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ANALYSIS OF ARTIFICIAL FISH BASED MECHANISM

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Abstract - *The work here describes the efforts made to create a Fish mechanism, particularly aiming at developing a controlled kinematic focused environment to know how to model and propel artificial fishes. Compared to a three dimensional mechanism of artificial fish proposed by Liu, a newly developed fish based mechanism is made which is competent of multidirectional propulsion is considered while analyzing this mechanism and for this all the available propulsion data is studied to know different swimming ways of variety of natural fishes. Later on, the generated swimming information is given as input to the simulator to check the generated swimming propulsion mechanism. Most of the artificial fishes swim by different types of mechanisms which are being designed to validate new innovations to get an improved mechanism matching the actual fish based swimming ways.*

Key Words: Robotic Fishes, Artificial Mechanism, Digital Fish Stimulator, Propulsion modes.

1. INTRODUCTION

Imaginary virtual fishes are being made by different types of artificial fish. Inside the deep water, flow currents, the fishes using own muscles and fins for swimming correctly about fixed obstacle and aquatic plants and different fishes. Fishes use different locomotion in finding food. Huge, hungry monster fishes hunting little fishes. Small fishes swimming comfortably until they see a huge fishes. When a huge fish comes nearby, small fishes try their chances of escape. When a huge fish approaches a shoal, the fishes usually scatters away to save their lives. A chasing starts when the huge selects his food and eats them. Some types of fishes may not trouble by monsters. They find comfortable swimming on floating nearby, while fishes are hungry. The modeling of similar circumstances with performing outputs is needful. This invention, we made a simulation analysis in its scope comes all the mentioned critical patterns of action, without any key framing. The main thing need to accomplish at this critical level, with minimum intervention through designer, that to make a fully working artificial fish having ability of self-swimming. Artificial fishes are the automatic devices whose appearance and moves are almost same like the natural propulsion mechanism. Here researcher have applied compositional way in which we do modeling not only of the shape but the exact movements too, but also the basic physics of fish and its movements, it means of locomotion, its knowledge of world, with its behavior in environment. The holistic nature of this objective is to synthesis a artificial fishes which are important towards achieving natural propulsion swimming mechanism. Partial solutions which are modeled earlier will not produce required outcomes. An early outcome of this research is the computer simulation. The final outcome of this simulation shows different types of artificial fishes feeding in transparent water. Demetry proposed some rules for this analysis by which one can achieve the natural propulsion mechanism in artificial mechanism with minimum input from designer. The matching original view, move, and nature of artificial fishes, and also the locomotion patterns in fishes are found related to the work. We worked to convince for the natural complexity involved in modeling artificial fishes like an Underwater Autonomous Vehicle. To show the movements, we have made use of an artificial sea habitat. The world is occupied by robotic fishes. Swimming propulsion modes available in fishes can be differentiated as shown in below flowchart.

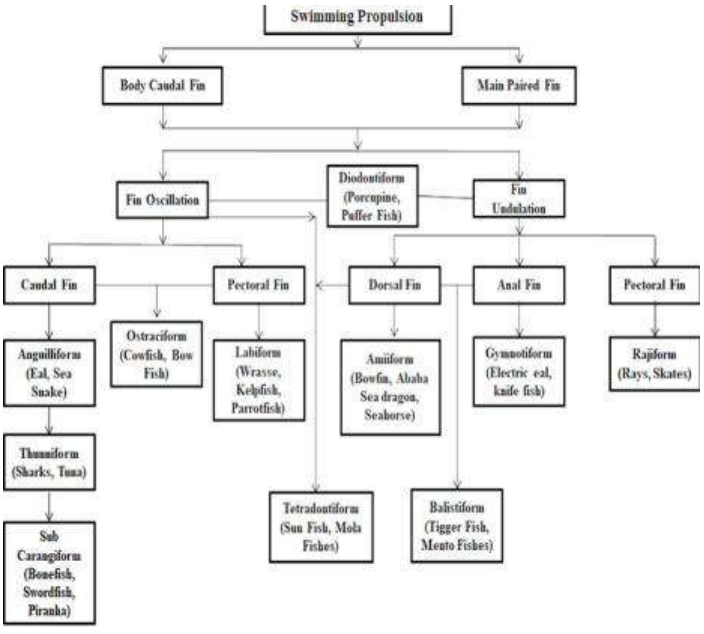

Fig-1 : Classification of fish propulsion modes

which can swim in the artificial water by motor controls and internal muscles that propel fins. Their range of behaviors depends on their view like dynamic habitat. As in nature, the detailed propulsion mechanism of artificial fishes in their artificial habitat is not exactly predicted because these were not documented anywhere. Junzhi Yu developed a good

