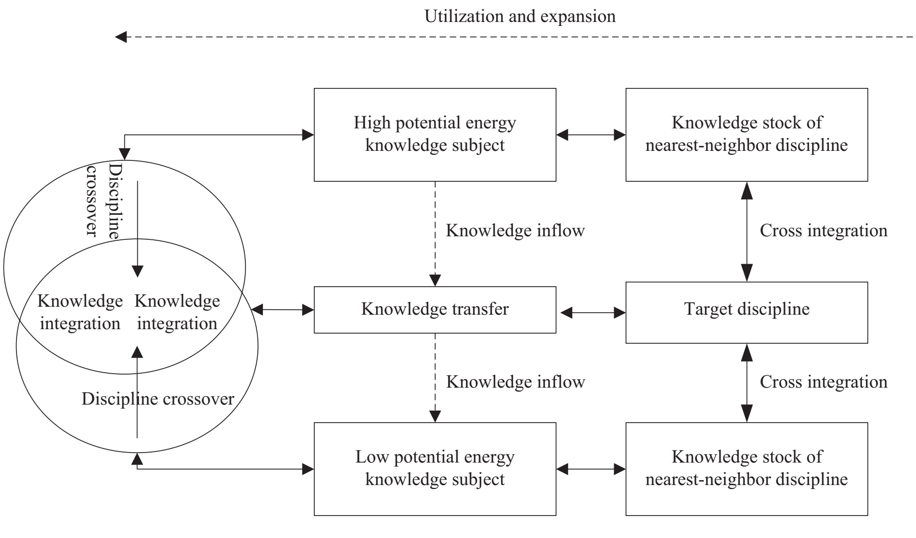

Fig. 3. Knowledge transfer dynamics model of interdisciplinary knowledge system

The complexity of knowledge may hinder the knowledge transfer or knowledge stickiness of the interdisciplinary knowledge system, so it's a meaningful work to discuss the relationship between knowledge stickiness, knowledge complexity, knowledge transfer scenario, knowledge transfer motivation, and other elements in the interdisciplinary knowledge system. Based on dynamics, this paper studied the main influencing factors of knowledge stickiness in the interdisciplinary knowledge system and explored the action mechanisms of these factors on the performance of knowledge utilization and expansion, and this work could promote the knowledge flow, knowledge utilization, and knowledge expansion of interdisciplinary knowledge system.

To figure out the relationship between each element in the interdisciplinary knowledge system and the knowledge stickiness, an influence function of knowledge stickiness should be established based on relevant preset assumptions. Figure 3 shows the knowledge transfer dynamics model of interdisciplinary knowledge system. Assuming: M represents the scale of the interdisciplinary knowledge system; there're two types of knowledge subjects in the knowledge stock of the knowledge system: the high potential energy knowledge subjects and the low potential energy knowledge subjects; let $F(o)$ and $R(o)$ represent the proportions of the number of the two-types of knowledge utilization and expansion subjects in the knowledge system, and they satisfy $F(o) + r(o) = 1$; n_i represents the number of the nearest-neighbor low potential energy knowledge subjects that are related to each high potential energy knowledge subject; $\xi(o)$ represents the knowledge stickiness during knowledge transfer.

Based on above assumptions, the proportion of knowledge transferred from low potential energy subjects to high potential energy subjects within per unit time is represented by $(1 - \xi(o))n_i R(o)$; then the growth rate of high potential energy subjects $MF(o)$ inside the interdisciplinary knowledge system within per unit time could be calculated to be $(1 - \xi(o))[n_i R(o)]MF(o)$, that is:

$$\frac{d(MF(o))}{do} = (1-\xi(o))[n_i R(o)]MF(o) \tag{14}$$

According to $R(o) = 1 - U(o)$, there is:

$$\begin{cases} \dfrac{dF}{do} = n_i(1-\xi)F(1-F) \\ F(o_0) = F_0 \end{cases} \tag{15}$$

By solving Formula 15, we have:

$$F(o) = \left[1 + \left(\frac{1}{F_0+1} - 1\right) p^{-n_i(1-\xi)}\right]^{-1} \tag{16}$$

When $d(MF)/do$ is the largest, the growth rate of the stock of high potential energy subjects is the fastest, at this time, there is $o_n = [n_i(1 - \xi)]^{-1} In(1/F_0 - 1)$. According to analysis, ξ is proportional to o_n and inversely proportional to $d(MF)/do$. Therefore, a higher growth rate of the overall knowledge stock of the interdisciplinary knowledge system indicates lower knowledge stickiness of the knowledge system, and it's easier for the knowledge of various disciplines to transfer between disciplines.

