101年大學部國際交流甄選專題成果展

A Study on Robot For TFT LCD Glass Handling

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5

Introduction

TFT-LCD stands for (Thin Film Transistor Liquid Crystal Display),which is very light, thin, energy saving and low radiation, becoming the most popular display technology now. With the evolution of digital technology, there are more and more demands for large-size glass panels in TFT-LCD manufacturing process . The panel after G6 are already taller than a human beings, so we have to use robot to transport such a large glass panel. In order not to collide the panels during the transportation process, we have to estimate the deformation of loading. After we analyzed the arms deformation, it is strong enough which almost no deformed .Therefore, we **focus on the deformation of blade and panel**.

Motivation

- To realize the robot arm design
- To learn CAE、CAD software ANSYS、Solidworks
- Use and prove the knowledge we have learned

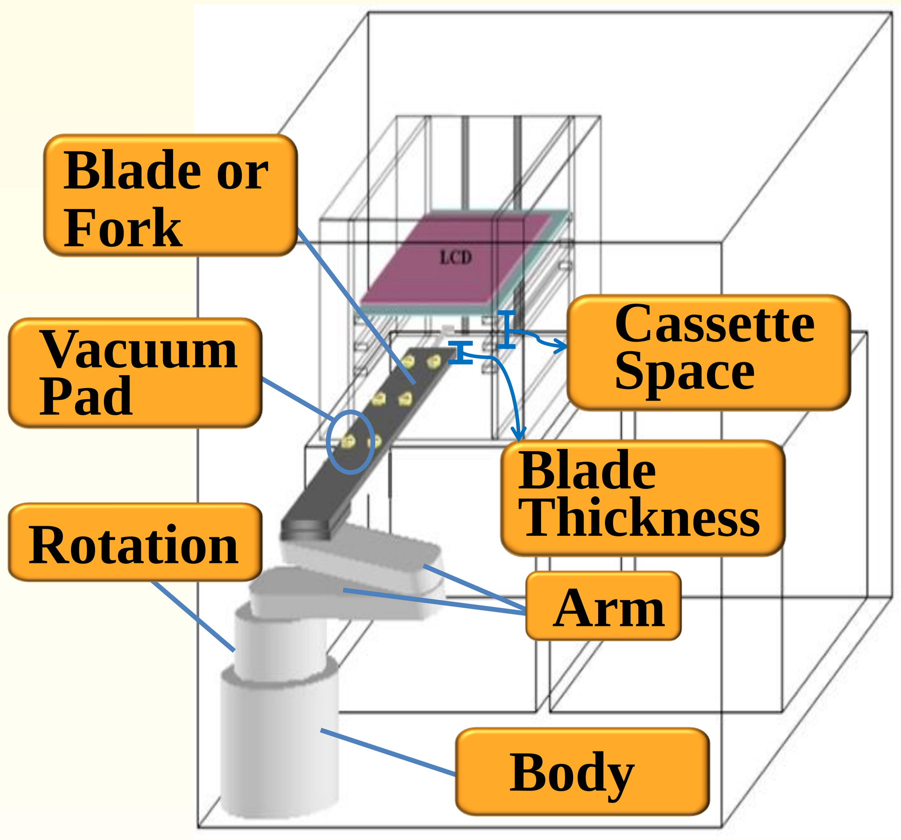


