Research on Computer-aided Automation Design of Mechanical Motion Scheme

Li Meixuan

Chifeng Industrial Vocational Technical College, 024005, China

Keywords: Computer Aided; Mechanical Motion; Automation

Abstract: The "design unit" is composed of the "functional unit" which seeks the solution of the mechanism and its subordinate functional units. By using the design element method, the simplified components of the complex motion scheme design can seek the mechanism solution for the single function element of each design unit separately. The motion state vector representation presented in this paper simplifies the design of complex motion schemes to the solution of motion function matching and constraint checking. From this, a mechanical motion scheme design pattern which can be recognized by computer is established, so that the motion scheme design can be realized. According to the matching propagation truth table, the non-zero element values of the motion behavior will continue to propagate once they appear in the matching process, and remain in the final search result encoding. The heuristic mechanism matching the propagation principle decomposes the complex motion requirements into simple ones, solving after the motion demand, thereby solving the complex motion requirements from top to bottom. It is more conducive to the realization of the computer-aided automatic solution process. Finally, the practical and feasible examples are proved.

1. Introduction

With the rapid development of science and technology, the demand for product functions is increasing, the complexity is increasing, and the speed of renewal is accelerating [1]. However, the design of products, especially the design of motion plans in the early stage of mechanical product development, seems to be unable to meet the needs of the times. This is related to the fact that computer aided mechanical motion design is still the weakest link in product design process. However, the mechanical motion scheme design basically stays in the manual stage, which largely depends on the experience of designers, and can not keep up with the needs of the times [2]. This is related to the fact that current CAD technology does not support conceptual design. Since the knowledge of institution selection is mostly uncertain, inaccurate, or even incomplete fuzzy knowledge, the information processed in the selection process is also fuzzy empirical knowledge, so the establishment of a knowledge of the organization that is both practical and necessary. Library and reasoning mechanism become the difficulty of institutional automation selection [3]. In addition, the intelligence of the search route and the matching degree of the algorithm, operability, and efficiency of the solution determine whether the final solution can achieve true computer-aided innovation, avoid combinatorial explosion, and screen optimal solutions [4-5].

At present, the design of packaging machinery in China is still in the stage of non-standardized design. Its design is mainly based on the experience of designers, and the degree of computer aid is still very low [6]. However, as the degree of globalization of manufacturing continues to increase, the most important thing is to design innovations in order to design high-performance mechanical products [7]. In 2003, some scholars studied the virtual human modeling problem from photography industry photography [8]. When the design process is staged, the task of innovation falls on the shoulders of conceptual design. The design process of motion scheme lacks the pattern that can be recognized by computer and the design method that can be described by computer program language. In view of this situation, this paper proposes a "design element method" to realize computer aided mechanical motion scheme design [9]. At the same time, the basic work of computer aided motion scheme design and the author's research results are introduced. Formal expression of design model is the basis of automatic design of mechanical motion scheme. At the

  DOI: 10.25236/icbsis.2019.007

same time, "state vector representation" is proposed to realize computer aided mechanical motion scheme design.

2. Methodology

The problem space of mechanism automatic selection system is composed of motion function requirement and function quality requirement. Owing to the fuzzy evaluation criteria of good or bad, high or low, large or small, the indicators for evaluating the functional quality of institutions are usually given. The working characteristics of different types of institutions are often different, and there are many differences in the evaluation indicators for their functional quality. Realize the formal expression of common characteristics in mechanism [10]. The constraint matrix is used to express the individual characteristics of the mechanism, and based on the motion information expressed by the two matrices, the matching of the mechanism modules and the generation of the motion scheme are realized. For complex mechanical motion scheme design, the total function to be realized by the motion scheme is usually decomposed to form a sub-function from top to bottom and the function is gradually simplified. Functional structure is used to express functional decomposition methods and integrated methods. The function functions and function meta-labels are used to Abstract the sub-functions after the total function decomposition.

If the direct match is unsuccessful, it is transferred to the split combination match. Then match the institutional metabase and the organization instance library. After searching for the organization library, there is no matching institution and then transferring to the split combination matching module. First, the matching input is the institutional element. Table 1 and list the partially matched items.

Table 1 Enter institutional elements with different attributes

Mechanism element	Input code	Output code
Gear mechanism	12	9
Sprocket mechanism	14	11

Motion transformation matrix qualitatively reflects some important motion transformation characteristics of mechanism, which are the basis of mechanism selection process. A motion transformation matrix corresponds to a group of mechanisms with the same motion characteristics. In addition, the requirements for product functional quality will not only vary with the application situation and use requirements of the product, but also the same functional quality requirements, different users will have different expressions. In this way, it is often impossible or difficult to describe functional quality requirements with accurate, standardized and computer-recognizable patterns. Therefore, in the problem space of mechanism automatic selection. However, because the amount of information that can be described by the matrix is extremely limited, and the search strategy adopts the "exhaustive method", the search process is random, which easily leads to the explosion of the program combination, and the search intelligence is not high. Then, the system performs function matching according to the conditions input by the design requirements. If the function matches successfully enters the constraint check, if it does not match, the function is decomposed. Secondly, the original functional matrix is decomposed into a series of sub-function matrices, which are then matched with the functional matrix search in the organization module database.

