



# A CASE STUDY OF HAND GRIPPER AND ITS OPTIMIZATION USING FINITE ELEMENT ANALYSIS

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**Abstract--** The designed hand gripper mechanism in this work is a two jaw actuated gripper which is different from the conventional cam and follower gripper in the way that controlled movement of the jaws is done with the help of human hand and muscular power. In this case study we have focused the attention on the dimensional of the mechanisms in two-finger grippers that we have named as gripping mechanisms to emphasize on their basic gripping purpose. The design problem has been approached for the basic characteristics of gripping mechanisms. A case of study has been reported as a digital prototype to show the soundness of the proposed optimization procedure by using finite element analysis to computational and practical results. Abstract: In order to reduce the decline of the performance of the mechanism caused by the uncertainty in the manufacturing process, the paper gives A reliability-based geometric nonlinear topology optimization design method for compliant mechanisms. The objective function satisfies the stiffness and compliance requirements of the mechanism with minimum mean flexibility and maximum geometric gain; The probability constraint of the degree of reliability is calculated by the one-time reliability method; the sensitivity analysis of the objective function uses the adjoin solution technique; the optimization uses the solid isotropic material interpolation method and iteratively solves it with the moving asymptotic method. Finally, to be compliant the reliability topology optimization of the clamp is studied as an example, and the reliability-based topology optimization is obtained.

**Keywords:** Digital Prototype, compliant mechanism; FEA, reliability.

## I. INTRODUCTION

### 1.1 Introduction

Gripper is the effect or of a mechanism. In this sense, it is akin to a human hand which allows one to pick and place any given object. Grippers are used in areas which involve hazardous tasks such as space exploration, high-temperature welding, handling radioactive materials, defusing bombs, mines and exploring shipwrecks, to name a few. Moreover, grippers are also useful in areas that involve tasks which are complex in nature such as the fabrication of micro-electronic structures, surgery, and so forth. A substantial amount of research has been done on this subject. An extensive survey on problems arising from the building, planning, designing, and controlling operations. In this high-tech era, all high-industry products are becoming more sophisticated and more. It is small and easy to carry.

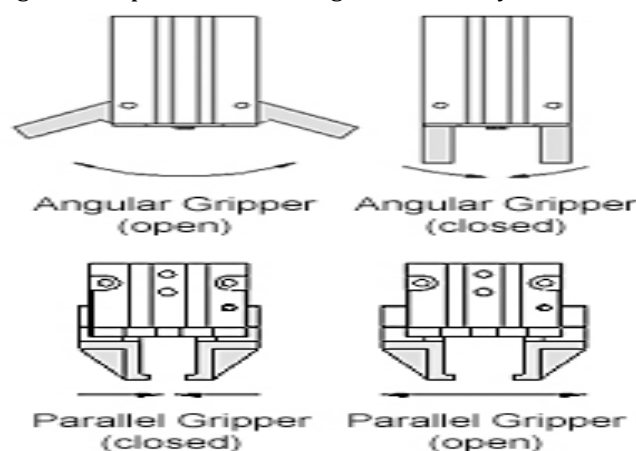
But now the desire for consumption is endless, they always hope can spend the least money to buy the best things, so current producers often want to break their heads, because transform and innovate in order to think about it. But the prerequisite for these high-tech products is to have good vibration protection, such as: Today's mobile phones, laptops, computers, and so on. And a lot of everyday items are also doing more the smaller, the better their vibration protection, because they can't afford to buy one. A mobile phone that you can't carry with you! So what we are going to do this time is the design and production of the vibration test gripper. A gripper that holds the motherboard of the computer and tests it to withstand external forces large amplitudes, then improved and adjusted. And let us know about some of these high-tech products. How much effort did the manufacturer spend to make it satisfy the consumer? In recent years, research on topology optimization of compliant mechanisms has been straightforward the focus of attention. Designing a compliant machine due to topology optimization. Time, just give the design field and specify the input and output position, no need to starting from a known rigid mechanism and the resulting mechanism is optimized. The force of a displacement input and output relationship has attracted people's attention. In practical applications, the compliant mechanism needs to be flexible on the one hand. In order to successfully complete the scheduled work, while having enough rigidity to ensure its mechanical efficiency and stability of work. Supple Mechanism topology optimization is a multi-objective optimization problem, and due to compliance the mechanism transmits force and movement by elastic deformation, therefore, the compliant mechanism topology optimization design is essentially a geometric nonlinear problem. So far, most of the existing compliant mechanism topology optimization studies the number is the load environment, structural parameters and design variables of the organization. Factor processing is a deterministic assumption. In the actual engineering structure, because manufacturing and various environmental factors, their applied loads and structural geometry parameters such as size inevitably exhibit randomness, using deterministic machine the structural safety margin obtained by the topology optimization design becomes smaller, and the failure mode.

### 1.2 Gripper technology

As for the translation units and of rotation, the constitution of the gripper is that of all effector actuators modular. Each module integrates seven functions:

- The pneumatic actuator;
- The mechanical guidance of the pre-jaws;
- The self-symmetrical transformer of movement; adjustable end stops (no existing on this model);
- The safe retention of the tightening case of loss of pneumatic supply
- adjustable sensor supports;
- The mechanical attachment surfaces.

