

Enhancement of Marine Communication for Bifurcated Vessels in Small Scale Fishing

SAHAYA ELSI. S[1*], MICHAEL RAJ. F[2], FREEDA.S[3], PRINCE MARY.S[4], C. EMINA. M.S[5]

[1, 5]Department of Electrical and Electronic Engineering, University College of Engineering Nagercoil, (A Anna University Constituent College Chennai), Tamil Nadu, India.

[2]Department of Mechanical Engineering, Stella Mary's College of Engineering, Aruthenganvilai, Azhikal Post - 629202, Tamil Nadu, India.

[3]Department of EEE, Udaya School of Engineering, Tamilnadu, India

[4]Department of CSE, Sathyabama Institute of Science and Technology, Chennai, Tamil Nadu, India.

[*]Corresponding Author: SAHAYA ELSI. S

Abstract

This paper deals with a smart safety system based on the satellite network communication setup deliver with an emergency alert to be stimulated. This device contains strain energy sensor, intrusion detection sensor, Linear Variable Differential Transformer (LVDT) position sensor, communication setup devices. The smart security system is inbuilt in the small scale fishing crafts of canoe (Vallam). It is able to successfully perform operations like switching functionalities, automatic control, and intrusion detection. In the latter case where the message comes, to the smart phone and the emergency team goes on. This work is proposed to the marine security and reporting to help the fisherman in case of broken marine craft and be alert in critical situations to the rescue operations.

Keywords: *Canoe, Strain Sensors, LVDT, Communication Setup.*

Introduction

Shipping is possibly the supreme international of all the world's great industries and one of the most dangerous [1]. In the world of more than 200 million people depending on small-scale fisheries [2]. The small scale fisheries using the fishing crafts consist of 12-meter long equipped with radar, satellite navigation, hydraulic steering, net-hauling and a life saving fleet manned by a person yet catching half a ton per fishing day [3].

 https://doi.org/10.37896/pd91.4/91417

India has a 7517 km long marine coastline and nearly 14.5 million fishermen working in fishing activity. In 2010, Indian fishermen were accompanied by 1.8 million of traditional craft, 0.36 million motorized traditional craft, 0.05 million mechanized boats, and 2350 deep-sea fishing crafts. However, 95 % of fishermen utilize GFRP material for manufacturing small-scale marine craft like a catamaran, canoe for fishing. These crafts are glass fiber reinforced plastic (GFRP) laminates have been used to fabricate [4–6] a wide variety of maritime vessels. It is suitable for the ability to absorb vibration and shock waves.

The design and fabrication of small-scale fishing crafts industries to get the necessary technology are now proven and available in coastal hamlet without sophisticated equipment and skilled workers. When it is loaded, the hull structure elastically absorbs strain energy and then releases it [7]. However, the most important aspects of fishing boat design are hull shape because it affects boat stability and seaworthiness. Good stability and seaworthiness make the boat control easy. While designing the structural integrity of a small scale fishing craft, the factors to be considered are slamming wave pressure, impact loading, crew weight, at no-load, full load and also on inertia load [8, 9]. After fishing, the vessel weight increases, this leads to an increase in the slamming wave pressure and rudder loading. The strength and load-bearing capacity of the hull mainly depends on the joints and strength of the stringers [10 -13]. In running small-scale fishing craft, the impact failure can be minimized by the vessel speed during rough sea surface conditions. The vessel should be carefully operated at an optimum speed in all sea waves and surface integrity [5]. Due to this sudden impact, the craft breaks and results in split or breakage.

These small scale fishing crafts have to withstand the rough sea storm surge and turbulent wave movements. Due to these adverse conditions, accidents occur which results in loss of life and wealth. Every year, nearly 24,000 deaths occurring as fishing accidents, besides, an estimated 24 million non-fatal accidents happen throughout the globe. In the developing world, accidents and deaths are frequent in small-scale fishing operations [2]. The year 2012 reported 27,558 marine accidents, including 668 boat collapses that occurred in Tamilnadu, Kanyakumari district administration office informed that nearly 104 fishermen died and 433 missing due to Occhi cyclone on December 1, 2017 [14, 15]. These accidents are mainly due to the breakage of the hull under impact load.

