Body Mold Setting and Motion Emulation Analysis of Steering Mechanism of Two Power Flow Tracked Vehicle based on CATIA

Yong Sun [1 2]，Wen-zhe Li[*2]，Tian-zhi Fu[1]，Hong-qiong Zhang [1]

1. College of engineering, Northeast Agricultural University, Harbin, Heilongjiang 150030, China;
2. Department of Mechanical and Electrical, Heilongjiang Agriculture Polytechnic University, Jiamusi, Heilongjiang 154007, China; sunyong740731@163.com

Abstract: CATIA is developed by Dassault System of French, one of integration Software of CAD / CAE / CAM. 3-D model building-up process of control body and part has been introduced detailedly using CATIA in the paper, tracked vehicles adopted double power flow differential turning mechanism, and carried out suppositional assembling. Validated characteristic and ruled through movement emulation. On designing the software platform in CATIA 3-D, electron model machine technology has been emulated in DMU Kinematics under Digital Mockup. Interference detection has been carried on whole device considering interference phenomenon between parts in motion. [Nature and Science. 2007;5(3):61-66]. (ISSN: 1545-0740).

Key words: CATIA；tracked vehicle；two power flow steering；setting mold；motion emulation

1. Introduction

CATIA is developed by Dessault System of French, one of integration Software of CAD / CAE / CAM. 3-D model building-up process of control body. CATIA has pieces of 11-modules and Including infrastructure, mechanical design, shape, analysis and simulation, AEC factories, NC models, equipment and systems, the processing of digital processes, ergonomic design and analysis, and so on. CATIA introduce feature modeling and parametric modeling technology that allows automatic or designated by the user-specific design parameters, or function of the geometric constraints of the design variables. The assembly design module based on the establishment and management of parts and 3D mechanical restraint installed accessories, auto parts on the connection between the definition and facilitate the movement mechanism for early analysis, greatly accelerated the purchase of accessories design, the follow-up application can use this model to the design, sub - Analysis and manufacturing. DMU module assembly process to be completed by the Movement for the establishment, analysis and interference checking, and the path planning and spatial analysis. According to its line of 3D planes, users can accurately the establishment, modification and analysis of 3D geometric models.

CATIA is a feature-based parametric solid modeling system, the traditional CAD technology for the fixed size of the geometric definition of the value elements of each input line has identified a location and length, in order to amend the map's content, only to delete the original lines and anew painting. While the development of new products need to repeatedly design changes，that make the shape and size of components to the comprehensive coordination and optimization. Stereotypes for product design, we need to create products, in order to address the production features users with different types of products. Parametric Design will design products with certain structural changes and the size automatically modified graphics. Feature-based design is the design of products as the basic unit and mechanical products described as an organic combination of characteristics.

2. Control components 3D model of building-up

Doing virtual assembly and motion simulation before, we must establish a system composed of parts of 3D models. This set of manipulating 3D modeling agency of this process, the control panel of tilt the modeling as an example, According to the first parts of the structure, the use of CATIA software module mechanical design of sub-module -- Part Design module functions entering into sketching interface, rendering the tilt control panel of wire frame, as shown in Figure 1.
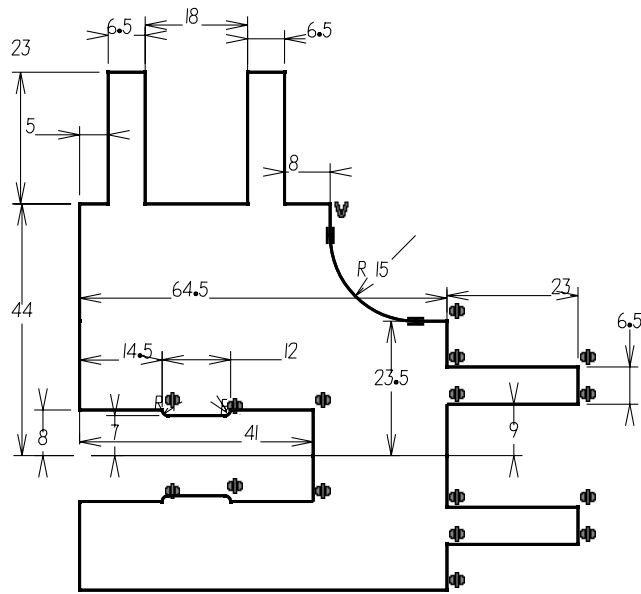
Figure 1. The sketch of controlling plate

