Virtual Reality Integration in Top-Down Communication Technology and Computer-Aided Industrial Design for Geometric Modeling Advancements

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Abstract. The top-down geometric modeling process of computer-aided industrial design is studied based on the general design theory. The meta-model, oriented to the design evolution process, and the sub-model, oriented to all aspects of industrial design, are used as the abstract level of the organizational geometric modeling process. Aircraft multidisciplinary design optimization (MDO) in computer simulation applications is inadequate in description ability and adaptability when design variables are controllable, combined with the modeling ideas of several current common methods. We introduce the concepts of graphic basis, curve multiplication correction, and addition correction, propose a more widely applicable parametric description method, and apply it to CAD geometric modeling; a semi-analytical hybrid parametric geometric modeling method based on CAD is derived. This method combines the advantages of CAD and analytical methods with strong description ability and simple implementation. Numerical examples of parametric modeling of airfoils and aircraft and shape optimization of warheads show that the semi-analytical hybrid parametric method based on CAD can be compatible with traditional parametric methods. Combining the design space composed of graphic bases with the traditional parameter space can effectively improve the description ability and adaptability of the parametric method.

Keywords: multidisciplinary design optimization; CAD; parametric modeling; Virtual Reality Integration
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1 INTRODUCTION

In the information age, people's life and work will prodDue to the advancement of a top-down design method for industrial product design, foreign countries have conducted some application research on top-down design for a long time and found that top-down design method shows its special advantages and unique reference design value for the design of some complex products, whether industrial products or other designs [14]. Although the term down design method has been established and applied for a long time, most of the studies are only based on some theoretical explanations and do not make a design process of practical verification for the design method. Although designers have used it, they do not provide a clear quantitative design reference [13]. Looking up the existing data at home and abroad, it is found that the design method is only a simple theoretical statement but not a feasible, practical application and verification of the design theory. In the field of daily product structure design, there are relatively few examples using the self-term downward design method at present [22]. On the other hand, the design of daily product structure based on the new design method is an innovative embodiment, and the optimization and effective design of daily products can not only improve people's living environment and life satisfaction but also optimize some of people's daily lifestyles, and at the same time, it is also an improvement of people's life concept. Successful innovative design cases of dairy products show that modern design concepts and methods must be accompanied by the pace of the times and social development to meet people's ability to adapt to changing life [3]. To explore some new values in modern product design from our daily life so as to bring new design experiences to our daily products so that the concept of daily product design can truly adapt to life, reflect life, and better serve our lives.

Industrial design needs to solve the aesthetic quality of product appearance and the man-machine performance of operating parts [7]. The geometric modeling of computer-aided industrial design needs a mechanism with controllable granularity of geometric information. The design method provided conforms to the cognitive characteristics of the design process. 1 The creative method that can give full play to the image thinking of industrial designers can meet the above requirements and conform to the solution strategy of industrial design. Conforming to the requirements of the whole process, integration of product design is an effective way to achieve computer-aided industrial design [20]. The industrial design process of products is carried out at a higher abstract level of product information. We have taken aircraft as an example. At present, the process of aircraft MDO using geometric models is CAD or analytical parametric modeling, mesh discretization, and finally, analysis by CAE or user program [25]. Conventional CAD parametric modeling methods are intuitive, simple, and adaptable, but they are mainly used for geometric dimension optimization problems. The description of complex objects requires more parameters, and parameter changes are prone to interference, so they do not have the ability to describe large deformation. Although the polynomial method spline and CST (Class Shape Transformation) methods used in analytical parametric modeling generally have good description ability, they are generally used for the description of simple geometric objects. When applied to the description of complex objects, the implementation process is complex and not intuitive, the fitting order increases rapidly, the design variables increase correspondingly, and the design performance is not significantly improved or even decreased, "Runge phenomenon" in numerical analysis theory appeared, showing poor adaptability [23]. MDO has become one of the main means of aircraft design, but its application value largely depends on the ability of geometric parametric modeling. Considering the limited geometric description ability of dimension based CAD modeling method, and the insufficient description adaptability of analytical optimization design for complex objects, the improved analytical parametric geometric modeling method proposed in this paper strives to organically combine the two, and try to introduce design experience information without losing the exploration ability for new geometric configurations, Establish a method to describe geometric objects with large shape changes with fewer design parameters, and provide support for improving the application level of MDO technology [24].