system called Fish-Inspired propulsive Simulation and Artificial Implementation system. It demonstrated the efforts to build up a Digital Fish Simulator (DFS), particularly resulted in making a controlled kinematic centered marine environment to further explain, how to develop, and design and control artificial fishes. By the outcomes received from the 3D stimulator Liu with Hu prepared a new body wave equation which helped for modeling multidimensional propulsive mechanisms where the data obtained will be further compared to different propulsion types. Thereafter, the propulsion data received by the system will be directly being fed in the fish robots for verification. Then artificial fishes with changed mechanical designs are being built to check the idea correctly and to reach a new level of achievement similar to original fishes.

2. OBJECTIVES

The Specific Objectives of the paper are:-

1. To study the Fish appendages and their effect.
2. To study of various mechanisms to co relate the actual fish motion in order to create an engineering model.
3. To do synthesis of mechanism for generation of motion kinematics.
4. To model a simple mechanism to be fitted inside fish body and its analysis.

3. SCOPE AND APPLICATION

Useful for Naval forces around the world to make it more capable and strong. We know that actual fishes can perform efficient locomotion in the water. There are about 28, 0000 fish species actually in existence and through years of evolution process, in particular, fishes and cetaceans have evolved with much body changes for moving through the water with great efficiency, speed, maneuverability, and strength, with which further superior to the presently available technology of autonomous underwater vehicles (AUVs). Biomimetic began in the 1960's has changed the entire biomimetic-based technology used in AUVs. Really inspired by the fish's remarkable propulsion abilities and also driven by copying such ability to update the earlier AUVs technology, a large theoretical and actual research has been conveyed out to advance fish artificial. Much effort & practice has been done to the research of artificial fishes. It generally involves kinematic and hydrodynamic analysis, mechanism design, control types and actual physical tests. It is anticipated that the artificial fishes with powerful motion capabilities in turn be more competent for water-based applications like underwater activities, oceanic surveillance. The main aim of fish propulsion is that there isn't any perfect artificial fish which can exactly copy the actual fish motion. A new discovery has put forward that actual fishes depends on multiple surfaces for propulsion including those of caudal , pectoral pelvic, dorsal, anal fins as well as their outer body structure to attain fast propulsion means These well-cohesive, configurable many controlled surfaces provide a unique way to create and control underwater systems. It is not easy to totally replicate an actual fish due to the large differences existing in between the actual and man-made habitat. One reason is that tradeoffs in engineering practice will have to be made between artificial mechanisms, engineered method, feasibility & cost/gain. Restricted research related to imitating and achievement of a artificial fishes is made using different type of fins using many different control surfaces, which are necessary for improved performance and steadiness. In consideration to view of artificial fishes and fish schools has been taken into consideration for 3D animation. For example, Tu and Terzopoulos modeled a prototype for behavioral simulation making used a artificial fishes to get exact collective propulsive mechanisms. Actually propelled artificial fishes in 3D artificial habitat are compatible to the action of natural fishes.

Typical applications of robotic fishes are as follow:-

1. Search and rescue.
2. Military reconnaissance and surveillance.
3. Fish habitat monitoring.
4. Museum public interaction and amusement.
5. To develop efficient transportation methods.
6. Environmental/meteorology; e.g., climate study, storm monitoring, general data collection.
7. Ocean photography.
8. Pipeline and oil rig inspection using infrared cameras.

4. RESULTS AND DISCUSSION

The current work is dealt with the simulation of artificial fishes. The efforts have been made towards the modeling of 3D Fish simulator. The developed simulator was compared to the available simulator in literature review to know the betterment in the design of 3D simulator. The fish simulator is used in the kinematic focused habitat. The 3D simulator is able to simulate different propulsion patterns to make the design in generalized form from the simulating point of view. The data obtained as output from the 3D simulator is given to the artificial fishes for checking. From the analysis it has been noted that the deigned 3D model has given better design as compared to the earlier ones.The 3D analysis of the artificial fishes is as discussed below:

The prototypes of the different types of artificial fish are as in shown in the figure 1. 1a to 1f. Respectively.