Then parts of the functional module design, drawing, rotation, scanning and grooving, drilling, a range of features such as modeling, tilt control panel completed the three-dimensional modeling, as shown in figure 2.
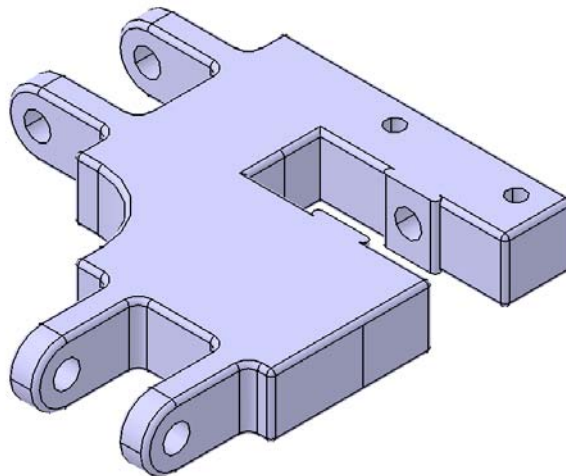

Figure 2. The entity model of controlling plate

Other parts of the modeling using the same steps, the first parts for sketching, and then use the function module parts, the parts were for 3D modeling, model other parts, as shown in Figure 3 typical Parts explosion map, thus to complete all parts of 3D solid modeling.

3. Virtual Assembly

Assemblies of many parts and sub-assembly of organic composition, which is the expression of the two-part information, part of the entity information is assembling the body parts of the combined entity information; Another part is assembling information intimate parts of the interrelationship between information. CATIA 3D software such as providing a powerful virtual assembly functions. Assembly body design module provides a powerful virtual assembly parts function. In this module, through parts of coaxial

elements, coplanar, distance, angle, as well as the anchor bound to achieve the virtual assembly parts. According parts entity model, the mechanical design module module -- assembly design (2935D Design) module, the import of spare parts assembled model for the appropriate location on the adjustment would make it easier to impose restraints. Then, using the toolbar binding orders, location binding methods used to achieve assembly constraint modeling, to ensure proper parts in parallel, coaxial or coplanar relationship. Construction Control Box typical parts entity model shown in Figure 3.
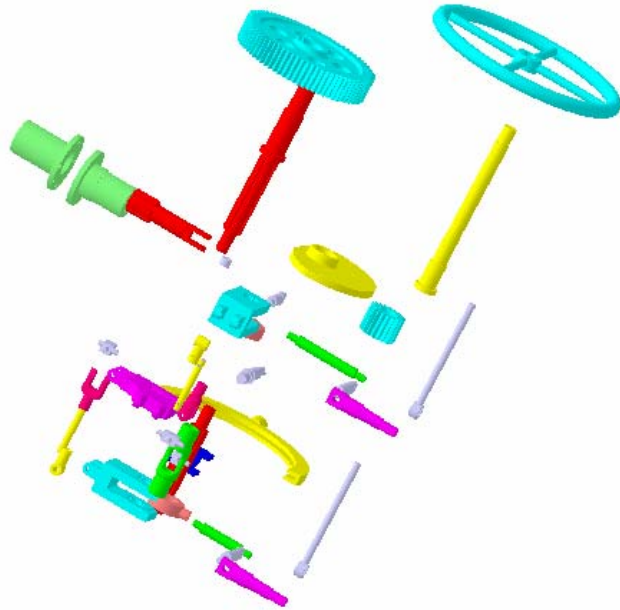