2 RELATED WORK

2.1 Bottom-Up Design Method

Before we understand the basic method of top-down design, let's explain its corresponding theory, that is, the traditional design theory of "bottom-up" design. To put it simply, whenever we are ready to design a new product, designers always start from the perspective of composing each part of the product, and then design and assemble the dimensions and constraints of these parts, so that they can complete the assembly in Creo's assembly work environment [10]. After that, the system checks. If there is an interference relationship, it needs to be modified. After the modification, the assembly is carried out. The assembly is not completed until the system prompts that there is no error, to meet the requirements of the design [11]. Through investigation and research, it is found that the bottom-up design method is also a design method that is more and more popular at present and has a simple process. It allows designers to have a good grasp of the details of each product, make timely modifications to some minor parts of the product design process, and more in line with people's design thinking at the early stage of design, so that the product can quickly and effectively express the designer's design intent, it has played a certain role in promoting the performance of daily product functions and effects [16]. In view of this, the traditional bottom-up design method is still adopted in most daily product structure design. Figure 1 is the top up design idea.

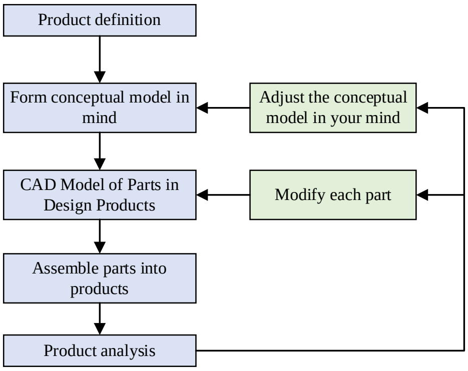


Figure 1: Top up design idea.

In the actual design of daily products, we found that whether the functions of a product can be realized is the first problem we need to consider when designing. After considering this aspect, the realization of functions requires us to design the geometric structure of the product that matches the realization of these functions. This design idea is consistent with our design process, A practical development process of design ideas [2]. Such a design idea requires us to constantly accumulate design, so that at the beginning of design, we need to learn how to fully consider these key constraints and coordination relationships between products, between products and components, between products and the use environment, and between components [6]. After that, we need to assign our design ideas and important attributes of the product to each subsystem of the product, so that during the design process, each subsystem of the designed product can cooperate well and avoid unnecessary conflict and interference during the design process [18]. In this way, in the product design process, all subsystems can interact with each other well, which is also conducive to the embodiment of concurrent design. This design process can make full use of the advantages of computer aided design, give full play to the design ideas of designers in the way possible, and at the same time, reduce some tedious and redundant work of our products in the design implementation stage to the greatest extent, ensure that the design resources of the design and construction unit are fully utilized, and the design efficiency is improved [15]. It plays an important role in reducing the design and research time of new products.

2.2 Top-Down Design Method

Compared with the white background up design method introduced earlier, the top-down design method is a new design idea against the traditional design concept [1]. The initial design idea of top-down design is more complex than that of bottom-up design. The top-up design idea is to let the designer start with the overall design of the product, first determine the overall product shape, and then refine the design product structure from the outside to the inside. At the same time, according to the function of the product, make an all-round grasp of the overall and local as well as their relationship [8]. In this way, the designer can have a good expectation and planning for the product at the initial stage. Nowadays, designers at home and abroad pay more and more attention to the product modeling system based on the top-down design method. This user oriented system based on the white top down design method allows designers to have a good grasp of the overall product from the perspective of designing the general shape characteristics of the product and some important assembly constraints between related parts. After that, In view of the previous constraints such as assembly relations, we can complete the design of each component of the product. After detailed design, we can modify each component according to the previous overall perspective [5]. The research summary of top-down design method shows that the top-down design method mainly has the following characteristics: (1) It conforms to the product design process and the thinking process of designers. When designing a product, the initial consideration is the functions that the product should realize, and the final consideration is the geometric structure to realize these functions. Therefore, the product design process is a gradual process from abstract to concrete [19]. (2) It is convenient to realize the cooperation of multiple subsystems and realize parallel design. In the initial stage of product design, namely the conceptual design stage, the main functions, key constraints, coordination relations and other important information of the product are determined. When task allocation is carried out, these key constraints are also allocated to each subsystem, so that each subsystem can cooperate well and avoid conflicts [4]. (3) Transfer the key constraints in the early stage to the subsequent design stage, so that the feasibility evaluation can be carried out in the subsequent design according to the constraint requirements of the early design [9]. Thus, design for assembly and design for manufacturing can be realized. Here we will simply explain the top-down theory. In the following, we will establish a theoretical model and make a detailed explanation of the essence of the top-down theory.