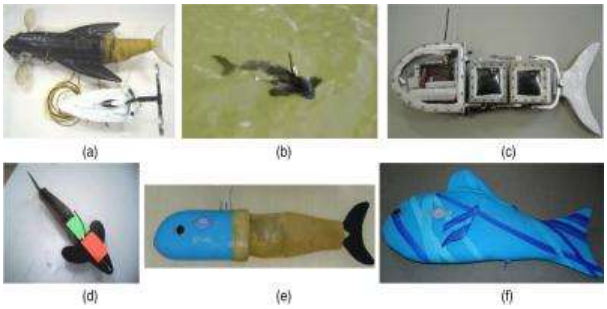

Fig-2: The models for different fishes (Junzhi Yu et al)

(a) Fish 3D model for swimming for mobile sensing application.
(b) Four-link multidimensional artificial fish propulsion 3D model
(c) Fish 3D model with two-module, changed artificial fish;
(d) Fish 3D model three-link artificial fish;
(e) Four bar-link artificial fish with three infrared sensors for obstacle avoidance;
(f) Two-link artificial fish decorated with waterproof clothing.

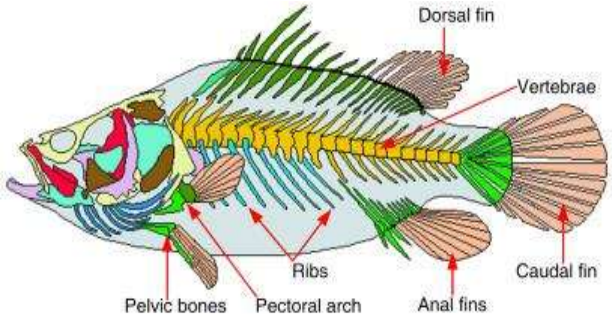

Fig-3: Skeleton of a generalized bony fish (Junzhi Yu et al)

The Skelton of the generalized bony fish is as shown in figure

3. All elements and the terminology are as shown in figure 4.

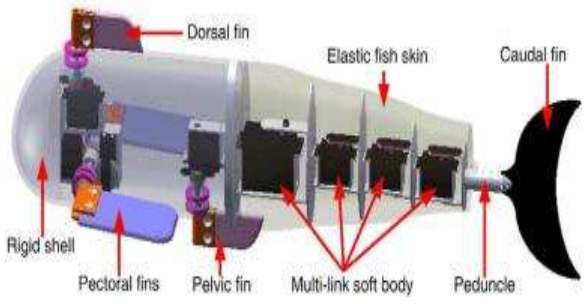

Fig-4: A conceptual design of the artificial fish (Junzhi Yu et al)

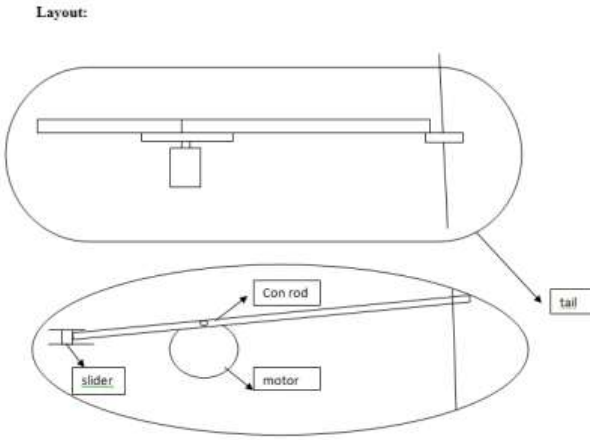

Fig-5: actual optimized model

After understanding the terminology linked with the artificial fishes, the next step is to develop the conceptual model using CAD environment. The developed CAD model for the artificial fish is as shown in Figure 3 and 4 respectively. Limitations are recharging the motor and extra electronic equipment underwater is difficult.

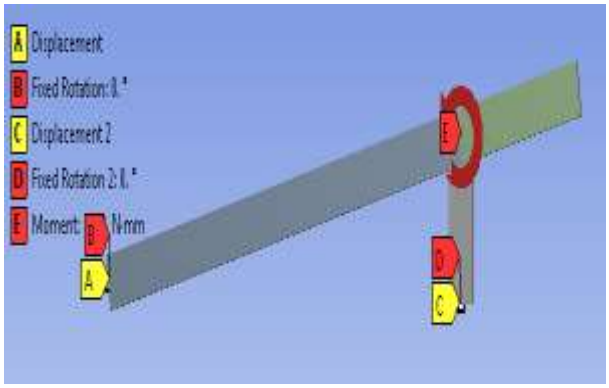

Fig-6 : Boundry conditions

The boundary conditions and the parameters linked to the analysis envirnoment are as shown in figure 5.