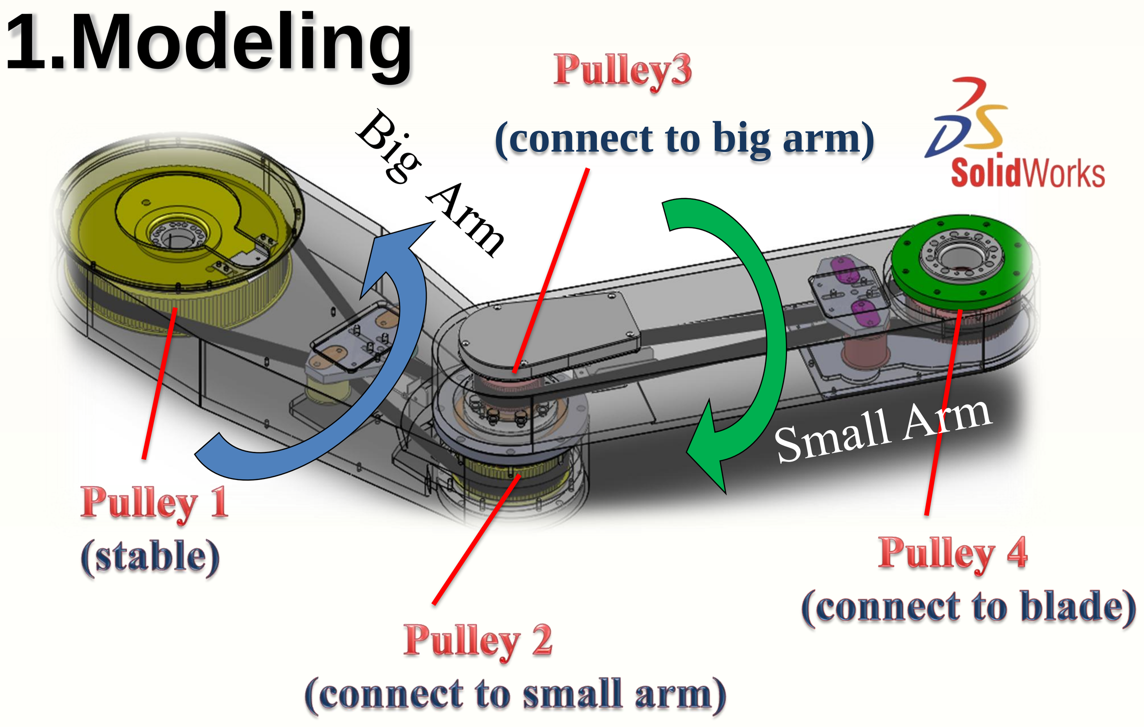
Fig1.1 Schematic of robot and cassette
(Source: Fork structure improve and finite element analysis of TFT-LCD glass handling robot fork)

Method

- **Survey**
  - What's the robot type?
  - How does the robot work?
- **Modeling**
  - Build CAD model by SolidWorks.
  - Assemble the CAD model.
- **Simulation**
  - Transmission of robot arm.
  - Structure analysis of blade by ANSYS.
- **Optimization**
  - Which type of blade conform our requirement.

Results & Discussion

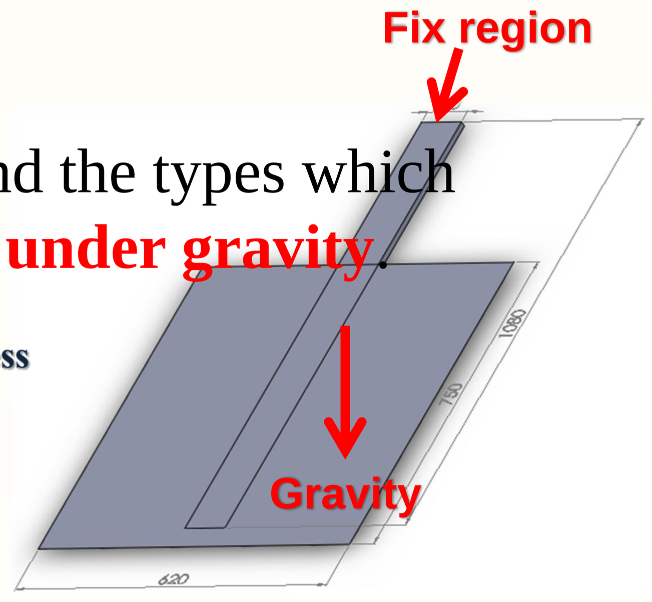
1.Modeling



The big arm is rotating, due to pulley 1 is stable, pulley 2 and small arm would be anti-rotation. Similarly, pulley 3 is connected to big arm, when the small arm rotate, pulley 4 and blade would be anti-rotation.

2.Finite Element Static Analysis

Design 3 types of section(T, U , hollow),using ANSYS to find the types which conform the **safety factor>2** and **the smallest deformation under gravity**.