In this paper develop the smart security system inbuilt in canoe and it successfully performs the operations via wireless transmission, to receive information and can be monitored via smart phone. The emergency team can rescue the sinking/swimming fishermen due to the biffercation of the hull.

Experimental Procedures

Tungsten Wire

In this work, a vacuum heated Tungsten wire of diameters 0.5 mm, and 0.2 mm, length of 20 m, 7.2 m respectively were purchased from JP metals, New Delhi. This filament is knotted to the distance of every 0.5 m. This has more grips on the hull structure with filament of the craft of polyester matrix coating.

Strain Gauge Sensor

This load sensor is a group of a half-bridge strain gauge ways to use four sensors to form a full-bridge measurement range of 200kg. The manufacturer part number of the strain sensor is SPA-SPBGBOA3247.

Linear Variable Differential Transformer (LVDT) Position Sensor

The LVDT is the linear displacement from a mechanical reference into a proportional electrical signal containing phase and amplitude of information. The manufacturer part number of the LVDT position sensor is Holstein 2PS0299.

Fabrication of Canoe

The materials used to construct GFRP boats include glass fiber mat, woven roving, resins, catalyst, accelerator, pigments, filler materials of wax, modeling clay and releasing agent with accessories of brushes, acetone, etc. The layer pattern depends on the thickness and number of plies to satisfy the functions and shapes. The building process of canoe by hand lay-up technique at low-temperature curing.

 https://doi.org/10.37896/pd91.4/91417

ISSN: 0369-8963

GFRP female mold surfaces are to be cleaned by using cotton and a very thin layer of wax applied on the surface of the mold. Poly Vinyl Alcohol (PVA) agents are mixed with water and applied to the female mold. This agent is used for easy separation of the mold and boat hull. The color may be used as a pigment, mixed with the accelerator, gel coat, and catalyst. They are stirred and relevant to the surface of the mold. Normally, curing time for the mold is a minimum of 1 to 2 hours.

After making the required thickness at the bottom of the craft, wooden pieces/stringers are used to strengthen the inside surface. The stringers are fixed on the surface of the boat hull by applying a compound of paste. To strengthen the stringers of single skin hull surface of crafts, it is covered by the mat and woven roving. At the final stage, the mold will be removed for the construction of single-hull surface of the fishing craft.

Experimental work Conducted on Canoe

A simple type of fishing craft used for fishing within short distances from the coast is called canoe and the experimental work conducted the canoe as shown in Figure 1. In this experiment, the length of canoe is 24ft, breadth 6ft, and height 3-3.5 ft, the outboard engine power of the boat is 15 HP. The bottom hull of the craft is built by a tungsten filament, covered by the glass fiber with the polyester matrix as indicated in Figure 2 (a). One end of the filament is connected to the strain gauge sensor, LVDT position sensor and communication kit are covered by a front top hull as shown in Figure 2 (b).

