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Navigation of a Boat using the FUEL CELL Integration and sea border identification using embedded system.

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ABSTRACT- **All-electric ships (AES) are considered as an effective solution for reducing greenhouse gas emissions as they provide a better platform to use alternative clean energy sources such as fuel cells (FC) in place of fossil fuel. Even though FCs are promising alternative, their response is not fast enough to meet load transients that can occur in ships at sea. Therefore, high-density rechargeable battery storage systems are required to achieve stable operation under such transient. This paper presents an intelligent FC power management strategy to improve FC performance at various operating points without employing dc/dc interfacing converters. The proposed method presents a Fuel cell based fishing system which can runs the boat upto 10 years without the usage of diesel, without employing dc/dc interfacing converters. The main objective of the paper is to help the fishermen not to navigate beyond other country's border. If a fisherman navigates beyond the country's border, an alarm is generated indicating that the fisherman has crossed the border. Additionally, a ZIGBEE transmitter interface will send a message to base station located on the sea shore indicating that a boat has crossed the border. Along with this, we have developed a cost-effective system for marine internet connectivity that provides assured 80+ km range which provide the weather informations to the fisherman from the base station. Along with this, an object sensor is placed to indicate the overload of the ship. Alarm will be generated to indicate about the overload of the boat. On the whole, it is an attempt to build a suitable device for the fishermen at a reasonably low cost.**

Index Terms- All-electric ships, FC control strategy, FC power Management, fuel cells, genetic algorithms, ZIGBEE.

I.INTRODUCTION

ELECTRIC Ships are becoming popular as a promising way of reducing greenhouse gas emission and dependency on fossil fuels. In addition to the use of electric propulsion, AESs increasingly employ alternative energy sources such as Fuel Cells (FC), solar cells, thermo-electric generators, wind energy conversion systems etc. Schematic of an example future zero emission AES, incorporating a FC stack, battery pack, super-capacitor bank and a photovoltaic (PV) power sys- tem, is shown in Fig. 1. Owing to the recent advancements fuel cells have become the most promising renewable energy technology that meet power levels in AES, ranging from several hundreds of kilowatts to several MWs. The well-known slow dynamic response of FCs requires support from energy storage systems such as lithium-ion battery with the fast-changing dynamic loads. The key requirement identified for the successful amalgamation of FCs and batteries is the efficient and intelligent power management between the two systems. A predictive control based strategy is reported for power management in a tramway that uses FC, battery and super-capacitors hybrid system. In this system, the main source is the battery and thus the power management is based on the battery State of Charge (SoC) constrains, especially in regenerative braking conditions and there is no control on the FC inputs and super-capacitor hybrid system. In this system, the main source is the battery and thus the power management is based on the battery State of Charge(SoC) constrains, especially in regenerative braking conditions and there is no control on the FC inputs. The efficiency of a working hydrogen fuel cell is directly proportional to the single cell voltage within the fuel cell stack. Therefore, drops in the FC voltage due to abrupt load power in- crease result in FC stack efficiency drops. In general, batteries are also connected to the main DC-link through an interfacing DC/DC converter. Therefore, the DC-link voltage could be tightly regulated through this arrangement. In some reported work, the battery is directly connected to the main DC bus bar.. The FC interfacing converter adjusts to the changes in the DC-link voltage while tracking the reference power.In some other cases, the FC is directly connected to the DC-link while the battery is connected through a DC/DC converter.. This paper presents a novel control method for the FC-battery hybrid systems that does not use interfacing DC/DC converters. independent input parameters and the FC output voltage as the target parameter by applying GP technique. The proposed method can adjust the input factors within the permissible range by using the Genetic Algorithm (GA) technique for a given output voltage and ensure the optimized FC performance without employing DC/DC interfacing converters. Ensure the optimized FC performance without employing DC/DC interfacing converters.

