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Design of Mechanical Fixture Based on Contact Thread Measuring Device

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Abstract: *The thread has a very wide application in machinery manufacturing, aerospace and other industrial fields. And thread accuracy detection becomes an important potion of thread measurement technology. Contact measurement is one of the most important direction of thread parameter measurement. It is necessary to design a mechanical fixture for contact measurement. This paper focus on the design of mechanical fixture based on contact thread measuring device. The stress, strain and deformation of the tip fixture are analyzed using ABAQUS. The simulation process is also introduced in the paper.*
Keywords: *thread, mechanical fixture, ABAQUS*

I. INTRODUCTION

The thread is applied in machinery manufacturing widely, such as tracks fastening technology, sealing, precision positioning, etc. Due to the big influence of precision on threaded parts characteristics such as interchangeability, reliability and airtightness, the thread accuracy detection becomes an important potion of thread measurement technology.

Scholars at home and abroad have done a lot of work on thread measurement. Tong[1] indicated a direction of multi parameter detection of thread. Sun[2] studied the comprehensive measurement and individual measurement of thread. Xu[3] introduced the measurement of thread particularly. Liu[4] studied the present situation and development trend of thread inspection technology. Xu[5] investigated the development of non-contact automatic thread detector. Su[6] researched on non-contact measurement of geometric parameters of external thread based on DSP and linear CCD. Lan[7] researched on non contact measuring technology of tubing thread based on linear CCD. Hong[8] developed virtual ring gauge based on virtual machine. Wu[9] studied the screw gauge measuring system for laser length measuring machine. Hua[10] predicted the direction of measuring technique. Marzani[11] developed a protocol for CCD calibration. Wang[12] made nonlinear analysis and compensation of a large scale lever type optical profilometer. Fan[13] put forward a non-contact automatic measurement for free-form surface profiles. Du[14] studied the development of control system for petroleum cone pipe thread measuring instrument. This paper focus on the design of tip fixture based on the contact thread measurement. And the stress, strain and deformation of the tip are analyzed using ABAQUS.

II. MECHANICAL FIXTURE DESIGN

According to the characteristics of the fixture, the tip fixture is divided into three parts: the upper, middle and lower parts. The upper one is to fix workpiece; the middle part is a vertical plate, mainly in order to improve the measurement center height; the bottom is sliding part and fixture device. Considering the machining process, each part of the thread is connected by screw.

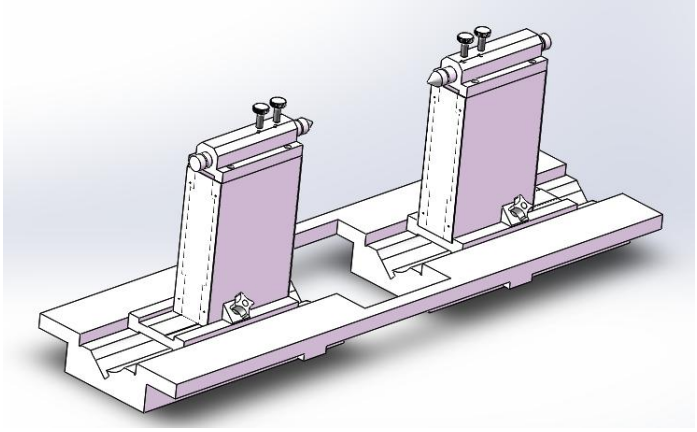
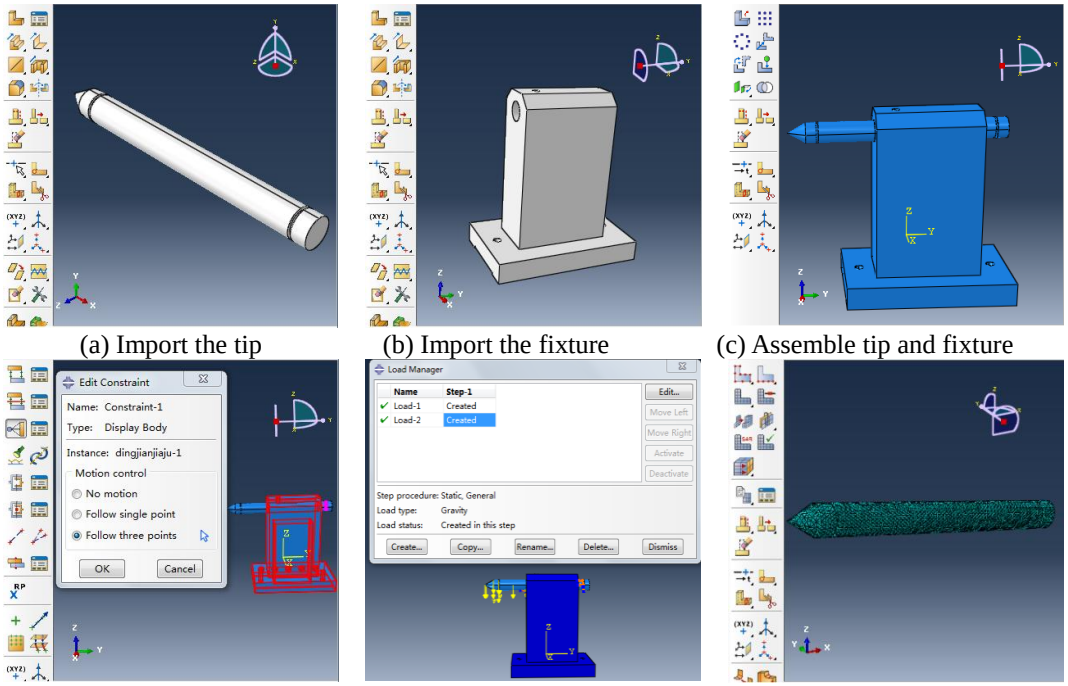