Figure 3. Entity model of typical parts

After the assembly of products also use the assembly analysis functions, the assembly of products for various analytical relations. If there is interference between parts happen, it could directly on the platform assembly of parts changes, so that only the actual assembly of the parts can be found at the series of problems now in modeling design to discover and remove

4. Motion Simulation

Motion simulation in the design of direct digital model （Digital Mockup） under the DMU Kinematics （digital simulation module）.Enter the sub-module DMU Kinematics, by the introduction of assembly design model. Then, using tools Kinematics Joints of the various campaigns deputy sports relations between the definition, sports institutions, the connection is generally a rotary joint （Revolute Joint）, sliding joints （Prismatic Joint）, cylindrical joints （Cylindrical Joint）, screw joints（Screw Joint）, and other connection methods, the use of simulation modules with orders （Simulation with commands） simulation can be achieved satisfactory results. As shown in figure 4.
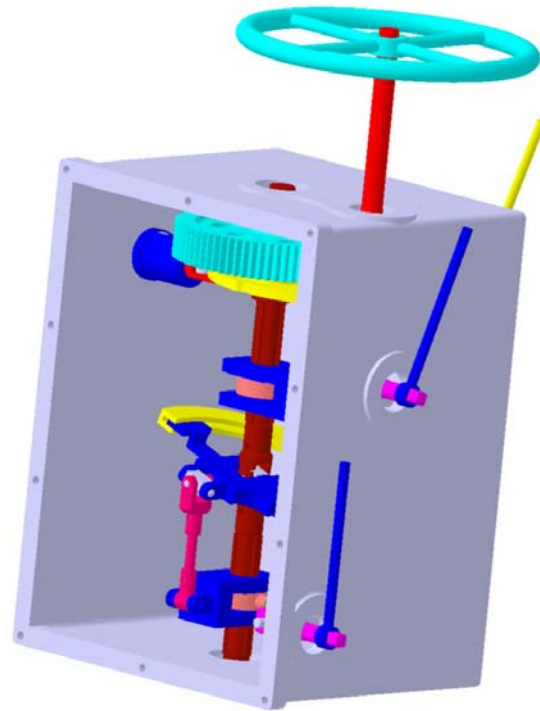
Figure 4. The simulated diagram of the mechanism while forward right steering situation

From Figure 4 can be manipulated to see a moving shot put with the rotation of the steering wheel and a swinging angle of this vehicle to achieve progress right turn, at the same time manipulating the straight shot put will gradually return to the initial position that will control line separating the speed gradually reduced, the deceleration of vehicles, the biggest point of the steering wheel to 360 ° manipulating straight shot put will return to the initial position and realize vehicle to the right place.

5. Interference Detection
Interference checking including static interference checking and dynamic interference checking, static interference checking refers to the virtual assembly structure, assembly inspection of the body parts between the relative position between the existence of interference, the assembly tolerance design is reasonable; Dynamic interference checking and assembly of the parts off the assembly campaign Cheng, his campaign enveloping body parts between the existence of a campaign to interfere. This sets manipulation detection devices to interfere in the process, the main consideration in this set of campaign process, the availability of components between interference, if it exists, the agency inspected to ascertain first assembly of parts between connecting whether there was a problem, if there should re-form its connections into OK bound connections, connecting to determine the form only after further interference detection, if there is still interference, we should interfere parts inspection, the right to re-amend parts, the number of specific changes, according to the test results interfere in the quantity to decide. The final revised the dynamic interference test results shown in Figure 5.
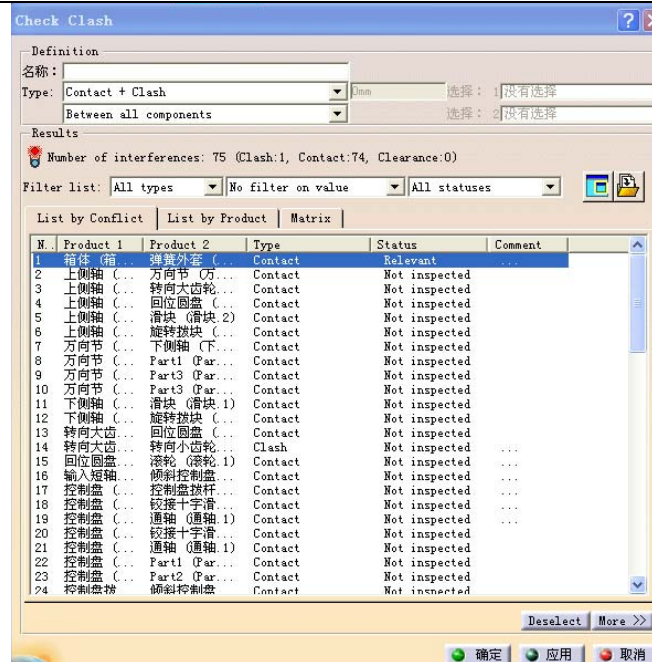
Figure 5. The result of interference analyze