Figure 1. The Image of Canoe of Fishing Craft

 https://doi.org/10.37896/pd91.4/91417

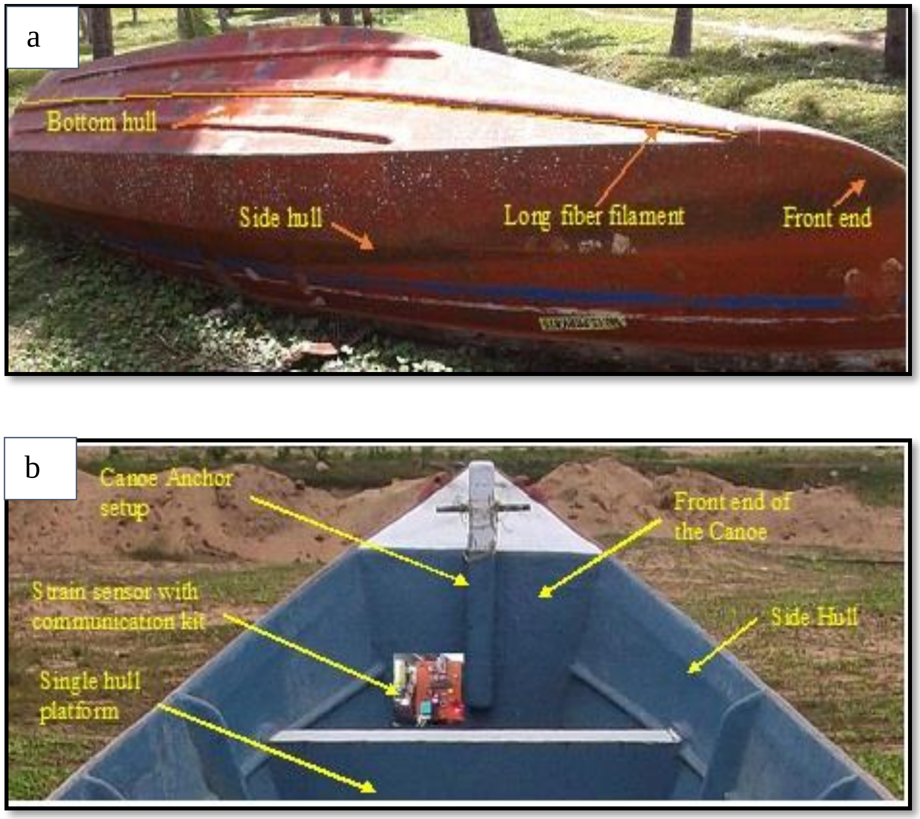


Figure 2. The experimental setup installed by the hull structure of the Canoe.

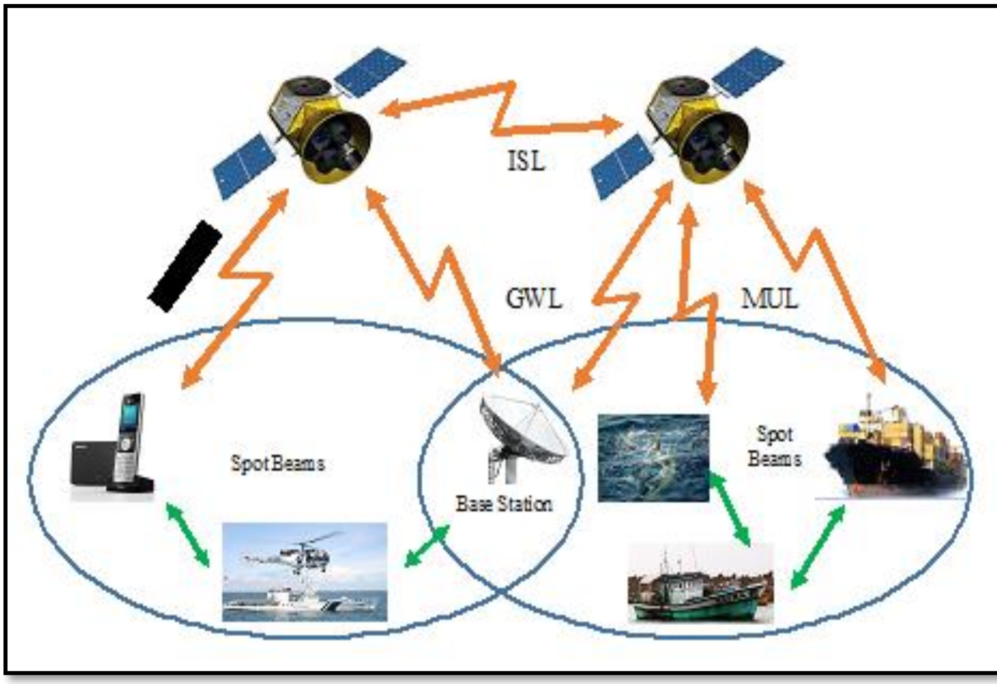
Communication kit

The smart sensor includes basic blocks for signal conditioning, digital signal processing (DSP), and A/D conversion. Let us briefly mention some of the issues here.