2.3 Basic Characteristics of Wireless Channel in Communication Technology

The vehicle wireless channel belongs to a kind of wireless channel, and its basic characteristics are the same as those of the wireless channel. The basic characteristics of the wireless channel are analyzed below [21]. In a wireless communication system, radio waves are transmitted from the transmitting end to the receiving end, and the airports they experience are called wireless propagation channels. The biggest feature of wireless channel is that the channel changes with time, which will cause the strength of the received signal to change, reflecting the time variability of the channel. This phenomenon is called fading [12].

As shown in Figure 2, the wireless channel fading phenomenon can be roughly divided into two categories according to different transmission distances: large-scale fading and small-scale fading. Large scale fading refers to the fading of signals when they are transmitted in the range of hundreds to thousands of meters. It is a relatively slow change, mainly caused by path loss and shadow effect [17].

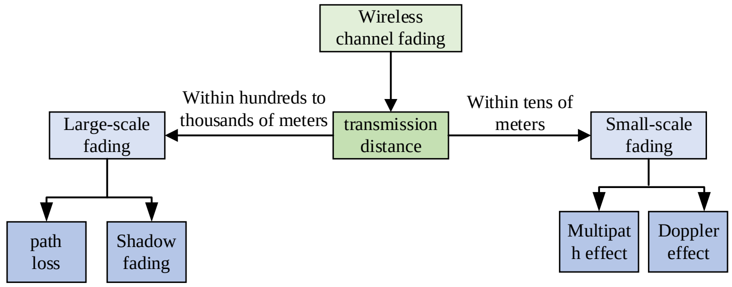


Figure 2: Wireless channel fading.

Small-scale fading refers to the fading of signals when they are transmitted within tens of meters. It is a rapid change, mainly caused by the multipath effect and the Doppler effect. Therefore, the study of vehicle wireless channels is the study of various fading. Using this information, researchers can design mobile communication systems with good performance.

2.4 Computer-Aided Industrial Design Technology

With industrial design knowledge as the core and computers as the auxiliary tool, CAID technology fully implements the concept and method of industrial design and realizes quantitative descriptions of shape, color, pleasant design, and aesthetic principles. It gives full play to the advantages of computer speed and efficiency and the creative thinking, aesthetic ability, and comprehensive analysis ability of designers so that the whole process of design includes the proposal of design plan, conceptual design, detailed design, scheme evaluation, comprehensive optimization and effect performance As well as the final production, computers are used for simulation, so as to create more practical, economical, beautiful, pleasant and innovative new products. Now, the status and role of CAID technology in modern design and manufacturing technology have been gradually recognized by people, and it has also been widely used in automobiles, machine tools, household appliances, and other fields. The research on computer-aided industrial design has been carried out abroad, and some commercial software systems have been developed to meet the basic requirements of industrial design. In China, with the gradual attention of production departments to industrial design and computer-aided technology, the research of computer-aided industrial design has also started, and some research results have been achieved. There are three types of software systems used in the industrial design of products. The first type is a general graphics and image processing system. Common software, such as CorelDraw, is mainly used for two-dimensional sketch drawing. Product design information cannot be integrated with subsequent engineering design and manufacturing processes. The second type is a general CAD system, such as UG, Pro/E, SolidWorks, AutoCAD, etc. This kind of software has very powerful functions, but it is mainly for product-oriented engineering design, which is far from meeting the needs of industrial design in terms of flexible and simple modeling methods, visualization functions, and aesthetic applications. The third type is software systems commonly used to assist industrial design, such as 3D Studio MAX and Alias Studio. These systems all have strong geometric model creation and modification functions, and users can modify the surface of the model just like plaster or soil. Compared with traditional CAD systems, these systems provide more powerful realistic graphics generation and visualization functions, enabling designers to express design ideas more accurately. These software systems have greatly improved the design quality and work efficiency of designers, but they only provide the possibility of design and do not provide the function of auxiliary modeling design. The special technology content of industrial design is not high, and the pertinence is not strong. As far as form design is concerned, these systems cannot be used to assist in the design of modeling elements with priority proportions and cannot be used for the homologation of curves. Therefore, this design software still rely on the designers' own aesthetic cultivation and expression skills, so that their application in modeling design is greatly limited. Therefore, they are not yet computer aided industrial design software. In a word, whether it is the social demand of form or the form design of industrial design, they all require the combination or integration of aesthetic factors in the form design and the application of aesthetic principles to obtain a form with higher artistic effect. Therefore, combining the form design methodology of industrial design, the research of computer aided design technology has become the need of the development of computer aided form design technology.

