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Comparison and Prospect Analysis of 3D Modelling Software based on Interactive Experience

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Abstract:

With the continuous advancement of 3D design technology, 3D modelling software plays an increasingly important role in several industries. The aim of this paper is to explore the strengths and limitations of five representative 3D modelling software Character Creator series, Gravity Sketch, ZBrush, Style3D Atelier and Maya by comparing and analysing their strengths and limitations in terms of interactive experience. Each of these software has its own strengths in the areas of character design, concept design, highly detailed sculpting, costume design and polygon modelling. This paper first introduces the basic functions and core technologies of each software, and then classifies and analyses them in comparison according to their user experience, technical requirements, application scenarios and detailed performance. Through this analysis, this paper aims to provide beginners with a clear guide to software selection, as well as providing software developers with a reference for future development directions. Finally, the article summarises the characteristics of various types of software and looks forward to the future development trend of 3D modelling software.

Keywords:3D_Modeling; modeling tool;process of modeling; software selection

1. Introduction

With the rapid development of 3D design technology, modern modelling software is not only limited to the animation and film industry, but also widely used in game design, fashion design, industrial manufacturing, architectural visualisation and many other fields. These tools provide an efficient workflow and powerful features to help designers and artists realise their creativity.

Nowadays, most of the mature 3D modelling processes require the collaboration of two or more software programs in order to complete a good enough finished model [1]. Even for hand-me-down statue models with high requirements on sculpting, although the sculpting can be done by ZBrush, if the material and texture need to be further optimised in order to render the expected image of the entity or to make

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surface prints, it is necessary to make use of the traditional software (e.g., substance designer) which is more mature in terms of uv and texture functions. Although most of the new software released in the past 2-3 years comes with the linkage design of transferring files with multiple modelling software with one click, which represents that the common software in the modelling industry each has its own focus on different aspects of expertise, but it also brings relative shortcomings. For example, due to the collaborative working characteristics of multiple software, it is difficult to understand the role of each software in the process at the introductory stage, in addition to the learning cost brought about by the different operating logics of multiple software, which is a huge obstacle for beginners to learn.

This paper will combine the experience of research, example interpretation, through the comparison of polygonal methods, brush class methods, high preset methods of the three major categories of modelling methods, from focusing on the strengths and weaknesses, the analysis of efficiency, in-depth analysis and comparison of the core features of each system, technical advantages, functionality, comparison and user experience, to provide beginners with a clearer idea of the choice of software, so that the user better understand their own needs for the model; and also hope that the At the same time, we also hope to inspire potential software developers to continue to refine a specialised type of software and develop more comprehensive software to provide references to the experience of existing software in two major directions.

2. Overview of Representative Software

The Character Creator series, developed by Reallusion, has been iteratively updated since its release in 2015, gradually expanding its reach in the character design field. Character Creator 4 is currently the latest version, integrating more intelligent and automated features.

Regarding its technical details and user experience, the core technology of the Character Creator series is based on a modular character system that allows users to quickly create high-precision characters with adjustable parameters, which is demonstrated by the convenience of an integrated system for creating character appearances similar to the preset ones found in major RPGs. In addition, its implied technical points also include human anatomy simulation and parametric design, the user can choose from a large number of presets and freely adjust the details of the character's appearance, body proportions and other details, and to maintain a high degree of realism of the human musculoskeletal arrangement. This highly formulaic and customisable design makes it particularly suitable for projects that require a large number of characters. For example, in game development, the Character Creator series is widely used to generate a large number of NPC characters. Compared to other modelling software, Character Creator has a more user-friendly interface and low learning costs, so even users without complex modelling experience can easily get started. However, due to the way it has been developed so far is based on the initial version to expand the functions over time, so far the latest version CC4 has many important functions and operations integrated in a separate window, the interface is not the best among modelling software in terms of simplicity and beauty. As shown in the figure 1, the left and right windows are burdened with a lot of important functions, such as the content panel (left), which is for the character's body, face, hairstyle, skin, pose (Figure 2), and other elements, and the Modify panel, which is for fine manipulation of the bones to modify the pose and expression.