Gateway link (GWL) consists of a satellite modem for demodulation of signal from the satellite to data packets to be sent to the local network. Also, GWL is connected to the base station and the maximum uplink rate is 1000 Mbits/sec. The mobile user link (MUL) is connected from the base station to the mobile user or base station to satellite. The Inter-Satellite Link (ISL) is used to communicate between various satellites. The entire communication process is shown in figure 3foran operating a ship or mechanized boats or small scale fishing crafts through mobile users.

 https://doi.org/10.37896/pd91.4/91417

ISSN: 0369-8963



ISL – Inter-Satellite Link, MUL – Mobile User Link, GWL – Gateway Link

Figure 3. The perfect functions of the communication setup

Figure 3 shows the perfect functions of the communication setup that is used to communicate the messages of a moving small scale fishing craft through mobile users. If anyone in the ground call, the person in the ship or crafts, the signal will be given to the satellite receiver. This satellite searches the corresponding end-user of mobile, using ISL of various satellites. Once the base station of the corresponding mobile user is traced, the connection is given to MUL of the approximate base station. This data is received and transmitted to the corresponding end mobile user. For the data and text transmission, we can use GWL for uploading and downloading data through the base station. Also, data or connection between different ships or mechanized boats or small scale fishing crafts is possible due to the presence of their individual base station.

Descriptions of the work

The experimental work can be carried in the small scale fishing craft for sailing. The sensors, communication setup and strain gauges are attached to the top hull portion of the craft. Case: 1 indicates the wave height of 1.0 m and case 2 shows the wave height of 1.5 m and

 https://doi.org/10.37896/pd91.4/91417

similarly in case 3 of wave height 2.0 m. Case 4 indicates the wave height of above 2.0 m at the core displacement is high when compared to others The flow diagram indicates the sequence of various operations on the craft during sailing operation as indicated in Figure 4. The communication setup will operate the signals through the related network processes going in ON condition.

