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A knowledge push technology based on applicable probability matching and multidimensional context driving

Key words: Product design; Knowledge push; Applicable probability matching; Multidimensional context; Personalization

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Motivation

1. Knowledge push is one of the key technologies in intelligent product design, which is the future direction of manufacturing (Xu et al., 2013).
2. A knowledge push technology usually includes matching of related knowledge and proper pushing of matching results.
3. Knowledge matching methods commonly use similarity calculation to set the filtering threshold according to experiments and manual intervention, which is insufficient.
4. Pushing of matching results is less personalized. Some advanced methods, such as design intent capture and interest acquisition, are in the early stages of research and not mature.

Main idea

1. Combining design content with the knowledge center, including the design knowledge base and design case library, the applicable probability matching method serves knowledge matching using probability theory.
2. The method of personalized knowledge push is driven by multidimensional contexts, which include design knowledge, design context, design content, and the designer. The highly demanded knowledge can be ranked first in the push queue to the designers.

Method

1. Knowledge matching is performed via the method of applicable probability matching, which is inspired by the Naive Bayes classifier.
2. The hierarchical design content models are built to filter the knowledge in push results.
3. The multidimensional contexts decide the final sorting rules for personalized push results from the four dimensions, including design knowledge, design context, design content, and the designer.

Major results

Applicable probability matching method can match the correct design knowledge and avoid manual setting of the filter threshold.