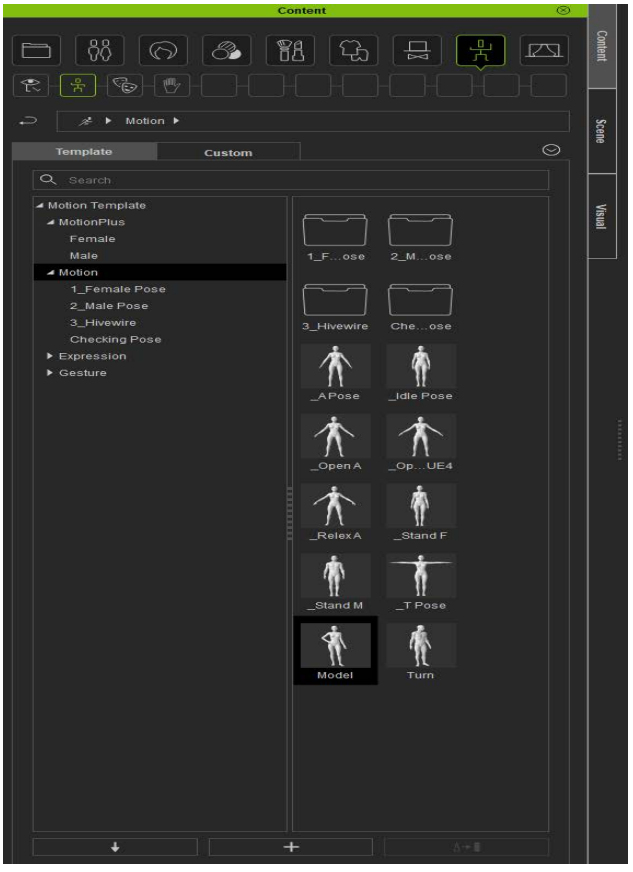

Fig. 1 Content panel (Photo/Picture credit : Original)

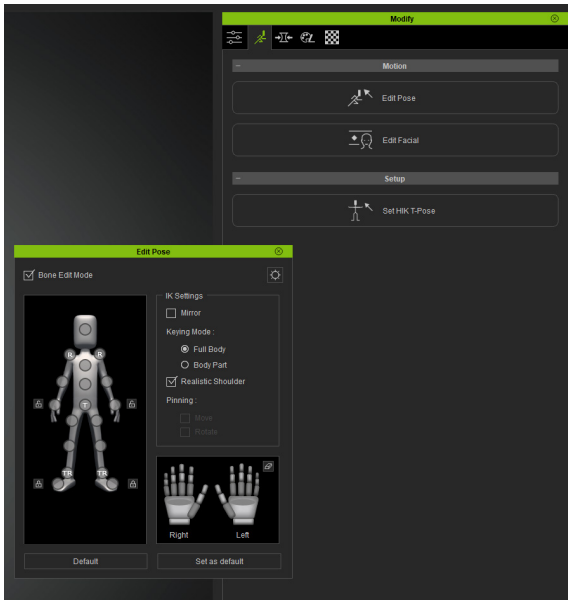

Fig. 2 Edit pose (Photo/Picture credit : Original)

The official plug-in features are so independent of the software itself that it can almost be considered as a separate piece of software. On the Reallusion website, plug-ins account for a significant proportion of the total price of the software-in-a-box package [1].

Such as Headshot is a plugin designed by Reallusion to follow the general direction of AI technology, built-in ai technology to achieve automated facial adjustment function, which is able to generate highly reproducible 3D portraits based on real photos. This function can be achieved with a high degree of completion also relies on the highly modular design of its software ontology [2].

In addition, as a relatively young software, its display of more than ten interoperability supporting software on the official website, such as ZBrush, Unreal Engine and iClone, etc., seamlessly transferring to each other [2], reflects the focus on compatibility with other software. This makes it easier to integrate into the existing multi-software collaborative modelling industrial system and be included in the choice of modelling practitioners.