3 METHODOLOGY

3.1 Top-down Design for the Establishment of Product Structure Design Ideas

When designing the daily product structure, first, do not think about the design of the single part involved in the daily product, but think about its shape and the functional purpose it will achieve for the user from the elements of the field and functional attributes involved in the whole daily product. Then, with the deepening of design, the functional elements and appearance shape elements involved in the product design process are divided step by step. At the same time, the functions to be realized by daily products are divided step by step through the product design elements to achieve the final function matching until the elements to be designed are finally decomposed to the point where no further division is necessary, At this time, we will conduct a feedback survey on the usage habits involved in the daily product structure, and then we can design the appearance and function of local parts of the daily product according to the results. This kind of design process generally describes a top-down design process. The advantage of the daily products designed with this assembly-oriented design method is that it can make the daily product structure present multiple levels in the logical structure of the design, and well show the design factors and design forms. Therefore, a hierarchical model or process must be provided on the daily product assembly model designed to match the process. In the design process of daily product structure, hierarchical processing of daily product structure is a very important link for a top-down design process. It is used to realize the "parent-child" relationship between the ontology of a daily product and its parts in the product design process. In the process of our design based on the theory of top-down design, it plays a very important role in establishing the relationship between daily product function models and realizing the relationship of each level under the conditions of daily product use. In the design process, the relationship between the whole and parts, parts and parts, whole and datum plane, parts, and datum plane represented by the level is established, Therefore, the hierarchical relationship of the design system that needs to be established in the field of new product design, such as daily products, is an important basis for the application of top-down design theory to achieve the design purpose. Figure 3. Top-down design hierarchy tree:

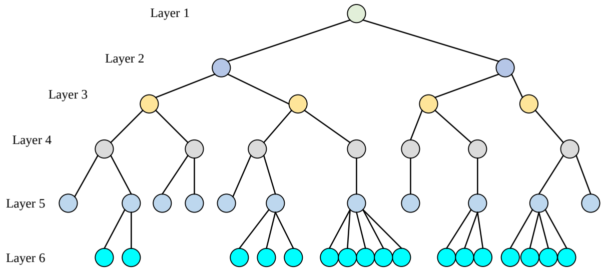


Figure 3: Tree diagram of daily product structure model.

Among them, layer 1 is the final design product, layer 2 represents the subassembly, layer 3 represents the component, layer 4 represents the part, layer 5 represents the datum plane, and layer 6 represents the assembly relationship. The connection between levels indicates the relationship between levels.

3.2 Morphological Segmentation Method of Industrial Scheme Library

Face segmentation plays an important role in the form composition design of designers. Facade layout using face segmentation design form is easy to obtain better artistic effect.

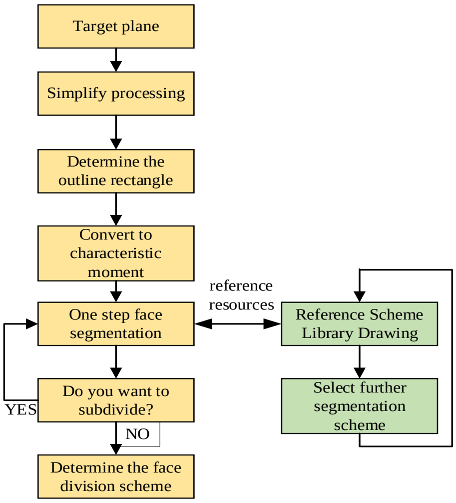


Figure 4: Face segmentation method.

