

Modeling and Simulation of Virtual Prototype of the forming Machine based on Solid Works and ADMAS

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Abstract: *The virtual prototype technology was applied to mechanism designing. The modeling and dynamic of forming machine was proposed by using SolidWorks and ADAMS software. The advantage of the technology is that the product characteristics can be calculated in the design stage, and the feasible study and design of the forming machine can be completed in a virtual environment. As a result, the design quality and efficiency of the forming machine are improved, and its developing and manufacturing period is reduced correspondingly.*

Keywords: *Forming machine, Virtual assembly, Virtual prototype, Modeling and simulating*

I. INTRODUCTION

In the traditional design and manufacture process, the first thing to do is the conceptual design and demonstration program, and product design. After the design is completed, in order to verify the design, products need to go through the prototype experiment, but a defect is found through experiment, and then back to modify the design prototype verification, only through the design test iterative design process, the product can meet the performance requirement. This design pattern is complex and long, the design cycle not only cannot be shortened, and the manufacturing cost of the product will be greatly increased.

Virtual prototype technology is a new technology that blends with the scattered components design and analysis technology in the process of product design and development (refer to the parts in a single system in the CAD and FEA Technology) to create the whole product model in the computer, and the products were analyzed by simulation software in different working conditions after putting into use, to predict the overall performance of products, and improve product design and performance^[1]. Virtual prototyping technology is a new technology in the field of current design and manufacturing, and ADAMS is also widely used. ADAMS kinematics simulation software is developed by the United States MDI company, which is widely used in various industries currently (machinery, automotive and aerospace), the modeling and simulation accuracy and reliability in the existing dynamics analysis software in the top, the main steps include pre-treatment, applied loading & solving and post-processing^[2].

Moreover, the automatic forming machine is the rapid prototyping equipment of high-voltage motor stator coil. In this paper, in the design of forming machine development, using the SOLIDWORKS software and the mechanical dynamics simulation software ADAMS, to complete three-dimensional solid modeling and virtual assembly of forming machine parts/components, and simulation analysis of the actual working conditions, to obtain the optimal design scheme, and then create a physical prototype, can greatly improve the quality and efficiency of product design, but also reduce the design cost, realize the true meaning of the computer aided design.

II. FORMING MACHINE SOLID MODELING AND VIRTUAL ASSEMBLY

Before the establishment of the virtual prototype model of forming machine, firstly, using solidworks tools such as stretching, rotating, lofting, scanning, to establish the part model; then in accordance with the matching relation between each part of the assembly machine, Using the bottom-up assembly technology for all parts of the three-dimensional entity model of virtual assembly, and finally get the three-dimensional entity the assembly virtual model of the whole machine. Fig1

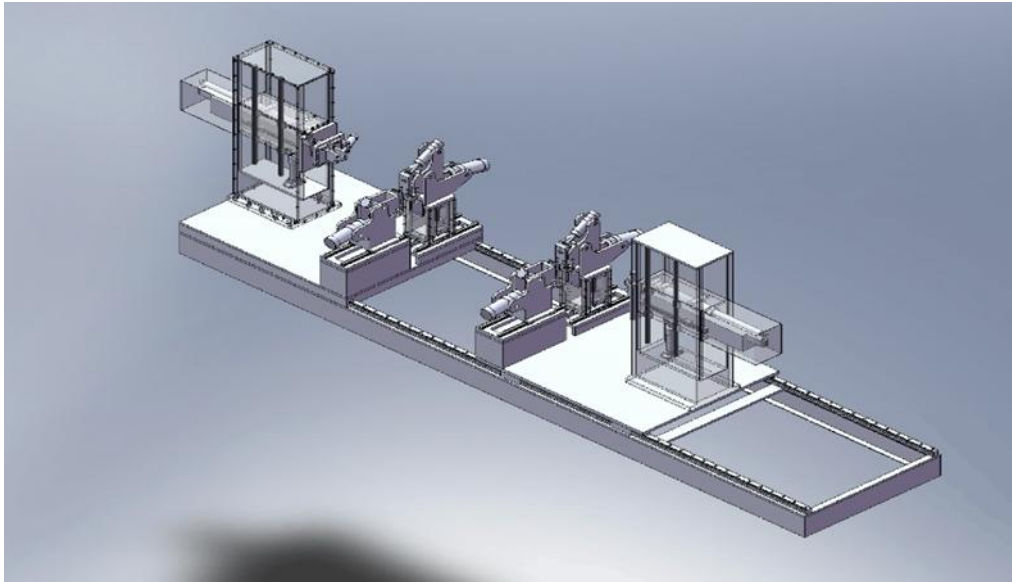


Fig1 the virtual assembly model of forming machine

Using solidworks tool-"Interference" and "physical simulation" to realize the static interference checking and dynamic collision checking of the assembly model, in order to find problems and timely change it^[3].

After creating the forming machine model from solidworks software, using ADAMS/Exchange module of ADAMS software to the assembly model file into the ADAMS, then get a geometric model of virtual prototype, adding drivers and constraints for the geometric model of parts.