Similar to the CC series of software is Style3D Atelier [3], whose software focus is not on giving the user the ability to freely manipulate model points, lines, and topology to modify the model from the ground up, but rather on enabling the user to complete the design in an extremely efficient manner based on a number of mature, high-level prefabricated content. S3D was born out of apparel design and was first launched in 2020, making it the 3D virtual. The leading tool for apparel design. It has the potential to compete head-to-head with similar mature software Marvelous designer by virtue of its high degree of simulation of the real clothing patternmaking process, simpler operation difficulty, and more accurate calculations in the face of a large number of folds. In terms of technical details, Style3D uses a physics engine to simulate the real behaviour of fabrics [3], allowing users to select different types of fabrics during the design process and observe their dynamic effects in a 3D environment. In addition, the software also supports fine garment craftsmanship design, such as stitching, seam lines, pleats, and other details to meet the detail requirements of any finished model.

In addition to the aforementioned systems that simplify modelling with presets and arithmetic, brush-based modelling has attracted many potential creators in recent years due to the low threshold brought about by excellent intuitive manipulation. For example, Gravity Sketch, a modelling software that combines VR and brushes, has changed the traditional in-plane 3D design, enabling designers to design in 3D in virtual environments with a variety of free perspectives [4]. The addition of brushes further accelerates its speed in drawing 3D drafts.

Out of design thinking trade-offs, although GS has the advantage of being intuitive and fast, for reasons of VR equipment errors and 3D space drawing, the accuracy is still not enough to meet the standards of most software, and can only realise the draft nature of the model to build a large shape. In contrast, Zbrush, which is an in-plane modeller but has a mature and accurate brush system, can independently undertake most projects from draft to finished product. Since its first release in 1999, ZBrush was originally a software for stereoscopic painting, with an underlying design that is more different from mainstream graphical 3D modelling software such as Maya, blender, and MAX [5]. This crossover characteristic gives it the ability to support ultra-high face count sculpting, eliminating the need for users to strictly follow the polygonal topology process of traditional modelling software [5]. It also greatly reduces the dependence of the number of faces on GPU arithmetic, creating a completely revolutionary way of modelling. These features allow artists who are not well versed in traditional modelling software to get started at a low technical and financial threshold, and to create complex model details as freely as they would sculpt a sculpture using a variety of tools in the real world.

The above software that simplifies the modelling process reduces the technical barrier to entry, but ultimately has its own limitations. In specific industries, traditional modelling software such as Maya and 3Ds MAX are still irreplaceable.

Developed by Alias|Wavefront, Maya has quickly become a standard tool in the film, animation, and game industries since its introduction in 1998. With the acquisition of Autodesk, Maya has gradually integrated more plug-ins

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and enhancements [6] to become a versatile and comprehensive 3D design tool.Maya is extremely flexible and extensible in 3D modelling, animation, and rendering [7]. Maya's built-in Arnold renderer delivers high-quality ray-traced rendering to support cinematic-quality visual effects. .

3. Analysing Characteristics based on Focus on Classifications

3.1 Type I: Artistic Modelling with Brush Specialisation

In terms of similarities, both ZBrush and Gravity Sketch demonstrate a high degree of freedom and flexibility, helping designers to create models free from the limitations of traditional modelling software, giving more room for creativity and expression. Both emphasise the core function of brush manipulation, allowing users to handle models as intuitively as if they were operating sculpting tools in the physical world [8]. ZBrush's brush system is extremely rich, offering a large number of preset brushes and customisation options that allow users to adjust brush form, strength, stroke detail, etc., as required, thus enabling them to switch freely from rough sculpting to fine sculpting. Gravity Sketch, on the other hand, takes advantage of the unique benefits of VR devices, allowing users to use gesture-controlled brushes to dynamically modify models in a virtual 3D space. Its handle-based linear pressure-sensing technology simulates the feel of real-life sculpting, allowing the thickness of the brush strokes to change with the gesture, further enhancing the smoothness and naturalness of the creation.