The vertical division of form is shown in Figure 4. The scheme library contains many segmentation schemes of characteristic rectangular faces (as shown in Figure 5), which can prompt and guide designers to design morphological elevations. The scheme formed by each step of segmentation of the feature rectangle is included in the scheme library. Because the description of the face segmentation scheme is difficult, the scheme library does not use the mass retrieval method to match the segmentation scheme. The schemes in the evolutionary relationship library of the face segmentation scheme are organized into a tree structure.

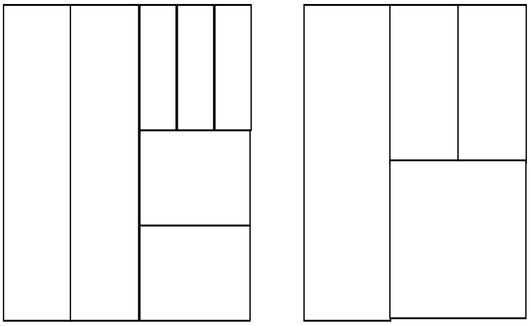


Figure 5: Division of characteristic rectangular surface.

3.3 Parametric Geometric Modeling Method

The design space of parametric geometric model is the set G of all geometric models determined by design parameters. In practice, geometric objects are not directly studied, This geometry is usually mapped to the parameter space B ∈ P ∈ R ", n is the dimension of the design variable. To strengthen the description ability and adaptability of the parametric geometric modeling method, the parameter selection principle of the parametric modeling is given below, and a method for comprehensive evaluation of the parametric description ability and adaptability is defined. The characteristics of the parametric method are discussed from the qualitative and quantitative perspectives respectively. The selection of parameters in the parametric geometric modeling is directly related to the characteristics of the design space. In general, the parameterization method should have strong description ability and adaptability, and the parameters should meet the following basic principles: (1) Significance. The variables that are directly or indirectly related to the objective function and have a significant impact on the objective function should be selected, and the secondary variables should be omitted. (2) Independence. The independence of design variables shall be ensured as far as possible. The non-independence of design variables means that the dimension of design variables is increased, and the calculation amount is greatly increased. (3) Intuitive. Dimensionless quantities with practical physical and geometric significance shall be selected as design variables as far as possible. In general, after the topological configuration (layout) of geometric objects is determined (geometric objects with variable topological configurations are not considered in this paper), the design shape can be determined by a set of characteristic curves Y (x), so the design performance is the monomorphism of this set of curves, that is, J: Y (X) --. J, which is a function about y (X). The corresponding mathematical model of optimal design is min J [y (x)] (1). In the formula, Y (x)= [y, (x), Y: (x)..., y. (x)] T. In engineering applications, functional J [Y (X)] cannot be described analytically, so it is difficult to directly solve functional problems. For example, in the design of aircraft aerodynamics, J is the functional from aircraft geometry to aerodynamic performance. At present, in engineering applications, it is generally transformed into a parameter optimization problem for approximate solutions, thus mapping the problem of functional space to vector space. This is achieved by using the method of function approximation, as shown in formula (1):

$$y_i(x) = f_i(x;\beta_i) = \sum_{j=1}^{nj} f_{\text{ij}}\,(x)\beta_{\text{ij}} \tag{1}$$

The original functional problem is converted into a parameter optimization problem, as shown in Formula (2):

$$\begin{cases} \text{find } \beta \\ min\, J\,[y(x;\beta)] \end{cases} \tag{2}$$

In order to evaluate the description ability and adaptability of different parameterization methods, we can compare the optimized design performance index J+, select the performance index slice (slice>0) of parameter space optimization composed of a certain base as a reference, and assume that the optimization performance index of a group of parameters B is J: (Ji *>0), then we can define the corresponding "relative fitness optimization, as shown in Formula (3):

$$\sigma(\mathrm{J}_\mathrm{i}^*;\mathrm{J}_0^*) = \frac{\mathrm{J}_0^*}{\mathrm{J}_\mathrm{i}^*}\begin{cases} > 1, & \text{Performance improvement} \\ = 1, & \text{Performance retention} \\ < 1, & \text{Performance degradation} \end{cases} \tag{3}$$