Define：Safety Factor= (S-T)/δ

S：Cassette space T：Blade thickness
δ：Deformation of blade &panel

- **Glass panel size**
  750mm x 620mm x 0.7mm

Corning E2K	
Density	2370 Kg/m³
Young's Modulus	69.2 GPa
Poisson's Ratio	0.23

- **Blade size：**
  1080mm x 80mm x 12mm

Aluminum 7075-T6	
Density	2810 Kg/m³
Young's Modulus	72.0 GPa
Poisson's Ratio	0.33

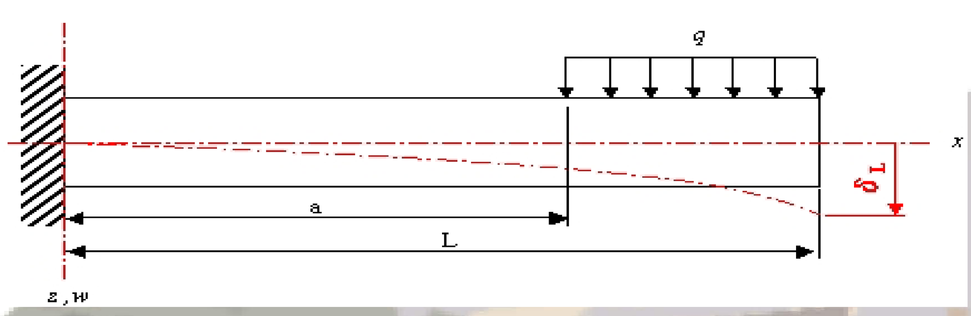
	Dimension	Maximum deformation	Safety factor
Hollow-type		9.51mm	2.1
T-type		12.39mm	1.6
U-type		22.60mm	0.9

- **Hollow type is the best section**

4.Optimization of hollow type

The thickness of original design is **4mm**.Try to find the lightest blade which conform our condition.

We can simplify the loading to 2D case.
Blade → Cantilever beam
Glass panel→Distributed loading



$$\delta_L = \frac{q}{24EI}\left[2L^4 + aL^3 - 6a^2L^2 + (L-a)^4\right]$$

q：distributed load L：bean length
a：unloading length E：elastic modulus

Writing a program in Matlab to find the matching value

5.Verify by ANSYS

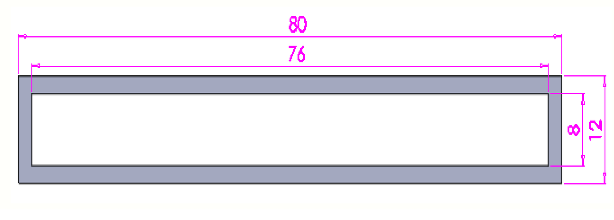


Fig. 5.1 Dimension of optimization

	Original	Optimization
Thickness	4mm	2mm
Deformation(mm)	9.51	9.27
Weight(kg)	2.17	1.13(52% original)

Table5.1 Comparison of original and optimization

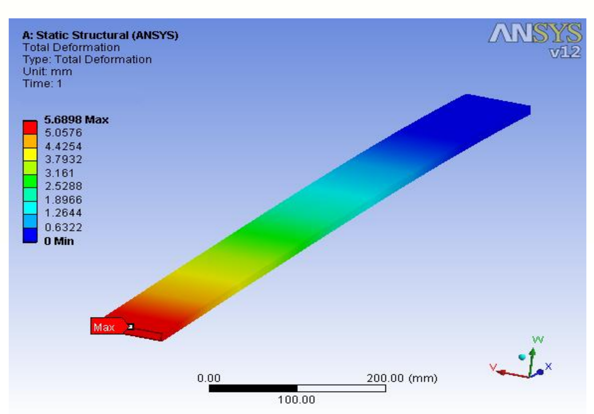


Fig 5.2 The model without panel

- Maximum deformation 5.68mm
- Safety factor：3.52 >2

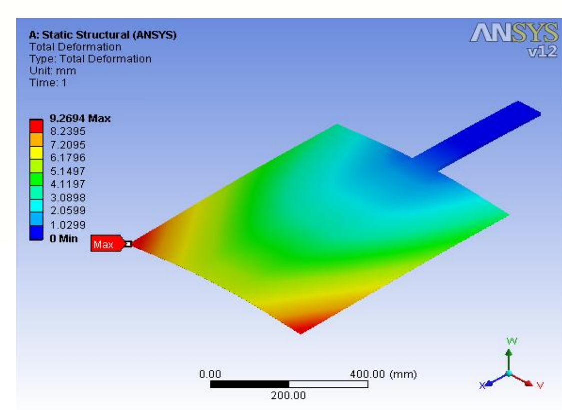


Fig. 5.3 The model with panel

- Maximum deformation 9.27mm
- Safety factor：2.16 >2

Conclusions

We have finished the followings:

- Build the CAD model by SolidWorks
- Realize how does the arm work .
- Analyze different section of blade.
- The best type of blade is hollow type.
- When cassette space is 32mm,the best thickness of blade is 2mm.