In addition, both of them aim to "remove topological restrictions", so that designers can focus on artistic expression in the creative process, without having to pay too much attention to the technical details of traditional polygon modelling.ZBrush dynamically updates the topology of the model through its unique Dynamesh function, ensuring that users are not limited by the number of surfaces and topology when sculpting complex details. ZBrush's unique Dynamesh feature dynamically updates the topology of the model, ensuring that users can sculpt complex details without being limited by the number of faces or topology, truly realising the creative experience of "sculpting at will". Gravity Sketch, on the other hand, fundamentally changes the way designers interact with models through an immersive VR environment [4], allowing users to directly manipulate the model from any angle. Although Dynamesh does not automatically reconfigure the topology to fit the current shape of the structure, it also dramatically improves the sense of design space and creative freedom.

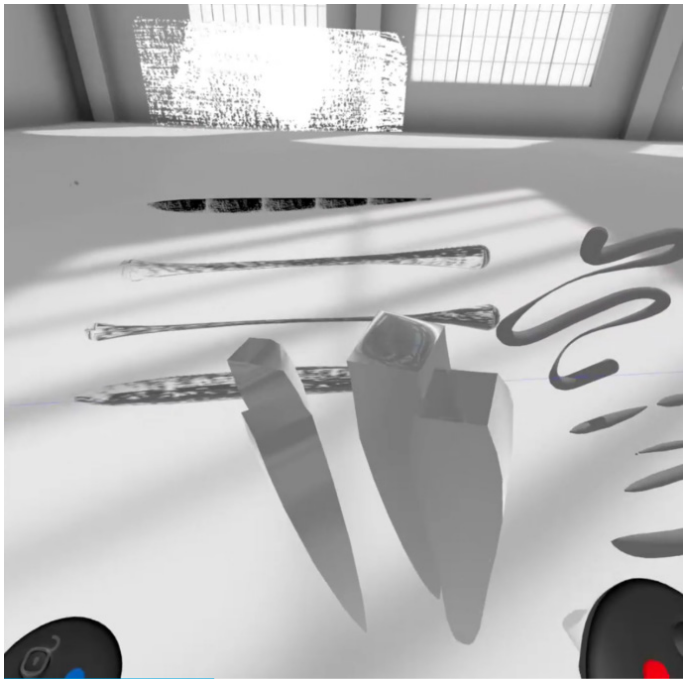

Fig.3 Gravity Sketch interfaces [4]

However, there are significant differences between the two in terms of technical implementation and application scenarios. the core technology of ZBrush is its multi-level subdivision mesh editing and Dynamesh feature [5],

which allows the user to update the topology in real time during the sculpting process and handle millions of polygons, making it suitable for sculpting work that requires a high level of detail. zbrush is mainly used in the sculpting of film and television characters, monster designs and toy figurines. ZBrush is mainly used in film and television characters, monster design, and toys, and has an unrivalled advantage in handling complex detail sculpting and texture drawing.Gravity Sketch, although intuitive and efficient in VR space (Figure 3), is less accurate due to hardware limitations of VR devices, and is mainly used in the early stages of conceptual design for quick sketches and preliminary models [4].

In terms of operating experience, the interface and operation of ZBrush is more complex, especially for users who are unfamiliar with traditional polygon modelling, although it is easier to start than traditional graphics-centred software such as maya and 3dmax, there is also a certain degree of learning difficulty. In contrast, Gravity Sketch's gesture control and immersive VR operation simplifies the modelling process, allowing designers to quickly realise creative ideas through intuitive joystick operation, especially during collaborative design, where remote teams can participate in design discussions at the same time, further enhancing efficiency.

3.2 Type II: Traditional Polygon Modelling

3DsMax and Maya are two iconic tools for polygon modelling, both of which are products of Autodesk [7]. There are many similarities in their basic polygon modelling workflows, which are generally reflected in the underlying logic of polygon mesh-based computer graphics [7], which relies on the manipulation of vertices, edges, and faces to create complex 3D forms. Whether creating basic geometry or dealing with advanced modelling needs, they both offer well-developed tool sets that support everything from rough shape construction to fine detail adjustment. Users of both software can freely edit their models through common modelling operations such as extrusion, stretching, cutting, chamfering, etc., and complete the creation of simple models to complex scenes.