Fig.1. The structure of the tip fixture

III. SIMULATION OF MECHANICAL FIXTURE AND SIMULATION PROCEDURE

Import part tip and the fixture into ABAQUS and create a numerical example, as shown in Fig.2(a),(b). Set the material as the steel, yong's modulus as 2.1×10^{5}, poisson's ratio as 0.3, density of 7.85×10^{-6} kg/mm^{3}. Assemble the tip and the fixture and adjust the position, make them coaxial constraint, as shown in Fig.2(c). Add a fixed constraint to the interface between the tip and fixture. This paper only analyze the stress, strain and deformation of tip, thus the fixture is defined display body regardless of its deformation, as shown in Fig.2(d). Divide the grid and apply load on the tip, as shown in Fig.2(e),(f). Create a job and submit it, the simulation will running if there is no error. The concrete simulation process is shown as Fig.3.



(a) Import the tip (b) Import the fixture (c) Assemble tip and fixture

(d) Define display body (e) Create load (f) Divide the grid

Fig.2. The simulation in ABAQUS

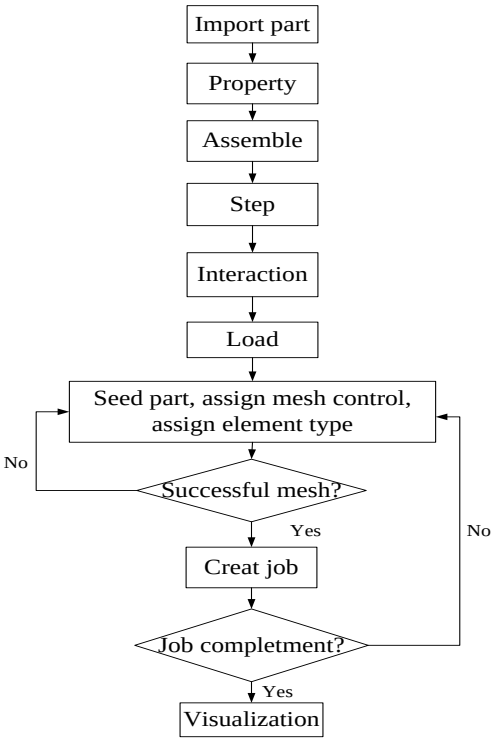
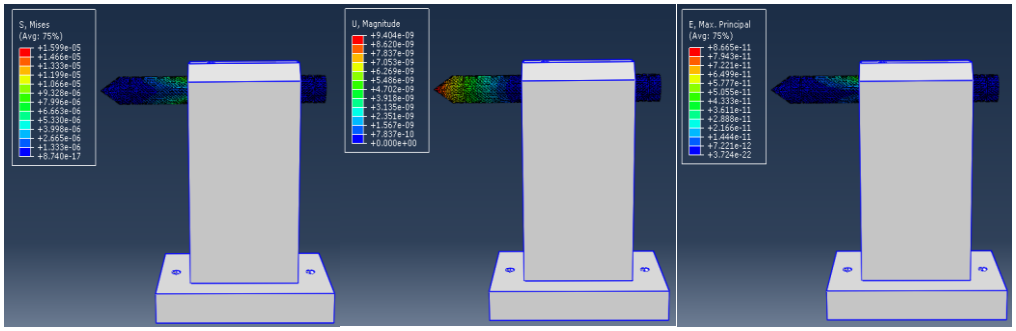


Fig.3. The simulation procedure diagram

IV. SIMULATION RESULTS

The simulation results are shown in Figure 4(a),(b),(c). The stress diagram shows that when the top is out of 65mm, the maximum stress value is 1.599×10^{-5} MPa; smaller than the permissible stress. The maximum value of strain is 8.665×10^{-11}. By the displacement diagram it can be drawn that when the tip out of 65mm, the maximum displacement is 9.404×10^{-9} mm, the maximum deformation is occurred in the thimble, less than the thread measuring device top deformation error structure design $\delta=\pm40\mu m$. The simulation results indicate that the tip fixture is reasonable.



(a) Stress distribution (b) Deformation of the tip (C) Strain distribution

Fig.4. The simulation results

V. CONCLUSION

Aiming at the existing problem of contact thread measuring device, this paper design a a high precision and large stroke fixture. The research has completed the design of mechanical fixture, including design and assembly of all parts of the tip fixture. Then the stress, strain and deformation are obtained by simulation with ABAQUS. The results indicate that the tip fixture is reasonable.

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