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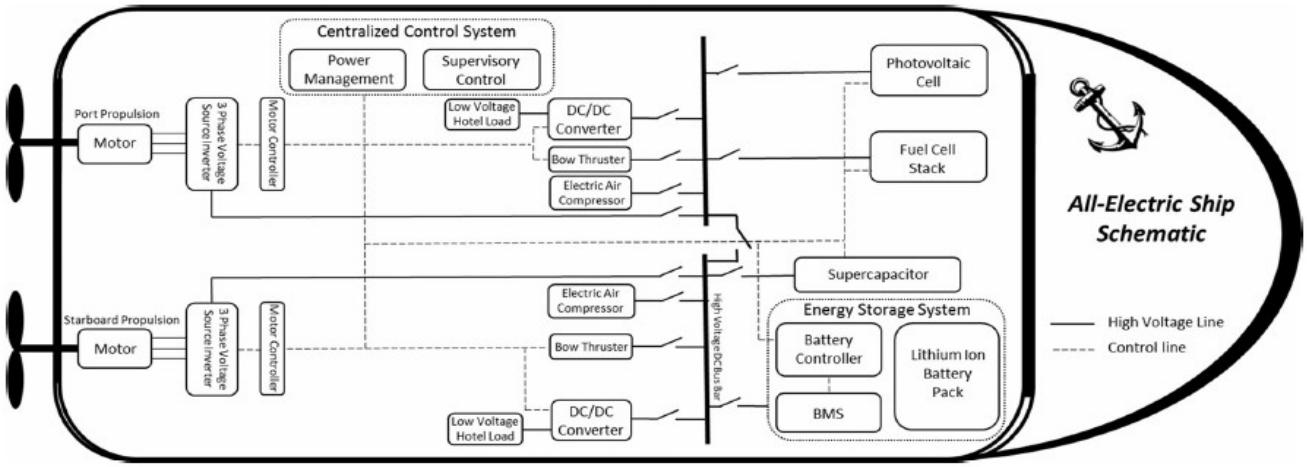

Fig. 1 Schematic diagram of a future zero emission of all electric ships

DC/DC interfacing converters. Ensure the optimized FC performance without employing DC/DC interfacing converters.

Nowadays many fisherman and people are traveling in sea are punished by other country due to crossing border. This is happening because they don't know the border limit when in sea. To help those people this project is designed. In this project ZIGBEE and embedded system plays a major role. This project consists of two units named control unit and guiding unit. Control unit is placed in the base coastal region, and guiding is placed with the fisherman. Control unit consists option keypad, embedded system and transmitter. Power supply unit supplies essential power required to this system. Option keypad uses to inform the emergency signals to the fisherman like rain, tsunami, etc. when a key is pressed in keypad embedded system receive that signal. Embedded system is programmed to analyze the signal and it is given to the transmitter through encoder. Whereas signal from the embedded system is a digital signal that can't be transmitted directly with the help of encoder, system is programmed to analyze the signal whether it is for emergency or crossing border. If it is emergency , it display that emergency condition in a display. If it is a crossing border signal it activates the alarm driver to produce alarm sound indicate the people. Voice Synthesizer and speaker used to produce the corresponding voice announcements. ZIGBEE receiver is used corresponding voice announcements. ZIGBEE receiver is used Voice Synthesizer and speaker used to produce the corresponding voice announcements. ZIGBEE receiver to identify the location of the boat or ship. Therefore this system protects fisherman and boating man from emergency cases as well as from the crossing country border.

II. ALL-ELECTRIC SHIP DRIVELINE MODEL

Physical testing of AESs and their experimental verifications are both expensive and extremely difficult. Therefore, simulation models are used to facilitate the design, system analysis and optimization process in such systems . Priceless research works are reported on the AES modeling. This paper is focused on the FCAES mode DC on- board power distribution system as shown in Fig. 1.The AES model consists of a number of sub-systems and components; including propulsion electric motors, voltage source inverters, motor controllers, HV energy sources and associated control systems, renewable energy sources and associate control systems, propulsion blades, coupling mechanical shafts and the vessel's body dynamic model. Such systems can be simulated as a structural or functional model systems.

