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Bionic mechanical fish design

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Abstract: In this paper, most of the approaches reported in the literature consider steel reinforcement and cross-sectional dimensions of beam as design variables of the flexural aspect only, the dimensions and reinforcing steel in this research were introduced as design variables, considering the flexural, shear, and torsion effects on the beam. The constant parameters specified prior to the solution of the optimization problem included the number of bays, lengths of span, support conditions, loads, material properties, and unit costs. The forces, moments, and deformations needed in the GA constraints were determined from the analysis. The beam dimensions were corrected to the nearest 25 m.
Keywords: Goldmine, flotation, constant parameters, surface methodology, beam dimensions.

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1. INTRODUCTION

The current era is an era of rapid development of the marine sector. With the gradual acceleration of the process of resource development, the marine sector has become an important part of development. During the development process, underwater robots have gradually developed into the main tools for the exploration of marine resources. Underwater robots generally use propellers as their propulsion method. However, the propellers generate large noise during operation, and their power consumption is high. Moreover, the manufacturing cost of the blades is high. These characteristics make their application have certain limitations. Bionic robotic fish is superior to propeller propulsion because of its high propulsion efficiency, low noise during swimming process, flexible agility in sports, high swing frequency during swimming, good turning performance, etc. It has become an activity for people to explore marine resources or collect underwater information. Preferred [1].

In the 1930s, people began to study various fish shapes and swimming methods, and tried to use mechanical means to achieve various functions of fish. In recent years, people have continued to in-depth research on biomimetic fish, the renewal of mechanical structure, the enhancement of simulation software, the improvement of automation level, and the continuous emergence of new materials. The mastery of bionic mechanical fish technology has been quite mature, and there have been a lot of Multifunctional bionic mechanical fish [2].

2. RESEARCH STATUS AT HOME AND ABROAD

Bionic mechanical fish has been researched for more than 20 years. In 1994, a research team named MIT developed the world's first robotic fish, Robotuna, which can swim in the water. The following year, we have also developed a modified pike for Robotuna. By 1998, the highest version of the robotuna vcuuv was developed. The research results of mechanical fish are more prominent in the United States and Japan.

In the United States, the MIT research team studied mainly eddy current control and sound reduction mechanisms. The research group of the Northern Arizona Department of Biology focused on the study of fish swimming behavior. The Department of Biology of the University of California has mathematically modeled the advancement of fish. The University of Connecticut is responsible for studying the structure and function of fish swimming.

In Japan, the kato laboratory at Tokai University has made breakthroughs in the research of pectoral fin propulsion. Nagoya University has developed a miniature underwater pectoral fin modelling robot (PZT). The Institute of Naval Architecture has made improvements in the drive and mobility.

Fig.1

In China, Beijing University of Aeronautics and Astronautics and Harbin Engineering University have done a better job in the field of biomimetic fish. Beijing University of Aeronautics and Astronautics proposed the “wave motion theory” in the development of the bionic fish, and developed a mechanical squid with a speed of 0.6m/s.

Harbin Institute of Technology developed a bionic mechanical fish named “HRFC”. It has improved the tail fin and the pectoral fins. It has performed simulations of lifting and steering. The maximum speed of swimming is 0.5 m/s. .

Another bionic mechanical fish named Bionic-1 developed by Harbin Institute of Technology is 2.5m in length and 0.7m in diameter, and has a maximum speed of 12m/s. It is the largest bionic fish in China.

Fig. 2

3. OVERALL DESIGN

(1) Design of tail fin propulsion device

The tail fin driving method adopted by the mechanical fish swimming propulsion device drives the tail fin to swing through the crank rocker mechanism.