Assuming: $g(l,w)$ represents the knowledge cognition factor of the interdisciplinary knowledge system; $h(\psi,e,u)$ represents the knowledge transfer motivation; $k(o,v,\varepsilon)$ represents the knowledge transfer scenario; it can be considered that knowledge stickiness ξ is affected by the joint action of $g(l,w)$, $h(\psi,e,u)$ and $k(o,v,\varepsilon)$. Assuming: α represents the original damping coefficient of knowledge source i to knowledge acceptor j; $R_j(o) = \{R_{i,j}(o) i = 1,2,\ldots,M\}$ represents the knowledge potential energy of knowledge acceptor j at different time moments o; ΔR represents the difference of knowledge potential energy between subjects i and j; $\gamma_i (i = 1,2,3)$ represents the influence coefficient of different factors; then the expression of the influence function of ξ is:

$$\xi(o) = \frac{1}{10}\left[\alpha\left(1+\frac{R_j(o)}{\Delta R}\right)+(\gamma_1 g-\gamma_2 h-\gamma_3 k)\right] \tag{17}$$

Assuming: l represents the influence of knowledge complexity and fuzziness on knowledge stickiness; w represents the influence component of knowledge cognition structure on knowledge stickiness; $\omega_{ij} \in (0,\pi/2)$ represents the matching degree parameter that describes the degree of knowledge transfer; when $\omega_{ij} = \pi/2$, knowledge transfer won't happen, μ is a parameter larger than 1. The expression of $g(l,w)$ is:

$$g(l,w) = \frac{\mu}{R_i(o)\cdot R_j(o)\cdot cos\omega_{ij}} \tag{18}$$

$h(\psi,e,u)$ has a negative influence on knowledge stickiness. Assuming: ψ represents the willingness of subjects in the knowledge transfer motivation; e represents the absorption ability; u represents the influence of the degree of trust, then the influence function of $h(\psi,e,u)$ is given by the following formula:

$$h(p,e,u) = \frac{1}{1+K_0(i,j)^{-1}+p^{-\left[R_i(o)+R_j(o)\right]}} \tag{19}$$

In the $k(o,v,\varepsilon)$ dimension, the incentive mechanism is represented by o, the degree of openness of the network is represented by v, the external pressure is represented by ε; o, v, and ε all have a negative influence on knowledge stickiness. Assuming: $x(o)$, $y(o)$, and $Sc(o)$ respectively represent the influence of incentive mechanism, external pressure, and openness degree of the interdisciplinary knowledge system on knowledge stickiness, then there is a $k(o,v,\varepsilon)$-dimensional linear influence function, which is represented by $k(o,v,\varepsilon) = x(o) \times y(o) + Sc(o)$, and the final influence function of ξ_{ij} is:

$$\begin{aligned}\xi_{ij} = \frac{1}{10}\Bigg[&\alpha\left(1+\frac{R_j}{\Delta R}\right)+\gamma_1\cdot\mu / R_i\cdot R_j cos\omega_{ij}-\gamma_2\cdot \\ &\left[1+K_0(i,j)^{-1}+p^{-[R_i,R_j]}\right]^{-1}-\gamma_3(x\times y+Sc(o))\Bigg]\end{aligned} \tag{20}$$

6 Experimental results and analysis

Table 1. The community division effects of different algorithms

Community Discovery Method	Community No.	Node Number	Edge Number	Connection Strength	Density	Clustering Coefficient	Average Path Length
Reference algorithm	1	135	218	1.135	0.069	0.714	1.628
	2	88	152	1.691	0.057	0.362	2.368
	3	31	74	1.485	0.163	0.695	2.113
	4	25	29	1.412	0.024	0.581	2.517
Proposed algorithm	1	93	137	3.528	0.069	0.136	1.528
	2	35	58	4.162	0.038	0.128	1.704
	3	31	51	3.924	0.045	0.271	1.217
	4	17	23	2.507	0.118	0.357	1.144
	5	12	15	1.347	0.192	0.184	1.685