This paper is focused on the FCAES modeling using a DC onboard power distribution system as shown in Fig 1. The AES model consists of a number of sub-systems and components; including propulsion electric motors, voltage source inverters, motor controllers, HV energy sources and associated control systems, renewable energy sources and associated control systems, propulsion blades, coupling mechanical shafts and the vessel's body dynamic model. Such systems can be simulated as a structural or functional model. Structural model is based on interconnecting individual sub-system models according to their physical structures, whereas a functional model is based on interconnecting mathematical equations of all sub-

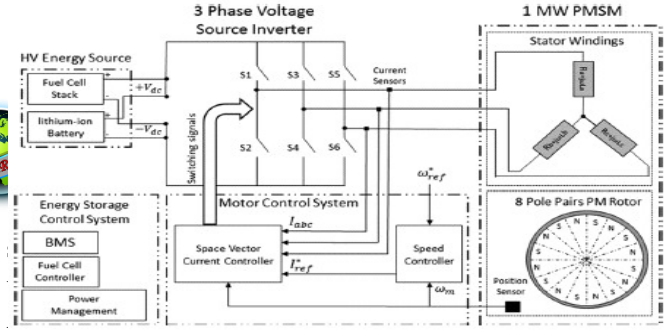

Fig. 2. Schematic diagram of the simplified AES driveline including the modeled 1 MW PMSM drive.

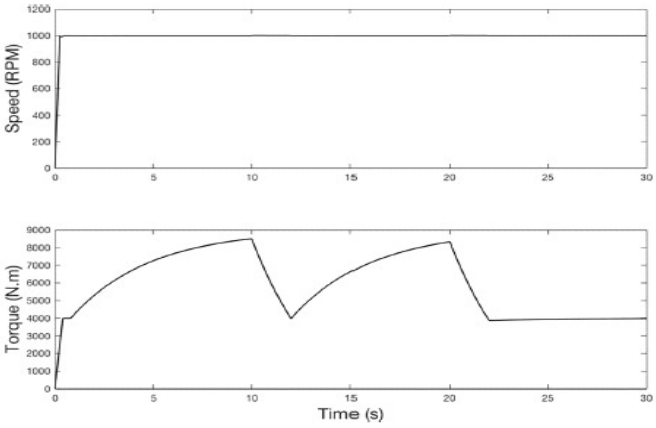

Fig.3. PMSM speed and torque characteristics.

combined with space vector-based hysteresis current controller, proposed by Deyetal; Both energy sources are connected in parallel and used to model the AES driveline. The PMSM control drive includes a closed loop Proportional Integral (PI) speed controller that regulates the motor current through a space vector-based current controller to deliver the required torque to maintain the reference speed. The motor model is developed according to there all data of MJB0500 MB8PMSM from Marelli Generators.

III. MODELING BY THE GENETIC PROGRAMMING

GP is among artificial intelligence methods which first developed by Koza, whereby computer programs are encoded as a set of genes . Then an evolutionary algorithm is employed to modify (evolve) the genes in the form of an Evolutionary Tree (ET) structure. The chromosomes in the resulted genes (sub- ETs) and may contain input parameters (in this paper, FC operation parameters), constants or including current density, fuel cell temperature, anode humidification temperature, cathode humidification temperature, FC operating pressures, oxygen flow rate, air flow rate and active surface area of FC were used to model performance of three types FCs. More than 90% accuracy was achieved in the proposed models. Chakraborty has proposed a time-series GP to predict the variation of FC stack voltage with changes in the fuel utilization factor. Accuracies parameter affecting power characteristics of the considered FC. Drachetal and Hershkovitzetal have utilized impedance mathematical functions. GP has been employed by a wide variety of engineering fields for modeling at get parameter which depends on various independent input parameters. FC is one of the interesting electrical devices which its performance strongly depends on several independent operational factors. In a previous study presented in, voltage of the proton exchange membrane FC is predicted by GP as an index of its performance.. Power density and open circuit voltage were targeted for modeling based on three inputs parameters including methanol flow rate, methanol concentration and the cell temperature. They have found Methanol concentration the most important types of FC.

A. Data Collection

The GP model in this paper was used to correlate the DC bus voltage (V) as the target parameter to air flow rate (A), fuel flow rate (F) and FC current (I) as independent input parameters. In addition to discrete modeling where a set of data are trained by the model, GP can provide continuous modeling to correlate a graph to its multiple input parameters. The simulated V, A, F and I graphs were finely digitized and a total number of 149,930 datasets at time intervals of 0.0002 s were acquired. Table I illustrates the statistical values for all input and output parameters. The achieved dataset was then randomly divided to 104, 950, 22,490 and 22,490 sets and used for training, testing and validating of the GP model to use.