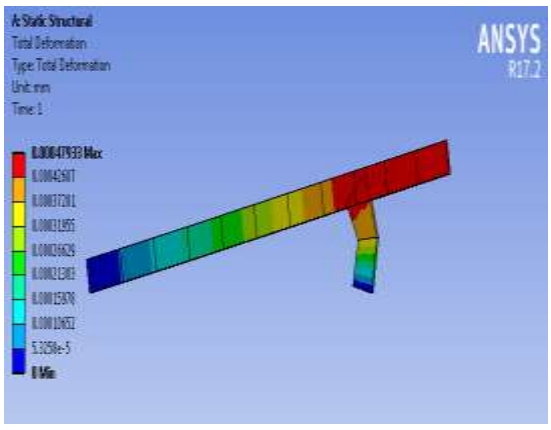

Fig-7: Static structural stress having negligible deformation 0.00047mm.

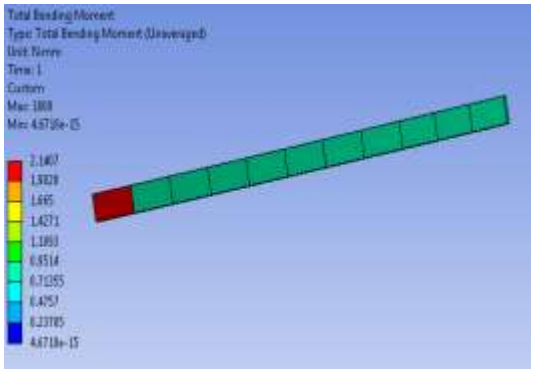

Fig-8 :Safe bending moment

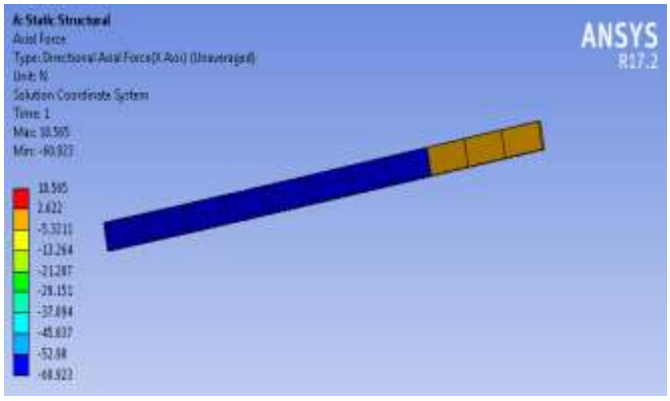

Fig-9: Safe static structure by axial force

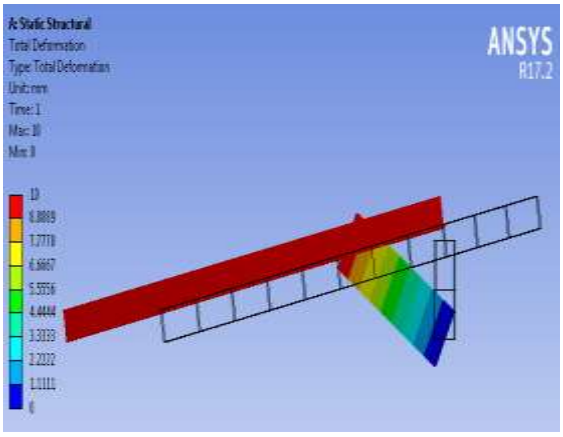

Fig -10: Safe total deformation of static structure

5. CONCLUSIONS

This paper has elucidated a general way of artificial fishes with their realization. In multi-link based propulsion framework, an improvement on widely used mechanism is being made to produce multidimensional propulsion motions. A two direction propulsion data exchange system is well integrated in the model, enabling capture fish propulsion data generated and tested. Accompanying with this software platform, various artificial fishes with their control methods are being studied. However, only simplified kinematical model information is used to achieve fishlike propulsion. The present and hereafter work has focused on going ahead to improve existing model and electronic structure of artificial fishes. Analyzed results are acceptable and if found correct it can proceed to manufacture and test this mechanism so realised.

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