The existing analytical parameterization methods are various and have different application ranges. To enhance their description ability and adaptability, this section first presents common parameterization methods, analyzes their characteristics, and then summarizes the general improved forms of analytical parameterization methods. Hicks Henna Bump parameterization method is an airfoil parameterization method proposed in the 1970s. Its basic idea is to superimpose a perturbation function (called type function) on the initial airfoil curvature function, which is obtained by linear combination of basic functions. The bending equation of the wing can be expressed as, as shown in equation (4):

$$\begin{cases} y_l(x) = y_{0l}(x) + \sum_{i=1}^{6} f_i\,(x)\beta_i \\ y_u(x) = y_{\mathrm{ou}}(x) + \sum_{i=1}^{6} f_i\,(x)\beta_{i+6} \end{cases} \tag{4}$$

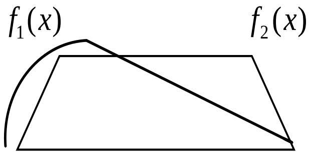
Where $f_i(x)$ is the basis function, as shown in Formula (5)

$$f_i(x) = \begin{cases} 9.3x^{0.5}(1-x)e^{-15x}, i = 1 \\ \sin^3\left(\pi x^{\ln\,0.5/\ln\,(0.125i)}\right), i = 2,3,L,6 \end{cases} \tag{5}$$

4 EXPERIMENTS

4.1 Example of Airfoil Curve Parameterization

The initial reference curve and correction curve are selected as shown in Figure 6, where f1 (x) and f2 (x) represent the upper half of the two airfoils respectively.



$$y_0(x) = 0$$
$$A(x) = 0$$
$$B(x) = \sum_{i=1}^{2} \beta_i f_i(x)$$
$$y(x) = \sum_{i=1}^{2} \beta_i f_i(x)$$

Figure 6: Supersonic and subsonic airfoil pattern.

For the given two graphic bases, the curves generated by two parameter controls can be converted between two different shapes to convert subsonic airfoils to supersonic airfoils, which is impossible to achieve with a single Bernstein basis or polynomial basis. At the same time, this can convert discrete variables describing different shapes into continuous variables, so that the gradient optimization algorithm can be effectively applied. And these graphics can be parameterized or manually adjusted intuitively in CAD software, which is more targeted and flexible, which shows that the method has strong description ability and adaptability. See Figure 7.

4.2 Example of Aircraft Parameterization

In this example, for aircraft with fixed topology (layout), feature curves are extracted, modified and feature parameters are obtained. It is verified that the semi analytical method based on CAD can meet the requirements of large deformation geometry deformation and has strong description ability and adaptability. As shown in Figure 8-10, the general aircraft geometric layout is divided into three parts: fuselage, wing, and tail. Each part is modeled from line to surface. For the feature contour, analytical correction method is adopted, and parameters are extracted.

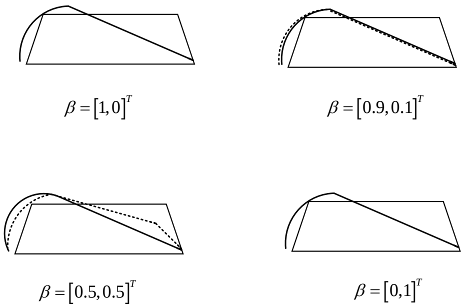


Figure 7: Reference curve and correction curve.

For the fuselage profile, to obtain an explicit curve, a large radius arc curve is used instead of a horizontal line segment. The airfoil is divided into upper and lower parts, which are expressed by analytical method respectively.

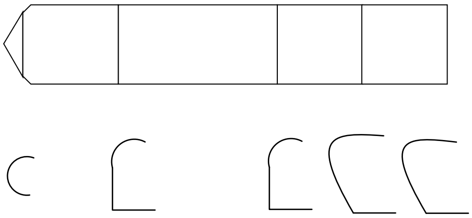


Figure 8: Fuselage outline and section shape.

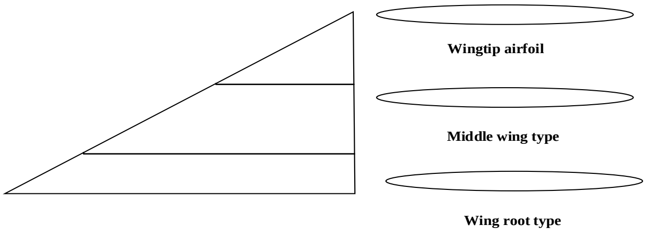


Figure 9: Wing plane and section shape.