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B. Genetic Programming Model

GeneXPro Tools 4 was used as the modeling platform to predict FC output voltage in terms of the air and fuel flow rates Parameter Minimum Maximum Range Average Standard deviation Sample variance Median Skewness Kurtosis as well as the FC load current. Basic operators including addition, subtraction, multiplication, division and other functions includingx^2,x^3,x, $3\sqrt{x}$,ex and ln(x) were considered as possible candidates for selecting the best choice of functions. The parameters used for the proposed GP model is summarized in Table II. Among these parameters, number of chromosomes, head size, linking function and number of sub-ETs are the most important factors which can primarily determine the accuracy of the model. Maximum number of chromosomes in each sub- ET is chosen 30 in this mode. The most acceptable method is to consider one sub-ET with a random value for number of chromosomes and head size and train the model. These values are then increased to improve the accuracy of the model. For complicated models with a substantial number of dataset, it is impossible to attain a model with high accuracy using a single sub-ET. Therefore, other sub-ETs are added and a linking function is selected to give the final equation. Addition was found to be the best linking function among all avail- able operators that resulted in a model which best represented the dataset.

C. Genetic Programming Results

The FC voltage equation is derived off-line by applying genetic programming using GeneXPro Tools 4 from the collected data of the system under predefined test conditions. However, optomisation of the derived equation by genetic algorithm is acquirable in a few milliseconds. The coefficient of determination R2, Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Relative Absolute Error (RAE) and Root Relative Square Error (RRSE) are used to evaluate the performance of the model

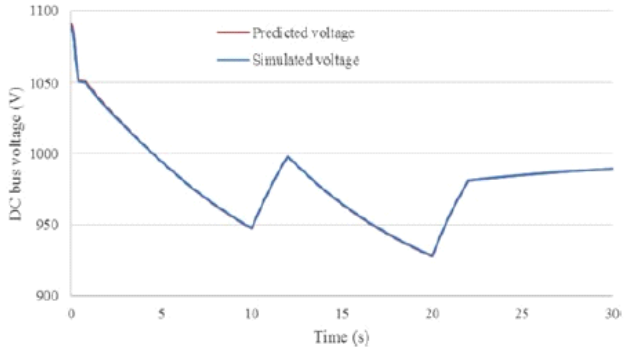

Fig 3: Simulated and the predicted DC bus voltage.

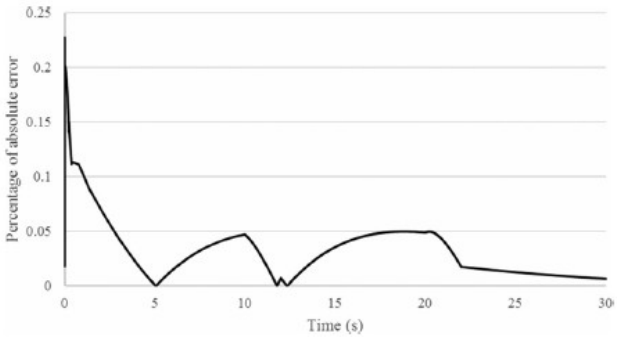

Fig. 4. The absolute percentage error for the GP model.

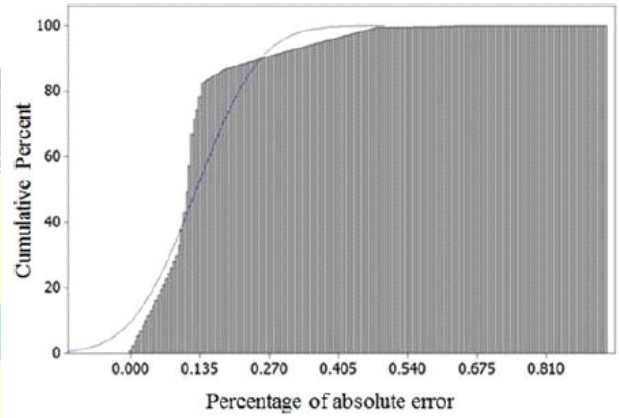

Fig. 5. Histogram of the percentage of absolute errors.