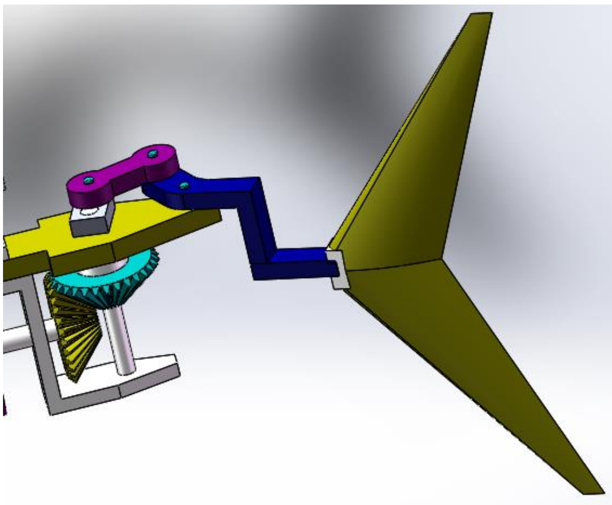

Fig.3

The movement diagram of the organization is shown in the figure below

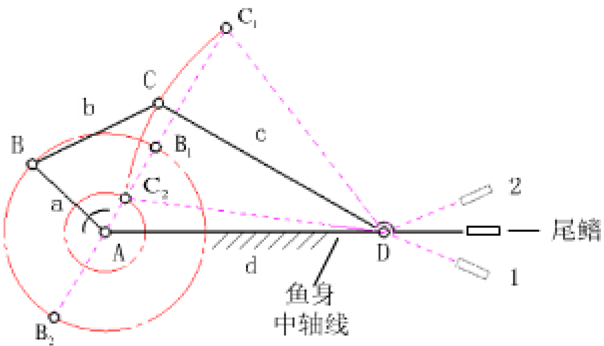

Fig. 4

4. DESIGN OF SINKING AND FLOATING MECHANISM

The side fin method is used in the sinking and floating mechanism. The side fin device is placed at the front of the fish, so that the front and rear weights of the fish can be balanced. The side fins are divided into a direction fin and a lifting fin, which are used to control the turning and ups and downs of the fish respectively. Due to the fact that the side fins do not need to turn around, and considering the compactness of the structure, I used a steering gear as a power source, which can reduce the design difficulty and improve the stability of the transmission[3].

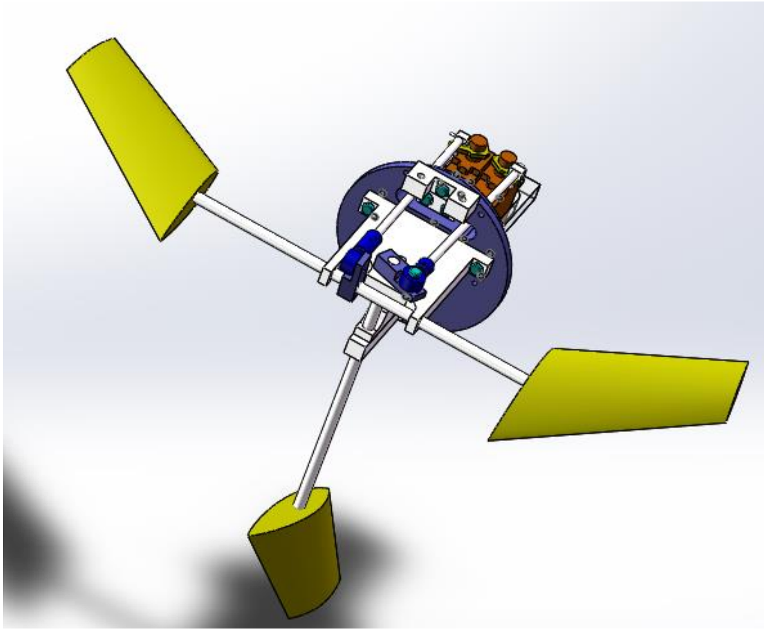

Fig. 5

The figure above is a diagram of the transmission mechanism of the side fins. The rudder is used to drive the rocker arm to drive the side fins to perform lift control.