Completion of this step can further three-dimensional map of the output of two-dimensional drawings, graphic drawings of simple changes can be conducted on the production and processing. Thus, the application of this set of CATIA software control agencies design and analysis greatly shorten the design cycle, and guarantee quality of the design.

6. Conclusion

（1）described the use of CATIA dual-tracked vehicle power flow shifted control box components 3D model of the process, virtual assembly, motion simulation and analysis of this set of certification bodies and the movement characteristics of movement.

（2）CATIA 3D design software platform, electronic technology in the digital prototype model （Digital Mockup） under the DMU Kinematics （digital simulation module） for motion simulation, and consider this set of institutions in the process of movement between the parts availability interference, manipulation package for a device interference Detection.

Correspondence to:
Yong Sun
Department of Mechanical and Electrical
Heilongjiang Agriculture Polytechnic University
Jiamusi, Heilongjiang 154007, China
Telephone: 01186-451-5519-1670
Cellular phone: 01186-13836145034
Email: sunyong740731@163.com

Wen-zhe Li
College of engineering
Northeast Agricultural University
Harbin, Heilongjiang 150080, China
Telephone: 01186-451-5519-1670
Cellular phone: 01186-13936491559
Email: liwenzhe9@163.com

References
1. Li Wen-zhe, Zhann Honnqiong.Strateny of auto-stepless deceleration of the tracked vehicles using split path transmisson steering mechanism during steering [J].Transactions of CSAE．2005．21（12）：67-70.
2. Y. Zhang, Z. Zou, X. Chen, X. Zhang and W. Tobler.Simulation and analysis of transmission shift dynamics [J]. Int. J. of Vehicle Design,2003,Vol.32,pp.273-289
3. Cao Fu-yi, Zhou Zhi-li, Jia Hong-she. Studying Actualities and Developing Tendency of Turning Mechanism of Crawler [J]. Journal of IIenan university of Science and Technolony (Natural Science) 2003.24（3）：89-92
4. K Huh1, B H Cho and J H Choi, Development of a track tension monitoring system in tracked vehicles on flat ground [J], Proc Instn Mech Engrs Vol 215 Part D,D08699 © IMechE 2001,567-578
5. Bi Xiao-ping, Wang Pukai,Li Haijun et al. A simulation model for dynamic steering processes of tracked vehicles [J]. Acta Armamentar(China), 2003（11）．551-554
6. Zhang Hong-qiong Design and Study on streering and mechanism of tracked vehicle [D]Dissertation for the Master Degree.Northeast Agricultural University．2005（in Chinese）
7. D. Rubinstein, R. Hitron. A Detailed Multi-body Model for Dynamic Simulation of Off-road Tracked Vehicles Journal of Terramechanics,41(2004) 163-173
8. Fu Tianzhi. Design and Study on control Mechanism of new tracked vehicle [D] Dissertation for the Master Degree. Northeast Agricultural University, 2007（in Chinese）.