Some modules integrate a course -Hall position transmitter associated with a parameterizable electronic, which gives three types of information: open clip, closed clamp and tight piece. These products, now very numerous on the market, are real constituents ready-to-use industrial automation systems, for which it suffices to make it the choice, the design of the jaws adapted to the piece and finally the dimensioning. The parallel clamps, concentric and angular can work in both meaning to achieve the desired tightening on the outside of the room or indoors, in a bore, for example. Angular pliers with full opening (180 °), in turn, only works in nature has mastered the use of Nano things made up of different things, and the men, as usual, are learning from their natural surroundings. Although the term Nano thing made up of different things represents a new and exciting field in material science and technology, the Nano things made up of different things have actually been there in the world of nature.



Using carbohydrates, lipids and proteins, nature makes strong Nano things made up of different things such as bones, shells and wood.<sup>7</sup> In the early 1990s, Nano filler loading resulted in an obvious improvement of thermal and mechanical properties of nylon-6. Toyota Central Research Laboratories in Japan reported a work on a Nylon-6.

### 1.2.1 Gripper operating comfort

According to the time process, the impact on the cost of the product is also set in the scope of the super-production. Use, the only requirement is the DIN33401, which can be valuable for the scope of the gripper. Knowledge. It is listed here by the standard set by the "Ergonomics" Standards Committee. The numerical quality feature aggregation in the document is used as a gripper evaluation comfort evaluation system. Information in order to get the best solution to the gripper designer, you should have the auxiliary materials available in the research design. In the stage, the relationship between the analysis and the cost can be applied at the time cost that can be implemented, and the relative cost and Set in cost. The evaluation catalog has advantages for the establishment of the operating system. The environment is affected by the habits, etc., and is determined by the gripper for drilling of small parts. The influence of the sketch influence and the operation time on the main components of the gripper and thus the best answer. The so-called operating time is the time base, which is considered for the entire process phase. 10% of the release time and the corresponding small batch manufacturing method level, about the method level and work the quality of the process is related to the manufacturing implementation and work system organization. In most cases, this type of classification is considered to be sufficient for rapid research. Accurate calculations cannot be dispensed with in the development of the best grippers. In this case, each must be improved. The principle factors, and the changes caused by the formation of the operation process must be grouped into the following grouping

Show the purpose:

- work piece placement and positioning
- work piece clamping
- Gripper positioning
- work piece removal
- Gripper cleaning and seizure

In addition to the above points, the automated work system and operational safety are also used for operational evaluation a judgment factor.

### 1.2.2 Work piece placement and positioning

The work piece must be placed in the gripper in a simple, accurate and fast manner. Applicable for positioning Requirements, but the positioning is not exactly the same as putting it in. Always committed to putting on time made in formulations:

- The middle plane of the plate is taken as the reference plane.
- The laminated plate consists of arbitrary number of homogeneous, linearly elastic orthotropic layers perfectly bonded to each other.
- The analysis follows linear constitutive relations i.e. Obeys generalized Hooke's law for the material.
- The lateral logical shifts are small compared to plate thickness.
- Normal strain in z-direction is neglected.

**Prototype:** A product frame, also called a wireframe, drawn with lines and graphics. Prototyping is at the forefront of the entire product flow, with a bearing role. How you said that? Before the prototyping, the requirements or functional information are relatively abstract. The process of prototyping is the process of transforming abstract information into figurative information. The subsequent product requirements document (PRD) is the layout, interface, elements and between them. The execution logic is described and illustrated. Therefore, the importance of prototyping is irreplaceable, and product managers should have absolute control and control. In other words, although prototype design is important, it should be limited. The role of prototype design has the following points:

- Because the prototype is a concrete representation of requirements and functions, the prototype can assist the product manager with leadership, interaction, UI and technology communication product ideas.
- Because the prototype is more convenient to modify than the UI draft, the prototype can improve the efficiency of the product manager's functional design without rework when passing the review.

The goal of the prototype is to clearly express the design philosophy of the product and the execution logic of the function, so I think that the prototypes that can achieve this goal are all qualified. The purpose of adding colour and interaction to the prototype is nothing more than letting the product manager communicate with the technology more. Smooth.

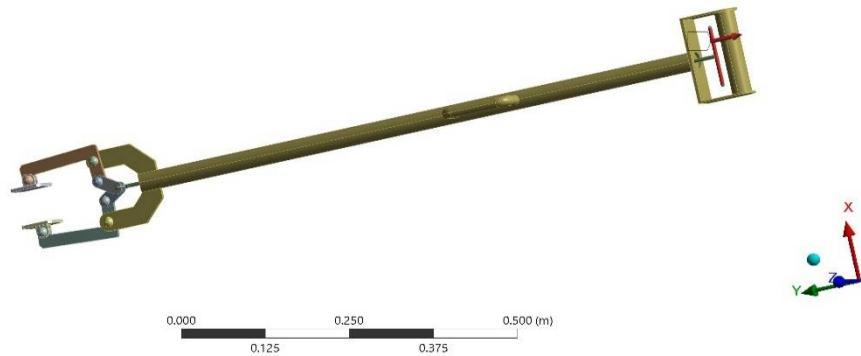
### 1.2.3 Digital Prototype:

Comprehensively consider the product objectives, functional requirements scenarios, user experience and other factors, the rational ordering process for each section, interface and elements of the product. Digital prototype refers to the digital model of the whole machine or subsystem of the mechanical product expressed on the computer. It has a 1:1 ratio and accurate size expression with the real physical product. Its function is to verify the function of the physical prototype with a digital prototype.

**A: Static Structural**

Force  
Time: 1. s  
09-03-2019 15:27

Force: 500. N  
Components: 0.,-500.,0. N



**A: Static Structural**

Pressure  
Time: 1. s  
09-03-2019 15:27

Pressure: -200. Pa