Table 2. Coupling types of potential and actual knowledge systems of inter-disciplines

Coupling Type		High Degree Coupling	Medium Degree Coupling	Low Degree Coupling
Number of disciplines		69	152	169
Actual interdisciplinary knowledge system	Uniformity	9.36	8.68	6.25
	Clustering coefficient	0.341	0.362	0.241
	Density	0.055	0.042	0.035
Potential interdisciplinary knowledge system	Uniformity	12.85	11.36	12.39
	Clustering coefficient	0.647	0.692	0.417
	Density	0.594	0.537	0.484

This paper adopted the community discovery method *Girvan-Newman* algorithm to mine the structural features of knowledge communities of the interdisciplinary knowledge system, and compared its community division effect with other classic algorithm of homogeneous networks, the comparison results are given in Table 1, as can be seen from the table, the proposed algorithm effectively reflected the distribution of knowledge in the space of the interdisciplinary knowledge system, the connection strength of nodes in the divided communities is higher, the average path length is shorter, and the clustering relationship of knowledge communities in the interdisciplinary knowledge system could be established through knowledge connections.

Table 2 shows the coupling types of potential and actual knowledge systems of inter-disciplines. According to the table, nearly 20% of the disciplines are the high-degree coupling type, and other disciplines belong to the medium and low degree coupling types, that is, there's a high consistency between the potential interdisciplinary knowledge system and the actual interdisciplinary knowledge system. In addition, there are few differences in potential or actual interdisciplinary knowledge systems corresponding to different coupling types in terms of the three evaluation indicators, meaning that correlation between coupling type and the discipline knowledge system structure attributes is not significant. That is, in terms of structure, the core nodes of actual and potential interdisciplinary knowledge systems are consistent, but the difference in node connections is identifiable, to a certain extent, this has verified the necessity of mining the potential knowledge integration relationship between the potential interdisciplinary knowledge systems.

To reveal the spatial clustering features of subject knowledge complexity in the interdisciplinary knowledge system, this paper plotted a 2D graph of discipline knowledge diversity and technology universality, as shown in Figure 4, the two exhibit a negative correlation, indicating that when the knowledge diversity of a discipline is higher, the ability of utilizing and expanding its technical knowledge is stronger. At the same time, it also verified that the knowledge complexity of a single disciplinary field has more obvious clustering feature than that of multi-disciplinary field.