2.1 Importing the virtual assembly model

As part of the assembly model is too much, inevitably produce loss of data between different CAD software, so the software in Solidworks will be the first forming machine assembly file saved as Parasolid format, and then importing the file into ADAMS^[4]. Using ADAMS software, renaming the machine base, machine tool guide, the forming arm, and then add constraint, define the part material, elastic modulus, Poisson's ratio, density and other parameters.

2.2 Creating virtual prototype simulation model

After importing three-dimensional model into ADAMS/View, among each part independently in ADAMS, as for the state, even if all the components are imported, does not constitute a whole virtual prototype. Therefore, must add the appropriate constraint, motion and force.

Adding the pair of motion : The fixed pair -between the machine guide rail and the ground, the shifting pair-between the machine base and the guide. Four forming arms and the machine base, two telescopic arms and the machine base, cylinder and piston. The rotating pair-the fixture plate and pin. In the process of adding pairs, should pay attention to the direction of movement between the two components. Because the moving rule of the forming arm's accuracy is the key of machining, so the definition of the main movement is the movement of four

forming arms. Fig 2

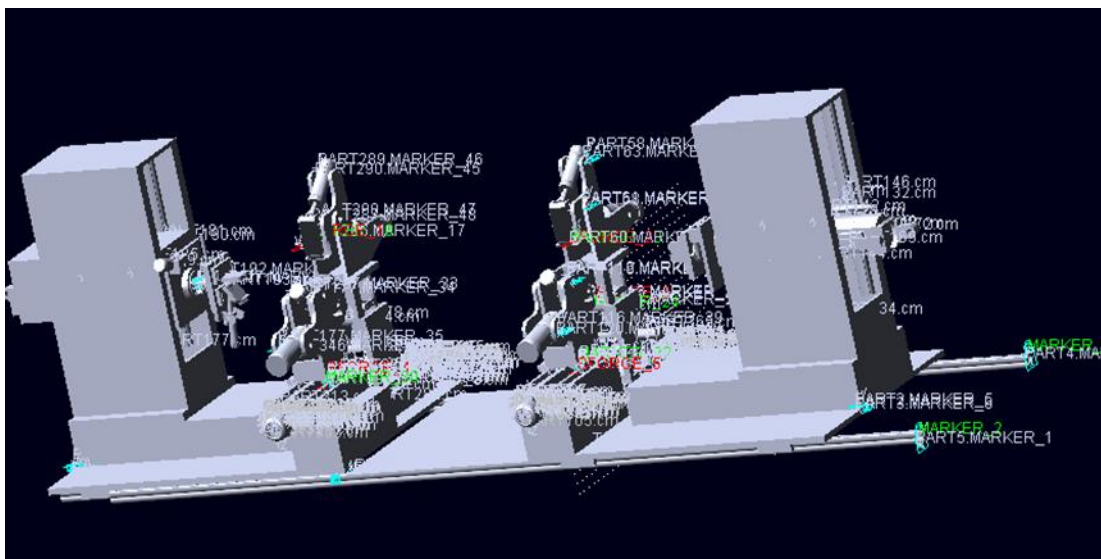


Fig 2 the virtual prototype model of forming machine

III. ANALYSIS AND SIMULATION OF FORMING MACHINE

The moving rule of the forming arm directly affects component quality of the forming machine, its performance reflects the overall performance of forming machine. Therefore, the kinematic and dynamic simulation for the forming process of forming arm, get the motion parameters of forming arm mechanism, realizing the optimization design of product. The motion simulation in ADAMS simulation interface, software can output the simulation animation type machine working and output the curve of the performance of different systems, a comprehensive comparative analysis of the simulation result, can realize the performance evaluation of different schemes of forming machine.

In this paper, the definition of the driving function is a function provided by ADAMS/View. $F = \text{step}(\text{time}, 0, 0, 0.5, 10) + \text{step}(\text{time}, 0.5, 0, 1, -10) + \text{step}(\text{time}, 1, 0, 1.5, -10) + \text{step}(\text{time}, 1.5, 0, 2, 10) + \text{step}(\text{time}, 2, 0, 2.5, -10) + \text{step}(\text{time}, 2.5, 0, 3, 10) + \text{step}(\text{time}, 3, 0, 3.5, 10) + \text{step}(\text{time}, 3.5, 0, 4, -10)$, the definition of the regular change force applied on forming arm. The total simulation time is 4s, simulation step size is 1000 for simulation, finally obtained the curve of forming arm speed and angular acceleration by post-processing. As shown in the following figure.