5. SHAPE DESIGN

Bionic mechanical fish must meet the following requirements:

1) In the absence of breeding, its buoyancy is slightly greater than its own gravity, and then its buoyancy and gravity are equalized by the weight.

2) The size should be similar to that of tuna

3) The appearance should be as streamlined as possible to reduce the resistance of water to itself

4) The shell should have waterproof measures

In order to reduce the resistance of water to the fish itself, taking the shape of the tuna as a reference, the tuna is cross-sectioned at different positions, and each cross section is staked out in solidworks to form a bionic fish shell resembling the shape of tuna. The material of the outer shell is more suitable for plastics, which can reduce the weight, facilitate the injection molding, and avoid the problem of rust in water.

After the exterior design is completed, the installation position of each institution must also be taken into consideration, so that the bionic fish can achieve the best results in terms of weight, coordination, control ability and space allocation. Through the overall analysis of various agencies, the various departments are modularized and divided into power modules, control modules, direction adjustment modules and power supply modules. In order to make the center of gravity as far forward as possible, after repeated calculations and modifications, and finally obtained as shown in the figure. Institutions, and through the gravity center of the buoyancy center of the calculation and weight, so that the bionic mechanical fish can swim smoothly in the water.

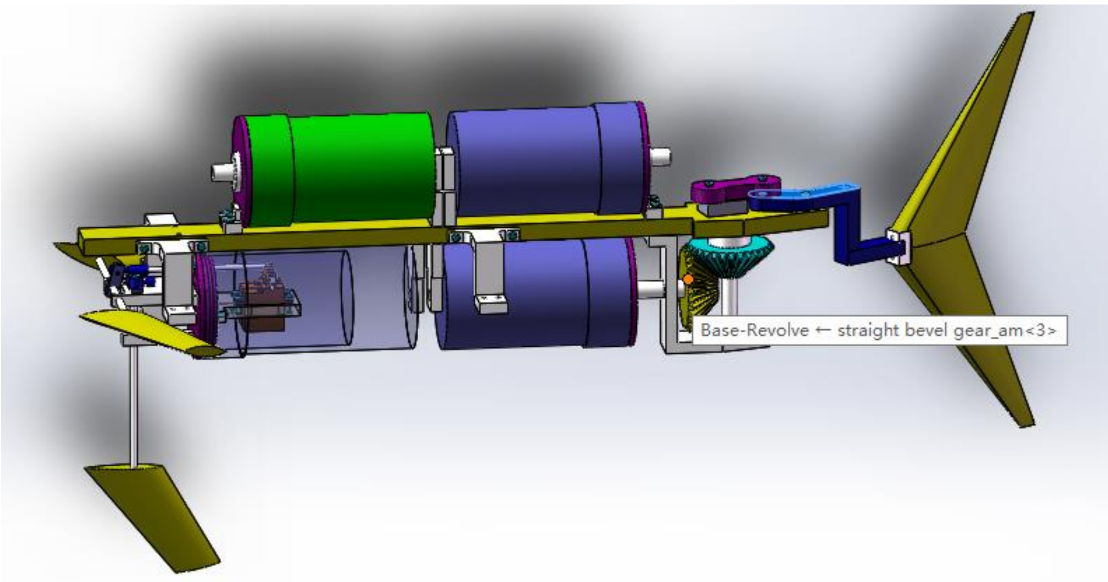

Fig. 6

6. ADD A CONSTRAINT

Nature is full of wisdom. It creates our beautiful world and integrates our wisdom into this world in the process of creation. Therefore, bionics is a good way for us to explore natural wisdom. Through bionics, we can apply some of the advantages of fish to our real life, thus creating more convenience for humans. In the paper, my main work is:

(1) Design of Bionic Mechanical Floating Mechanism.

(2) Design of Bionic Propeller Fish Tail Propeller.

(3) Design of Bionic Mechanical Fish Shape and Size.

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