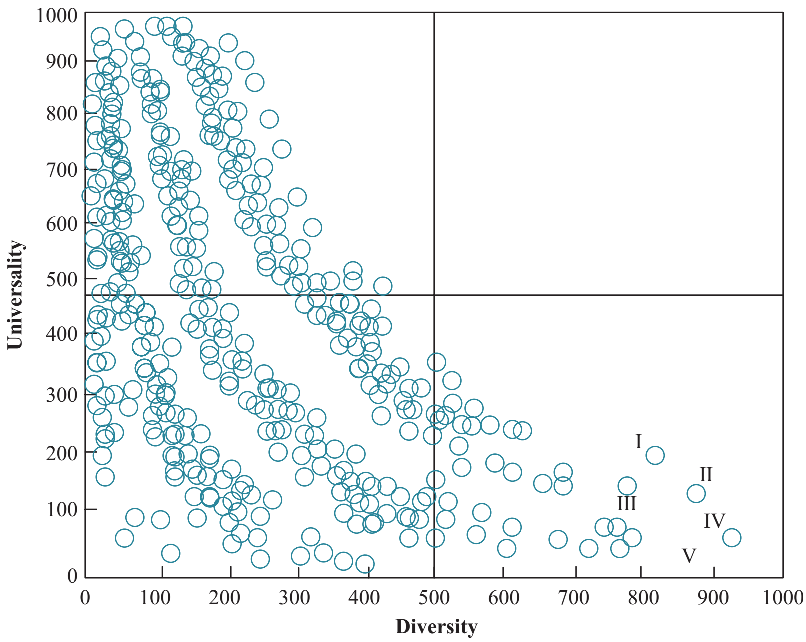

Fig. 4. 2D graph of discipline knowledge diversity and technology universality

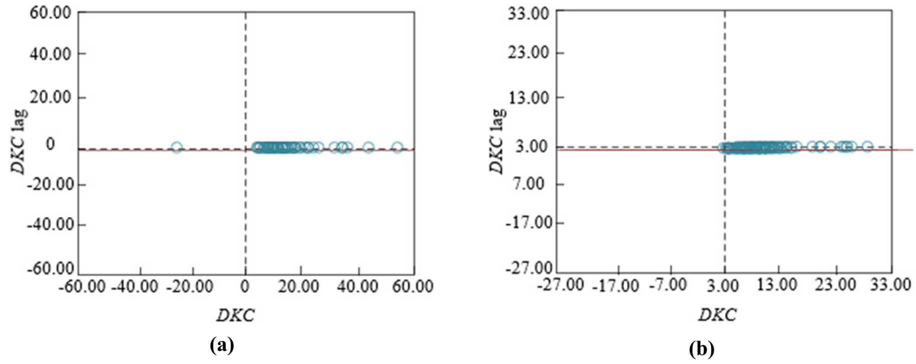

Fig. 5. Self-correlation features of discipline knowledge complexity in different time periods