Secondly, as shown above, both 3DsMax and Maya support powerful UV map unfolding and texturing capabilities [8], enabling users to accurately apply and adjust texture maps after completing the model build to ensure that the model renders or animates with photorealistic visual effects, seamlessly integrating the modelling and texturing processes within a single piece of software (Figure 4).

Fig. 4 Maya Rendering Interface [8]

From the point of view of user interface and operating habits, 3DMax's interface is more modular and customisable, allowing the user to adjust the layout to suit different project needs, similar to ZBrush's customisability, but without going into too much detail. Maya, on the other hand, employs a command-based operating system [9], whose learning process is consistently maintained at a high level of difficulty, but the powerful scripting language MEL (Maya Embedded Language) and Python integration features give Maya a significant advantage in automation and batch processing capabilities in large-scale productions. Although the logic of customisation is

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different, thanks to the traditional graphical underpinnings and the learning costs incurred by the user, both ways of customisation will bring equally significant efficiency gains.

Finally, in terms of ecosystem and plug-in support, 3Ds-Max has long accumulated a rich library of plug-ins in the architectural visualisation industry, such as rendering plug-ins for V-Ray, Corona, etc.[10], which makes it highly representative of the expressive power of light and shadow effects. Maya, on the other hand, has attracted a large number of third-party developers for its open architecture and wide range of industry applications to provide a wealth of extension tools, such as the Arnold renderer and the XGen hair system [9], which greatly enhances Maya's expressive power in film and television animation and special effects production. Both as a representative software modelling has a very long history, although the ecological form, functional orientation is different, but have a very mature aftermarket!

3.3 Type III: Minimalist Modelling With a High Degree of Pre-Programming

Style3D and Character Creator have different application areas and focuses, with S3D born from the need for virtual clothing design and CC for industrial production of character models. However, they serve similar functions by simplifying the complex modelling process and helping to create high-quality 3D models quickly. The similarity between the two is that both rely on a large number of presets and automation features, which greatly reduce the time and technical threshold of manual modelling. character Creator focuses on character creation, providing a wealth of preset character templates and automated facial and body adjustments, allowing the user to generate full-fledged character models with simple parameter adjustments. Similarly, Style3D simplifies the traditional modelling process in the field of clothing modelling by helping designers to quickly create clothing models with realistic wrinkle effects through preset clothing structure and fabric simulation. Both allow designers to focus on artistic expression and detail adjustment without the need for in-depth mastery of traditional polygon modelling techniques.

Since the features of the Character Creator series of software were introduced in detail in the overview phase using CC3 as an example, the focus of this comparative analysis chapter will be on the introduction of S3D in conjunction with the comparison of CC.

In terms of functional focus, Style3D's strengths are centred on its efficient fabric solving and physical simulation. It is able to simulate real clothing effects such as wrinkles, sagging, elasticity, etc. through the accurate fabric physics engine, which is especially suitable for scenes requiring dynamic display or animation [3].This feature of Style3D has a wide prospect in the field of apparel design and virtual fitting. Character Creator, on the other hand, focuses more on the generation and customisation of the character itself. It not only supports the detailed adjustment of the character's appearance, but also provides a wealth of options for the character's equipment and clothing, which facilitates the rapid generation of complete characters for games, animation, and virtual reality (Figure 5).