As shown in Figure 2, nesting of product line elements can specify components and variability elements to construct a tree structure XML model for SPL. You can also use the developed XML schema to effectively describe the variability with dependencies and dependencies between components.

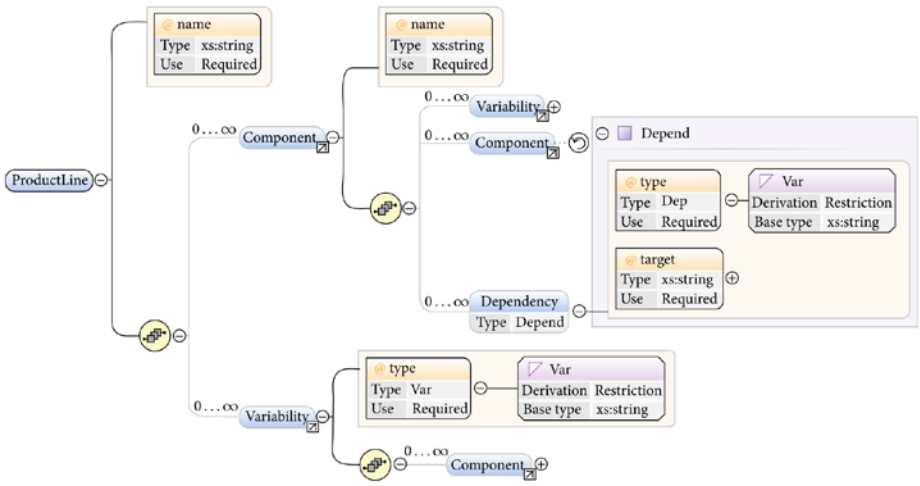

Fig.1. XML schema for software product line design

Since the lowest functional element of the functional structure is the smallest granularity functional element with a ready-made mechanism solution, the design of the mechanical motion scheme usually starts from the lowest level of the functional structure. Thus, the lowest functional element of the functional structure should be the smallest granularity functional element with a ready-made mechanism solution. The combination of each set of lower function elements is indicated by an arrow, such as a lower function element belonging to a function element. It can be seen that the mechanism selection process is based on the motion transformation matrix, and a relatively uncertain process is transformed into a logically deterministic process, which is convenient for computer implementation. On the other hand, it is the motion transformation matrix that expresses a group of mechanisms with the same motion characteristics, which accords with the idea that functions should be described abstractly, that is, a motion function can be realized by multiple mechanisms. Similar to the method used in describing functional quality requirements in problem space, human natural language is directly used to describe the attribute value of "features and applications" which is the attribute item of evaluating the functional quality of an organization in the decomposition knowledge base of an organization.

3. Result Analysis and Discussion

Because the motion continuity property (intermittent) of the output motion behavior in the design requirement requires adjusTable interval range, only ratchet mechanism can satisfy the query of the input-output motion constraint relationship property in the mechanism Table. So abandon the query results of the previous step. If the matching is unsuccessful, the sub-function matrix is decomposed until the function matching is successful. Thirdly, constraints symbolization operation is carried out on the mechanism modules corresponding to a series of sub-function matrices which are successfully matched to generate the constraints matrix of possible motion schemes. Next, constraints inspection is carried out on the possible motion schemes, which shows that there is no feasible mechanism to meet the design requirements and needs higher level mechanism innovation. The automatic description of functional elements and functional structures has a positive role in promoting and promoting the design of computer-aided mechanical motion schemes. Thus, a complete representation of each of the mechanism modules is achieved by a motion function transformation matrix, a primary constraint, and/or a secondary constraint. The first-order constraints of the rack and pinion mechanism and the crank-sliding mechanism are different.

The institutional solution knowledge base is the solution space for the organization's automated selection system. Corresponding to the problem space, the knowledge attributes in the organization solution knowledge base are divided into two types: institutional movement function and institutional function quality. Thus, from bottom to top, the solution directory of each function element is obtained layer by layer until the solution list of the total function is obtained. It is

preferable to evaluate each mechanism solution in the total functional solution catalog to obtain a mechanical motion scheme. The motion plan design is summarized into these three steps, and the design process of the mechanical motion plan is systematically and standardized to facilitate the establishment of a computer-recognizable design pattern. For mechanical motion schemes, designers all want to describe the desired behavior (design task) in detail with motion characteristics. The motion requirement is taken as the starting point of the design of the automation synthesis system, and described by the functions and constraints of the mechanism. Therefore, more than one possible solution satisfying the function is obtained, and then the possible solution is screened with constraints, and finally the feasible solution satisfying the design requirements is obtained.