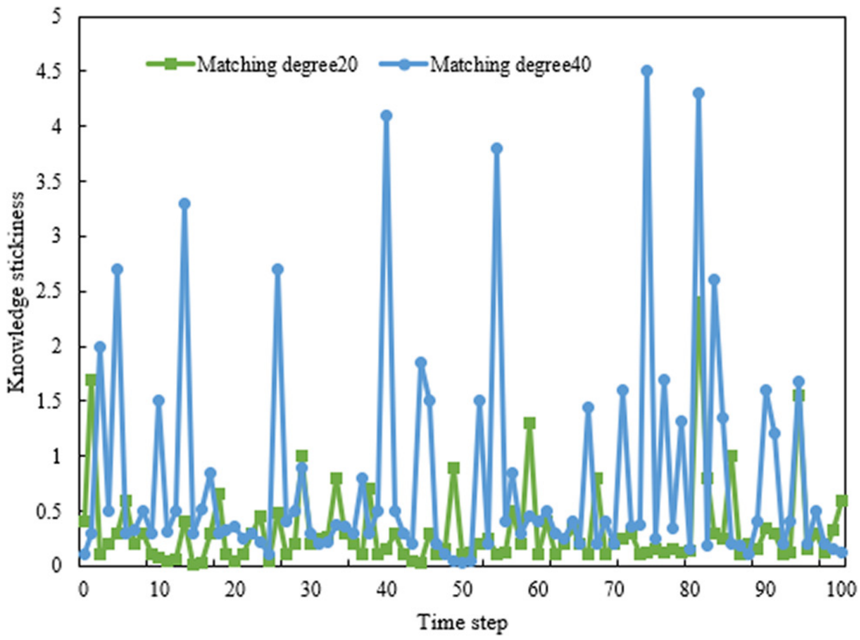

Fig. 6. Influence of time step on knowledge stickiness

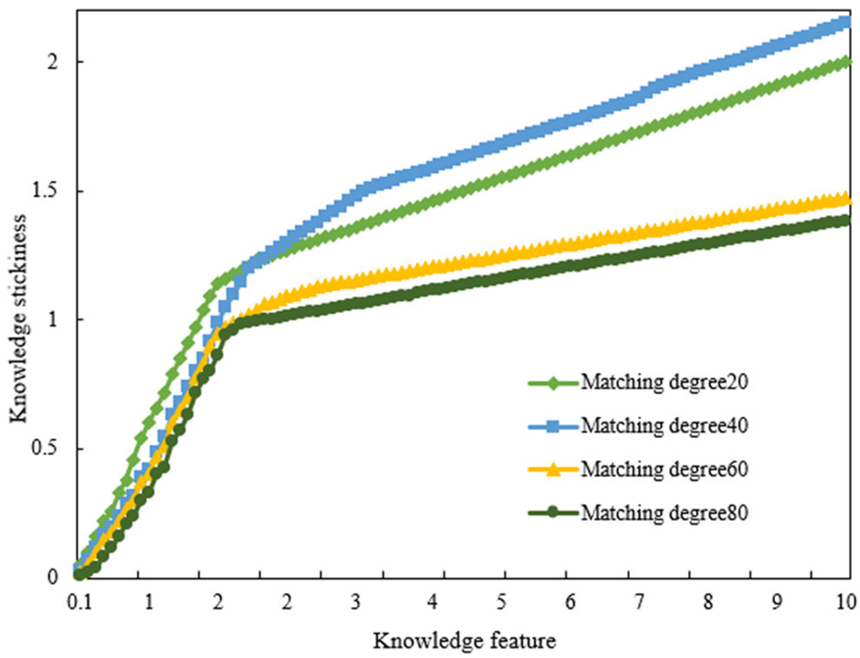

Fig. 7. Influence of knowledge complexity, fuzziness, and cognition structure on knowledge stickiness

Figure 5 shows the self-correlation features of discipline knowledge complexity in two time periods of 2016–2018 and 2018–2019. As can be seen from the figure, the global Moran's I of both time periods is close to and greater than 0, indicating there's a weak spatial self-correlation between the two within both time periods. P-value is less than 0.01, and Z-score is greater than 2, verifying that the distribution of the knowledge complexity of the interdisciplinary knowledge system shows a spatial clustering feature to a certain extent.

To figure out the influence mechanism of the knowledge stickiness of interdisciplinary knowledge system, the changes in the knowledge stickiness during knowledge transfer were analyzed by adjusting the matching degree parameter which describes the degree of knowledge transfer, and the simulation results are shown in Figures 6–7. The two figures respectively give the change trends of knowledge stickiness of two different knowledge subjects in the interdisciplinary knowledge system under the influence of time step, knowledge complexity, fuzziness, and cognition structure. As can be known from the figures, during the process of knowledge transfer, the influence of knowledge cognition structure on the knowledge stickiness of different knowledge subjects is highly consistent, and knowledge complexity, fuzziness, and cognition structure have positive influence on knowledge stickiness. For a knowledge, the higher the degree of its complexity and fuzziness, the lower the feasibility of integrating it with the knowledge of other disciplines, and the higher the stickiness. For two different knowledge subjects, the greater the gap between their cognition structures, the lower the feasibility of integrating them, and the higher the knowledge stickiness.

7 Conclusion

This paper analyzed the structural features of interdisciplinary knowledge system and built a spatial model for it. At first, key features of the interdisciplinary knowledge system were mined, and a knowledge system was built based on the coupling of knowledge and discipline. Then, the relationship between technical knowledge and discipline was discussed, and the complex spatial features of the interdisciplinary knowledge system were mined. After that, this paper built an evolutionary dynamics model for knowledge stickiness, and used it to study the main influencing factors of the knowledge stickiness of interdisciplinary knowledge system based on dynamics and figure out its action mechanisms on the performance of knowledge utilization and expansion. Combining with experiments, this paper analyzed the community division effects of different algorithms, verified the effectiveness of the GN-based community discovery method adopted in this paper in dividing the knowledge communities, and gave the coupling types of the potential and actual interdisciplinary knowledge systems, which had proved the necessity of mining the potential knowledge integration relationship between interdisciplinary knowledge systems to a certain extent. Moreover, this paper plotted a 2D graph of discipline knowledge diversity and technology universality, demonstrated that the knowledge complexity of a single disciplinary field often has more obvious clustering feature than that of multi-disciplinary field, and gave the self-correlation features of discipline knowledge complexity in two periods of 2016–2018 and 2018–2019. At last, by adjusting the matching degree parameter which describes the degree of knowledge transfer and analyzing the changes in the knowledge stickiness during knowledge transfer, the corresponding simulation results were given.

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