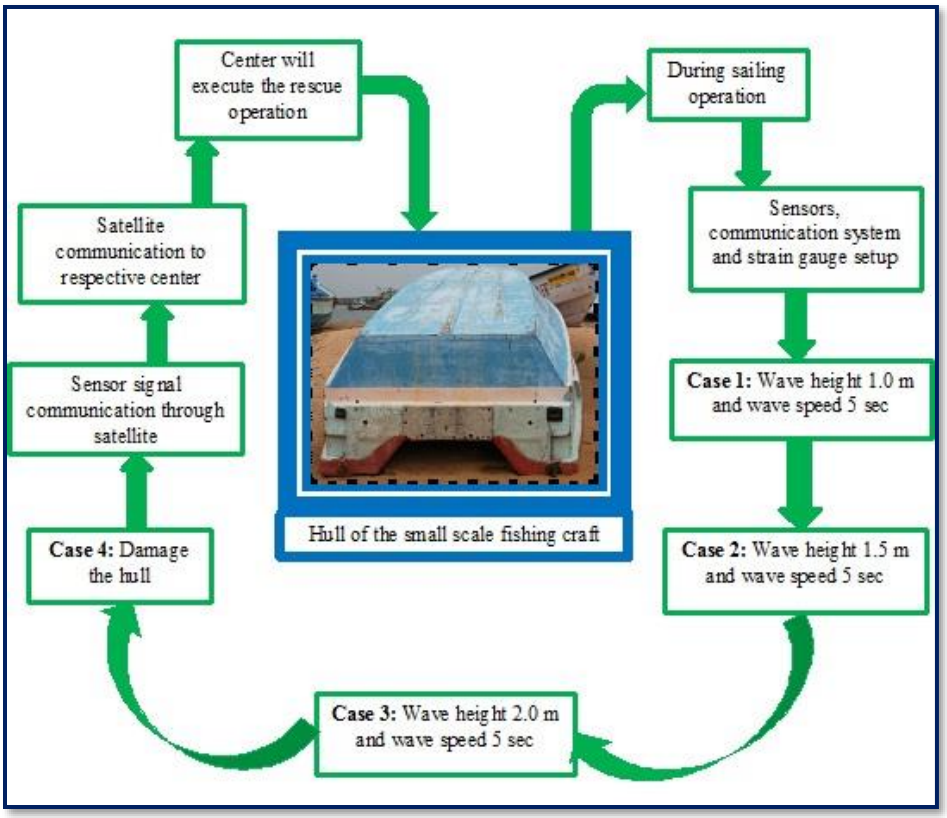


Figure 4. The Flow Diagram of Signal Communication during Sailing of the Craft

Results and Discussion

Conditions of the seashore

At the seashore originates a normalwavelength of 30-200 m and at a period of 1-30 sec, and wave speed of 15-115 km/hr. The wave height of minimum 1.0 m and the wave speed of 5 sec induced in the month of March, April, May, October and December of every year. However, the normal wave direction from the shore of depth is 6 m. The deepwater wave direction with

https://doi.org/10.37896/pd91.4/91417

ISSN: 0369-8963

respect north is 180 degrees for March and December and 271 degrees for April, May, and October. During this period sailing in the sea through small scale, crafts are smooth.

The common elements of seashore showed in the wave height of 1.5 m and the wave speed of 5 sec induced in the month of January and November of a year. However, the deepwater wave direction with respect to North is 180 degrees, for November and 360 degrees for January. This period of sailing on the sea in small scale crafts had some irregularity due to inappropriate wave height.

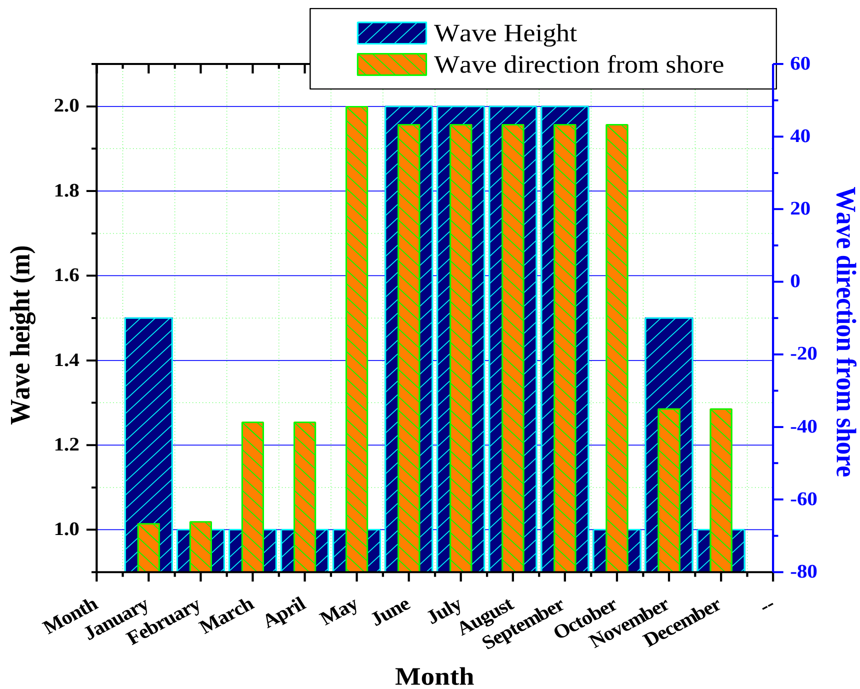


Figure 5. Month Vs Wave Height and Wave Direction from the Seashore.