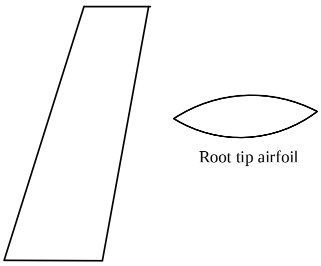


Figure 10: Tail plane and section shape.

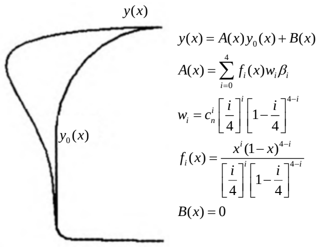


Figure 11: Correction of non-analytical profile curve by normalized bernstein basis.

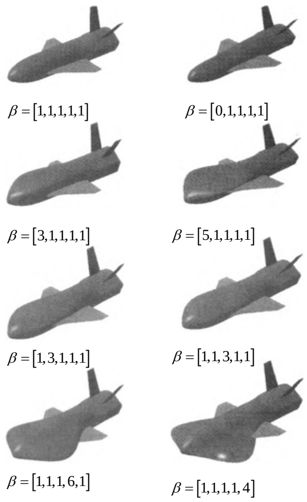


Figure 12: Semi-analytical parametric aircraft geometric model.

When the aircraft layout above is determined, it is only necessary to parameterize the characteristic contour lines of interest and select reasonable parameters to obtain rich design space. As shown in Figure 11, parameterize the profile characteristic curve of section 2. The basis function selected here is like the Bernstein basis. It is normalized by weighting to make the range of parameter changes consistent, and the geometric meaning represented is clearer. For example, the first component of the design variable is changed from 1 to 3, indicating that the correction ability of fo(x) is enhanced; that is, the upper part of the curve is raised. The overall number obtained. The model effect is shown in Figure 12. It can be seen from the comparison of various parameterized figures in Figure 12 that the extracted parameters are not changed much, and the shape of the aircraft can achieve significant changes, while the traditional CAD dimension parameterization only parameterizes the length and angle of the aircraft, and the shape change is not significant. It is not difficult to see that the combination of different characteristic curves can achieve changes in a larger design space, but the range of parameter changes needs to be limited according to the actual object to reduce the possibility of parameter interference. Here, the flexibility of parameter selection and base selection itself determines the diversity of design space, and meets the basic requirements of significance, independence, and intuition of parametric modeling.

4.3 Example of Optimization Calculation for the Head Bus of a Spinning Missile

In this case, the comprehensive performance of the description ability and adaptability of the selected parameterization method is evaluated quantitatively by optimizing the shape of the generatrix of the spinning body warhead. The shape design of spinning body warhead mainly considers aerodynamic resistance, heat flow constraint, electromagnetic constraint, volume, and technology. The commonly used warhead shapes are cone, arc, parabola, wavelet resistance, exponential and von Karman curve. If only aerodynamics and volume are considered, the basic unconstrained functional optimization mathematical model of the warhead is, as shown in equation (6):

$$min\,J = [C_d(y(x)), -V(y(x))]^T \tag{6}$$

The optimization problem solving process is shown in Figure 13. Parametric geometric model and mesh model are generated by CATS script script in CATIA.

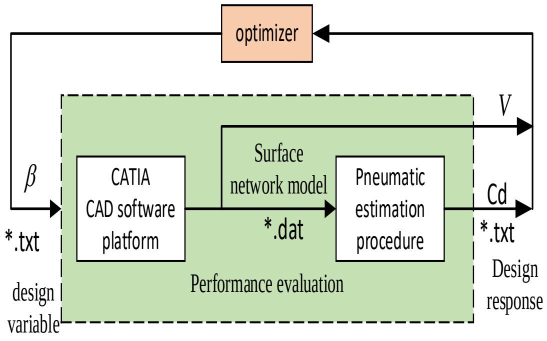


Figure 13: Optimization flow block diagram.

If you select the graphic space composed of 4 power exponential graphic bases as the design space. In the traditional design, the exponential warhead is selected as Y (x)=XN, and the optimization results are shown in Table 1 and Table 2.