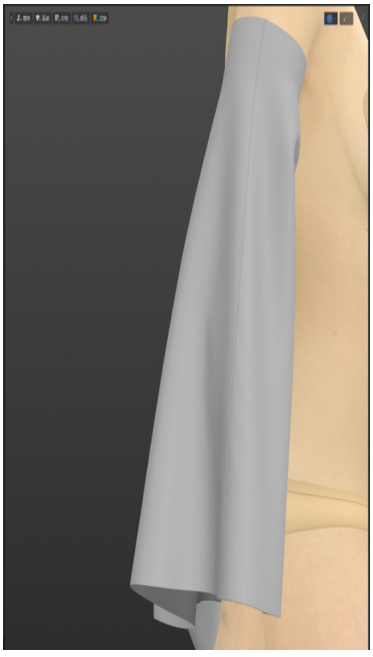

Fig. 5 The character's clothing [3]

In terms of application, Style3D's excellent real-time computing performance can achieve real-time fabric solving and dynamic wrinkle effects in animation, and producing animations such as virtual fashion runway shows and fitting simulations are also widely used directions [3]. Character Creator, on the other hand, is mainly used in game and film production, and can be seamlessly integrated into other 3D software and animation engines to quickly create animated characters with facial expressions and bone weights.

4. Type Comparison

In terms of freedom and sculpting details, ZBrush and Gravity Sketch are even better in terms of intuition and freedom of modelling. Style3D and Character Creator have unique advantages in costume design and character generation, especially in virtual costumes, rapid character generation and dynamic simulation. Traditional polygon modelling software requires users to have a higher level

of technical foundation, especially the understanding of topology and geometry, and its complex workflow also increases the difficulty of operation (Table 1).

Table 1 Different types comparison

Form	Hardware	Degree of freedom and sculptural details	Application Scenarios	Technical requirements	Detailed Representation
I: Significant advantages in terms of brush engraving capabilities	ZBrush	Extremely high degree of freedom, support for complex detail sculpting, multi-level subdivision grids and Dynamesh	Suitable for film and TV characters, monster designs and toys.	Some sculpting skills required, low polygon modelling required	Handles millions of polygons for high-precision detail engraving
	GravitySketch	High freedom of creation through VR manipulation for rapid conceptual design	Automotive design, industrial design, product prototyping, early concept design	Simple operation, VR joystick control, low technical threshold	Relatively low accuracy, suitable for preliminary model building and sketching
II: Traditional polygon modelling software	Maya	Traditional polygon modelling with flexible geometry editing	Film and television animation, complex scene design, character animation	High, requiring polygon modelling fundamentals and knowledge of animation processes	Lower precision in terms of ornamental details, with the advantage of: numerical precision, e.g. industrialisation; wiring precision, e.g. games, film and TV models.
	3DMAX	Focus on hard surface modelling to support efficient architectural and industrial design	Architectural Visualisation, Industrial Design, Game Art	Medium, simplified process compared to Maya	
III: Minimalist modelling with a high degree of pre-programming	Character Creator	Rapid generation of character models through predefined adjustments	Character creation in games and animations	Low, pre-defined template operations, automated role generation	Higher precision, utilising excellent presets, pipelined and efficient character creation
	Style3D	Efficient fabric simulation and automatic crease generation	Virtual Fashion Design, Fitting Simulation, Fashion Animation	Low, pre-programmed operation for fashion designers	Real-time fabric solving with top accuracy in fabrics

5. Conclusion

The previous section briefly outlined the workflows of the five major software tools, followed by a detailed classification and comparative analysis among the different categories.After an in-depth analysis of the three major types of 3D modelling software, it can be found that different types of software have their own strengths and weaknesses in terms of functional focus, operational complexity and applicable scenarios. Brush sculpting software, such as ZBrush and Gravity Sketch, provides a high degree of freedom and flexibility for artistic creation, and is suitable for handling complex details and conceptual design. Traditional polygon modelling software such as Maya and 3DMax, on the other hand, with their powerful geometry editing and polygon control, play an important role in accurate modelling and animation, and are suitable for projects requiring high precision and complex structures. Highly predefined minimalist modelling tools such as Style3D and Character Creator, on the other hand, dramatically increase modelling efficiency through automation features and are suitable for rapid character generation

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and costume design. In the future software development, the integration of different types of functions and technology optimisation will bring more possibilities to the 3D modelling industry.

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