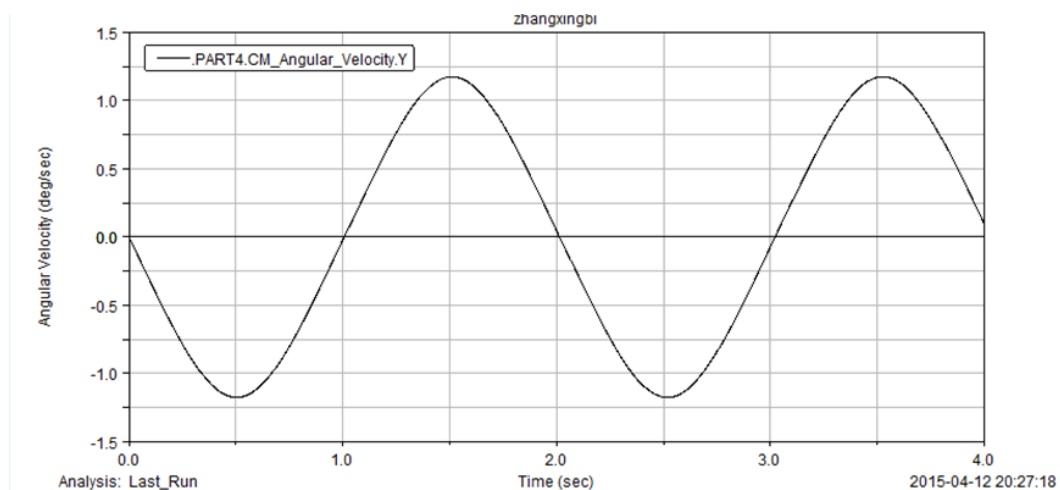


Fig 3 Angular acceleration curve of forming arms

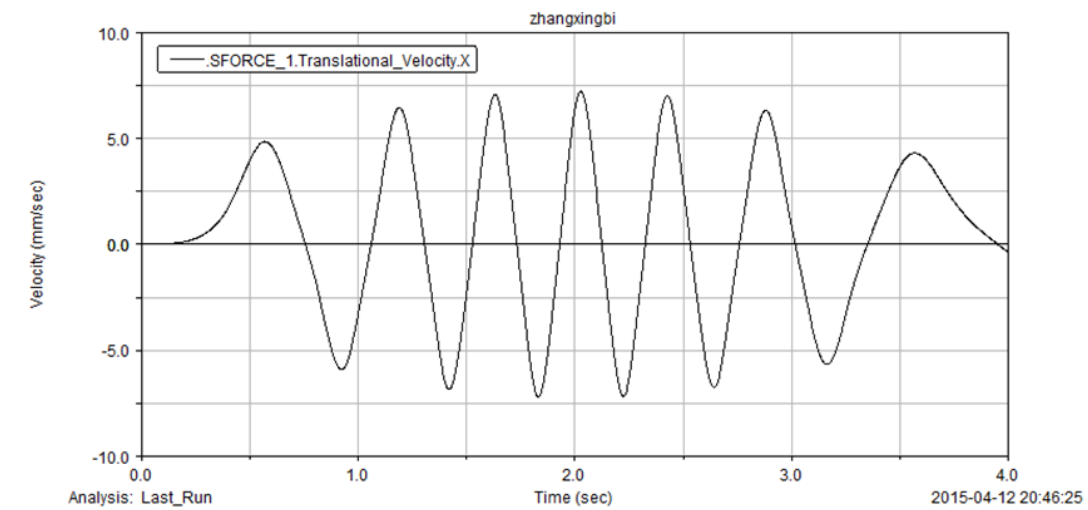


Fig 4Speed change curve of forming arms

Seen from theFigure 3.4, theforming arm in the mold processing is relatively uniform on the variation rule of the movement, meet the actual processing requirements.According to the simulation results, the design optimization model of the forming machine, and produced a physical prototype machine, through the test, theprototypemachine fully meet the requirements offorming machine performance such as assemblyperformance, sports performance, output force

IV. CONCLUSION

The modeling of forming machine parts/components and assembly by using the SolidWorks software, and the interference and collision check, and then importing the assembly model into ADAMS, and building up machine virtual prototype simulation model, set the boundary conditions and initial conditions, through the simulation on the properties and motion characteristics of forming arms, finally get the optimization results, and manufacture the prototype. Through the prototype test, showed that the performances of the forming machine meet the design requirements, and the performance is stable and reliable.

REFERENCES

- [1] Miao yu-gang, Zhao feng Design and motion simulation of virtual prototype of Turbo screw lift [J] Bei Jing: Hoisting and Conveying Machinery 2015 (1):36-38.
- [2] Chen feng-hua Virtual prototype technology ADAMS 2012 from entry to the master [M]. Bei Jing: Tsinghua University press, 2013
- [3] Zhang yi, Zhao he-ming, Fan song-bing, Zhao zhi-peng Slotting machine simulation and structure optimization of based on Pro/E and ADAMS[J].Tai Yuan: Mechanical Engineering & Automation 2015 (2):72-73
- [4] Xu you-li, Yang xiao-gang Construction and simulation analysis of gear reducer virtual prototyping [J]. Ha Er Bing Coal: Mine machinery 2012, 33 (10) :245-248.