Design status		*Design parameters*	
		Design variable β	*Design response J*
Initial design		$[0.5,0.5,0.5,0.6]^T$	$[0.112,-5816.1]^T$
optimal design	$min\,C_d$	$[0.03,0.78,0.89,0.86]^T$	$[0.090,-5094.9]^T$
	$max\,V$	$[0.76,0.81,0.21,0.01]^T$	$[0.172,-6929.2]^T$
	$max\,\frac{V}{C_d}$	$[0.03,0.83,0.92,0.09]^T$	$[0.094,5543.6]^T$

	$\min C_d$ $\max V$	*Pareto leading edge as shown in Figure 15*

Table 1: Optimization results of graphic basic parameters.

Design status		*Design parameters*	
		Design variable N	*Design response J*
Initial design		*0.5012*	$[0.121, -5926.4]^T$
optimal design	$\min C_d$	*0.1522*	$[0.100, -5514.4]^T$
	$\max V$	*1.0002*	$[0.184, -6810.3]^T$
	$\max \frac{V}{C_d}$	*0.1013*	$[0.102,5615.2]^T$
	$\min C_d$ $\max V$	*Pareto leading edge as shown in Figure 16*	

Table 2: Optimization results of exponential warhead.

According to the concept of relative fitness, taking traditional exponential warheads as reference, the relative fitness based on graphical basis function method is shown in Table 3, Figure 14 and Figure 15.

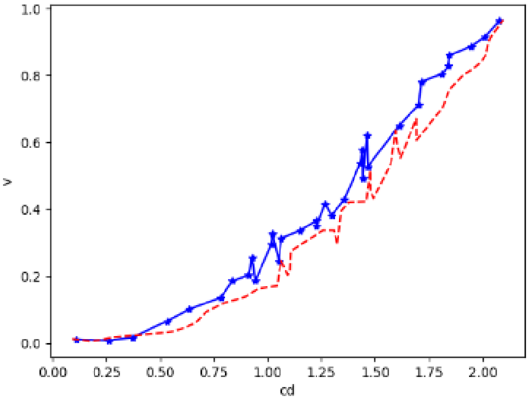


Figure 14: Graphical base optimization for pareto leading edge.

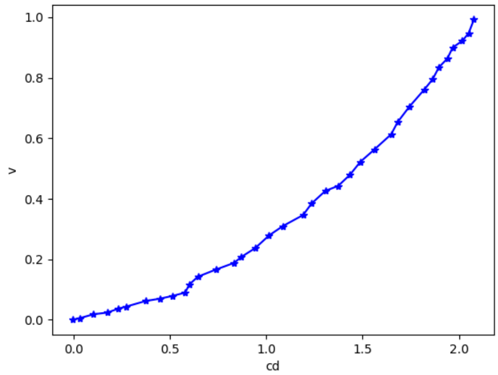


Figure 15: Exponential warhead optimized pareto leading edge.

Optimize performance indicators	*Relative fitness* σ
$max\ V$	$\frac{6929.2}{6810.3} = 1.0175$
$\min C_d$	$\frac{0.100}{0.090} = 1.11$
$\max \frac{V}{C_d}$	$\frac{5543.5/0.094}{5615.2/0.102} = 1.07$

Table 3: Relative fitness under different performance.

To sum up, the graphic basis function method has improved the single target performance and comprehensive performance of V and Cd, indicating that the correction curve graphic basis selected here has improved the description ability and adaptability of warhead geometric objects.

5 CONCLUSION

This paper makes a theoretical exploration of the top-down design method, hoping to have a theoretical design guidance for the structural design of daily products with the help of the top-down design method, aiming to improve some design problems in our industrial design under the background of social innovation. We summarize and geometry the communication scenarios in industrial design. The parametric geometric modeling method in computer simulation is studied. The introduced parameter selection and parametric evaluation index can quantitatively and qualitatively evaluate the ability and adaptability of the parametric method. With the modeling ability of CAD, the two-dimensional and three-dimensional parameterization problems are unified into the parameterization of two-dimensional characteristic curves, and analytical correction terms are introduced to expand them. It can parameterize complex objects, effectively expand the design space, increase the description ability and adaptability of parameterization methods, and overcome the limitations of fixed form parameterization methods to a certain extent. Virtual Reality with top-down communication technology and computer-aided industrial design holds tremendous promise for advancing geometric modeling in the field of industrial design. This innovative approach leverages the immersive capabilities of VR, streamlines communication through top-down platforms, and enhances precision and efficiency in computer-aided design tools. The synergistic integration of these technologies not only transforms the way designers conceptualize and iterate on geometric models but also fosters a collaborative and coherent environment within design teams.

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