In CHT, we first start an accumulator array of the same size as the edge detection image. The image is then scanned and voted at each point of the detected edge to determine the possibility of a circle in the accumulator array. Figure 2 is an ideal edge image detected from a smart detector and graph.

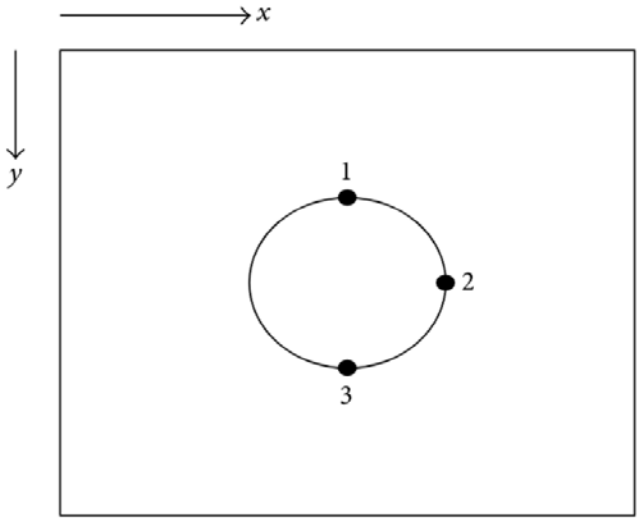

Fig.2. An image containing a circle

4. Conclusions

In this paper, the design unit method is proposed to simplify the design process of complex mechanical motion schemes into the institutional solution of the local functional elements in each design unit. This establishes a motion design pattern that can be recognized by the computer, making computer-aided mechanical motion scheme design possible. The automated description of functional elements is an important foundation for computer-aided implementation of design unit design goals. As the hardening index increases, the flattened end face of the forming ring is flatter and the end face quality is better. With the increase of hardening index, the average width and the axial metal flow decrease significantly, which is helpful to improve the radial dimension accuracy of the ring. With the increase of hardening index, the rolling force and moment required for forming increase significantly. The automatic mechanism selection process is divided into two stages: computer precise reasoning and designer evaluation and decision-making, which avoids the complicated fuzzy knowledge reasoning process, simplifies the reasoning mechanism and improves the flexibility and reliability of mechanism selection. This mechanism is similar to consulting a dynamic electronic manual of mechanism selection, which is convenient, rapid, accurate and universal.

References

[1] Matyukhin V I. Computer-Aided Integration of Motions of the Discontinuous Mechanical System [J]. Automation and Remote Control, 2003, 64(9):1401-1417.

[2] John C I P D D, Duffy M. Schemebuilder: computer aided knowledge based design of

mechatronic systems [J]. Assembly Automation, 1999, 19(2):129-138.

[3] Combined motion blur and partial volume correction for computer aided diagnosis of pulmonary nodules in PET/CT[J]. International Journal of Computer Assisted Radiology and Surgery, 2008, 3(1-2):105-113.

[4] Bardasz T, Zeid I. Cognitive model of memory for mechanical-design problems[J]. Computer Aided Design, 1992, 24(6):327-342.

[5] Glumov V M, Zemlyakov S D, Rutkovskii V Y, et al. Some Features of the Computer-aided Derivation of the Motion Equations of a Package of Mechanical Systems and Their Decomposition [J]. Automation and Remote Control, 2005, 66(5):752-764.

[6] Pennestrí Ettore, Vita L. Multibody dynamics in advanced education.[J]. Computational Methods in Applied Sciences, 2005, 2:345-370.

[7] Buss S R, Fillmore J P. Spherical Averages and Applications to Spherical Splines and Interpolation [J]. ACM Transactions on Graphics, 1970, 20(2):95-126.

[8] Wang C C L, Wang Y, Chang T K K, et al. Virtual human modeling from photographs for garment industry [J]. Computer Aided Design, 2003, 35(6):577-589.

[9] Hillyard R C, Braid I C. Analysis of dimensions and tolerances in computer-aided mechanical design [J]. Computer-Aided Design, 1978, 10(3):161-166.

[10] Huang H, Zhuang X, Shao Y, et al. Computer-aided scheme for functional index computation of left ventricle in cardiac CTA: segmentation and partitioning of left ventricle[J]. Proc Spie, 2013, 8670(4):17.