The wave height of 2.0 m and the wave speed of 5 sec or 6 sec induced in the month of June, July, August, and September of a year. However, the deepwater wave direction with respect north is 270 degrees in the above months. This period for sailing into the small scale crafts is found rough due to high slumming wave pressure as it is indicated in figure 5.

https://doi.org/10.37896/pd91.4/91417

ISSN: 0369-8963

Communication during sailing of the craft

The setup installed in the small scale fishing craft of canoe as shown in figure 6 (b) and 8 (b). When the vessel of the canoe is sailing on the sea during the period of a year; the wave height of 1.0 m (Case 1) and the core displacement maximum of 1.93 mm with output volt is 0.562 V and the induced strain is 22. At that time, there is no deformation of the tungsten filament attached to the bottom hull of the small scale fishing craft. When the craft is sailing on the wave height is 1.5 m (Case 2) the core displacement of maximum is 2.71 mm, output volt is 1.124 V and the induced strain is 72. During sailing of the craft at the wave height is 2.0 m (Case 3) the core displacement is a maximum of 3.62 mm, output volt is 1.496 V and the induced strain is 83 as depicted in table 1.

Table 1. Relations of input and output elements of the Canoe.

Wave height (m)	Core displacement (mm)	Output (Volt)	Induced strain
1	1	0.412	15
1	1.20	0.456	18
1	1.52	0.527	20
1	1.85	0.540	21
1	1.93	0.562	22
1.5	2.03	0.891	47
1.5	2.35	0.968	52
1.5	2.51	0.994	56
1.5	2.63	1.054	61
1.5	2.71	1.124	72
2	2.82	1.392	79
2	3.12	1.451	81
2	3.22	1.365	78
2	3.45	1.482	82
2	3.62	1.496	83

 https://doi.org/10.37896/pd91.4/91417

When the canoe was sailing during the period of a year; the wave height of 1.0 m (Case 1) and the core displacement maximum of 0.58 mm with output volt is 0.228 V and the induced strain is 6. At that time, there is no deformation of the tungsten filament attached to the bottom hull of canoe. When the craft is sailing on the wave height is 1.5 m (Case 2) the core displacement of maximum is 0.88 mm, output volt is 0.386 V and the induced strain is 14. During sailing of the craft at the wave height is 2.0 m (Case 3) the core displacement is a maximum of 1.08 mm, output volt is 0.521 V and the induced strain is 24 as represented in table 1.

The wave height of more than 2.0 m during sailing the craft is not in stable condition due to the speed of the wave and the speed of the craft. In such conditions, the structural integrity of a small scale fishing crafts to be considered are the slumming wave pressure, impact loading, and crew weight, at no-load, full load conditions and inertia loads. After fishing, the vessel weight increases due to the slumming wave pressure and rudder loading. FRP material under fatigue conditions exhibits complex failure mechanisms such as matrix cracking, fiber breakage, ply delamination and interfacial bonding. Marine composite structures or vessels are mainly failed due to impact loads even though other loads are predominant.