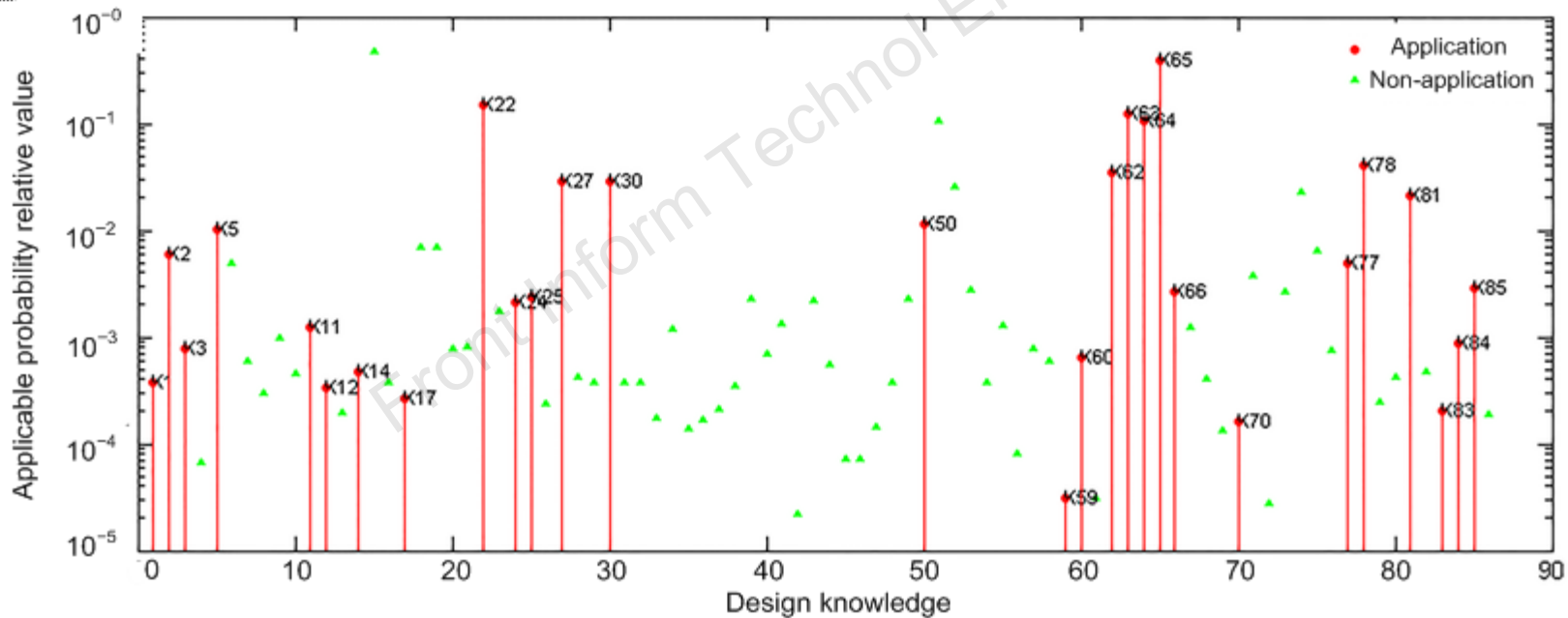


Fig. 6 Results for design knowledge matching (References to color refer to the online version of this figure)

Major results (Cont'd)

The hierarchical design content models and multidimensional context-driven sorting rules serve the personalized knowledge push for different designers.

The figure displays two screenshots of the 'National Key Major Project CNC Machine Tool Design Resource Sharing Platform' (国家科技重大专项 数控机床设计资源共享平台). Both screenshots show the 'Knowledge push' (知识推送) section, which is personalized for different users.

Left Screenshot (User ID: 11325045):

- User Info:** 11325045, Skilled, Design content.
- Table:**

No.	Title	Classification	知识推送	Designer	Last use time	Status
1	水平导轨力与	Formula	公式	/	2017.9.10 9:25	未读
2	比压计算公式	Formula	公式	/	2017.9.14 12:23	未读
3	铸铁导轨的许用比压	Chart	图表	/	2017.9.14 13:12	未读
4	自动导轨比压计算目的	Text	文档	/	2017.9.10 9:10	未读
5	导轨面比压的分布规律	Text	文档	/	2017.9.10 9:33	未读
6	高刚度导轨比压计算实例	Case	案例	11325045	2017.1.6 12:35	未读
7	高刚度导轨比压计算实例	Case	案例	11325045	2017.5.14 16:01	未读
- Keywords:** 比压计算, Sliding guide, Dovetail section, Horizontal lathe.

Right Screenshot (User ID: 11425068):

- User Info:** 11425068, General.
- Table:**

No.	Title	Classification	知识推送	Designer	Last use time	Status
1	高刚度导轨比压计算	Case	案例	11325045	/	未读
2	导轨比压计算实例	Case	案例	11325045	/	未读
3	比压计算	Formula	公式	/	2017.9.9 15:24	未读
4	水平导轨力与牵引力计算	Formula	公式	/	2017.9.9 15:40	未读
5	导轨内最大比压计算	Formula	公式	/	2017.9.9 15:40	未读
6	铸铁导轨的许用比压	Chart	图表	/	/	未读
7	导轨面比压的分布规律	Text	文档	/	2017.9.9 9:23	未读
8	自动导轨比压计算目的	Text	文档	/	2017.9.19 9:23	未读
9	导轨面比压的分布规律	Text	文档	/	2017.9.19 9:33	未读
- Keywords:** 比压计算, Sliding guide, Dovetail section, Horizontal lathe.

Annotations in the images highlight differences in the 'Knowledge push' results and 'Design content' for the two users, such as the inclusion of 'Case' and 'Formula' classifications for the same topic.

Fig. 10 Push results for two different designers

Conclusions

1. The applicable probability matching method in knowledge matching can set the filtering threshold automatically compared with traditional knowledge matching methods.
2. The hierarchical design content models overcame the difficulty that a traditional model cannot meet different designers' requirements. The multidimensional context driven sorting of push results ensures that designers can find the highly demanded knowledge as soon as possible.
3. We developed a knowledge push system based on intellectualized design of CNC machine tools and completed an illustrative example on the design of horizontal lathe guides. Experimental results showed that the push results were accurate, and that the system can provide a personalized knowledge push service.