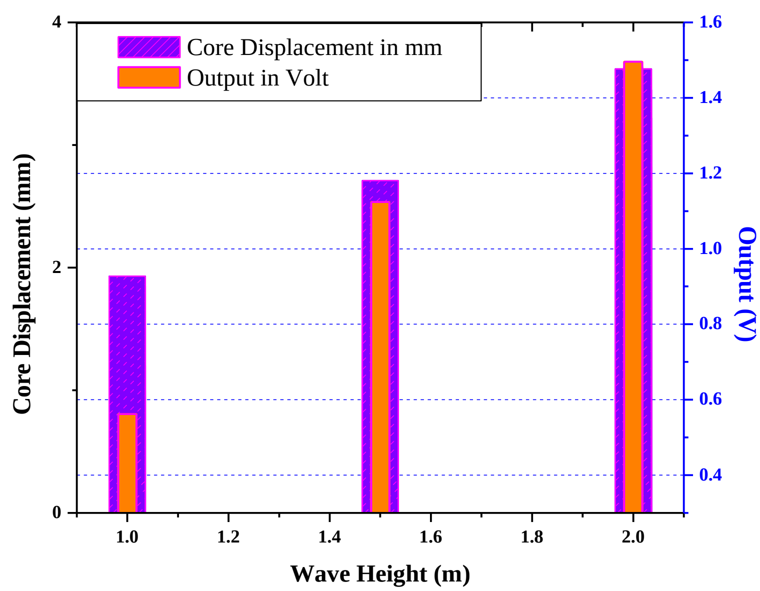


Figure 6. Various factors related to the wave height of Canoe.

https://doi.org/10.37896/pd91.4/91417

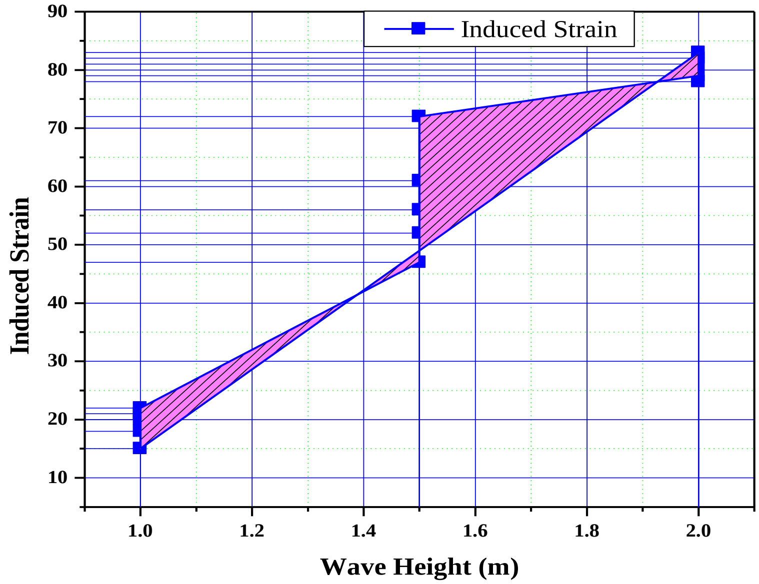


Figure 7. Different wave height Vs induced strain of the Canoe.

The small scale fishing crafts of canoe sails in rough sea on storming at high speed of wave height 2.0 m, the front portion of the bottom hull is up to the waterline and when sudden fall occurs due to short wave or dropping the speed suddenly, heavy impact blow is developed at the bottom of the hull which leads to the failure of the hull surface. Due to this sudden impact, the fiber in the craft breaks and results in split or breakage of craft. In the small scale fishing crafts, the impact failure can be minimized by the vessel speed controlled during rough weather conditions. The vessel should be carefully operated at an optimum speed in all sea waves and surface integrity. An increase in the induced strain of the craft also increases the displacement and proportional to the output voltage as depicted in canoe of figures 6 & 7.

Conclusion

The smart security system is built in the small scale fishing craft of canoe of tested under the wave height of 1.0 m, 1.5 m, and 2.0 m and revealed the results as given below.

- When the craft of canoe, the wave height of 1.0 m and 1.5 m, the induced strain rate, and core displacement are normal or without breakage of hull or tungsten wire.

https://doi.org/10.37896/pd91.4/91417

- The wave height of above 2.0 m, the strain rate, and core displacements are high of the craft of Canoe.
- The breakage of the tungsten filament due to the hull structure of the small scale fishing crafts of Canoe and it is able to successfully perform the operations.
- The wave height of below 2.0 m was good stable conditions and seaworthiness of the craft on sailing the canoe.

The smart security system helps the fisherman in case of broken marine craft and alert tham in critical situations to the rescue team. This system is more helpful for the fisherman during fishing and the application of small scale fishing craft like canoe (Vallam).

References

[1] International Maritime Organisation. (2004), *Introduction to IMO*. Retrieved 14/5.

[2] Jan Lehmkoster. Tim Schroder. Dimitri Ladischensky. Jorn Schmidt. Rudiger Voss. Kirsten Schafer. Simone Hoschack. Petra Kossmann. Peggy Wellerdt. Walther-Maria Scheid., and Druckhaus Berlin-Mitte. (2013), *World ocean review, living with the oceans. The Future of Fish – The Fisheries of the Future, maribus*, Hamburg.

[3] Mohamad Zawahid bin Shamsuddin., and Emil Ragnarsson. (2003), *A Conceptual Design of a Fibre Reinforced Plastic Fishing Boat for Traditional Fisheries in Malaysia*, Fisheries Industry Development Division, Fisheries Development Authority of Malaysia.

[4] Chandrika Sharma. (2006), *Sea Safety of Small-scale Fishers, Sea safety programmes for artisanal and small-scale fishing communities: Role of gender*, Bay of Bengal News - Chennai, India.

 https://doi.org/10.37896/pd91.4/91417

[5] Fisheries Policy note 2012-2013. (2013), *Animal Husbandry, Dairying and Fisheries Department*, Government of Tamilnadu.

[6] Michael Raj. F, Vinod Kumar. K. P, Sahaya Elsi. S., and C. M. G, Jersy. (2018), Hybrid composites with discarded fishnet and polyester: a novel boat-building material. *Ships and Offshore Structures*, 14(6): 1-s to 8-s.

[7] Michael Raj, F,. Nagarajan, V. A & SahayaElsi, S,. (2016). Mechanical, physical and dynamical properties of glass fiber and waste fishnet hybrid composites. *Polymer Bulletin*, 74 (5); 1441-s to 1460-s.

[8] Amala Mithin Minther Singh. A, Michael Raj. F, Arul Franco. P., and Binoj. J. S. (2018), Evaluation of mechanical behavior of multifilament discarded fishnet/glass fiber and polyester composites for marine applications. *Marine Structures*, 58: 361-s to 366-s.

[9] Michael Raj. F, V. A. Nagarajan. S. Sahaya Elsi., and R. S. Jayaram. (2016), Effect of fiber content on flexural properties of fishnet/GFRP hybrid composites. *Steel and Composite Structures*, 22(1):13-s to 24-s.

[10] Jan Lehmkoster. Tim Schroder. Dimitri Ladischensky. Jorn Schmidt. Rudiger Voss. Kirsten Schafer. Simone Hoschack. Petra Kossmann. Emanuel Söding. Martina Zeller., and Walther-Maria Scheid. (2010). *World ocean review*, maribus, Hamburg.

[11] Eva Munk-Madsen. Helga Mathiassen., and Anders Barfod. (2012), Fishing for the Millennium Development Goals; Sea small-scale fisheries showing the way forward, *Danish Society for a Living*, Denmark.

[12] Paul Zajicek. Scott Hardin., and Craig Watson. (2009), A Florida Marine Ornamental Pathway Risk Analysis. *Reviews In Fisheries Science*, 17(2): 156-s to 169-s.

[13] Michael Raj. F, V. A. Nagarajan., and S. SahayaElsi. (2017), Mechanical Characterization of Discarded Monofilament Fishnet/Glass Fiber and Polyester Hybrid Composites. *Indian Journal of Ecology*, 44(2): 402-s to 409-s.

[14] The Hindu Newspaper entitled. (2017), District Administration’s Estimate, and Need a centralized monitoring system, say fishermen, *on December 31*.

[15] The Hindu Newspaper entitled. (2017), Fishermen must have good communication gear, *on December 16*.