The maximum value of R^2 the minimum value of errors are obtained through training the model; whereas these values in testing and validating phases are very close to the corresponding values of the phase. These values are then increased to improve the accuracy of the model. For complicated models with a substantial number of dataset, it is impossible to attain a model with high accuracy.

IV EXISTING SYSTEM

The fishing vessels are operated using diesel. No information can be communicated with the fisherman and the base coastal station. There is no indication about the overload of the boat. There are few existing systems which helps to identify the current position of the boats/ships using GPS system and view them in an electronic map. The accurate position information becomes even more critical as the boat departs from or arrives in port. In olden days there is no efficient technique for identifying the border in sea. The prevention techniques followed were roaming near the boundary with the help of man power and they guided the fishermen. Usage of connected large sized balls along the boundary, even though it is a good method, but big fishes can disturb the alignment of fence and it is difficult to recognize.

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V. PROPOSED SYSTEM

The proposed strategy is to maintain the efficient performance of the FC stack by keeping the FC voltage within the desired DC bus voltage range by optimizing air and fuel flow rates to the FC at different load currents. Genetic algorithm is a conventional optimization method which has been extensively used in numerous engineering applications. In this paper, GA is used to optimize the derived FC voltage equation according to the utilized boundaries for the air and fuel flow rates at various load currents which is suitable to run the boat motor without the fuel. For the sea border identification by overcoming the past and present techniques it will be better if we introduce a audio announcement, which is nothing but the device will communicate in their local language which could be easily understood by the fisherman. And at the same time, we can make the people to be aware before reaching the border. In addition to that it is possible to give the alert about the natural calamities to the ship sailing at the sea from the light house. It may be may be, Tsunami, heavy rain, storm. A buzzer facility also added. When any damage or sinking of boat causes, the fishermen can easily alert the guards near to them. When the buzzer is pressed, an RF signal carrying the latitude and longitude information will be send to the sea.

VI. MAIN UNITS OF PROJECT

There are two units implemented in this project and they are control unit and a guiding unit. The communication established between the two units is done with the help of RF transmitter.

A. Control Unit

Control unit is placed at the light house in that there will be a option keypad, PIC microcontroller, encoder, decoder, ZIGBEE transmitter and receiver, LCD display, and a power supply for giving the input power. Option keypad is used for sending emergency information. There will be a LCD display for displaying the information from the guiding unit.

B. Guiding Unit

The guiding unit is placed in the boat with the fisherman. In the guiding unit there will be a receiver, decoder, PIC microcontroller, ZIGBEE receiver, LCD display, alarm driver, alarm, voice synthesizer and speaker. From the receiver the latitude and longitude values are fed into the PIC microcontroller and the values are compared to the border values when it exceeds the border values an alarm will be generated. In addition to that information will be send to the control unit. There will be a speaker for guiding them in their local language.

C. Controller

The controller used is PIC-microcontroller PIC is “peripheral interface controller ”PICs are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming capability. Some of the features of PIC microcontroller are, A small number of fixed length instructions Most instructions are single cycle execution, with single delay cycles upon branches and skips A single accumulator (W), the use of which is implied. PIC-16F877A is a 40 pin controller from that controller pins encoder,decoder,RS-232, LCD display are connected to the pins. PICs have a set of registers that function as general purpose RAM. Special purpose control registers for on-chip hardware resources are also mapped into the data space(RAM). The addressability of memory varies depending on device series, and all PIC devices have some banking mechanism to extend the addressing to additional memory. Later series of devices feature move instructions which can cover the whole addressable space, independent of the selected bank. In earlier devices any register move had to be achieved via the accumulator. This PIC is used because it is possible to connect more number of peripherals.368 bytes of RAM,256 bytes of EEPROM data memory 15 Interrupt Sources, Two 8-bit Timers / counters with pre scalars, One 16-bit timer /counter, Two 16-bit compare / capture PWM modules,10-bit 8-channel ADC, Two analog comparators, Programmable UART Serial Channel, Programmable Watchdog Timer.

D. Alarm

It will be given in their local language. In addition to that information is send to the control unit that the boat has crossed the border. The device used for the system is given as follows, it consists of battery from which power is being generated and from the GPS the values are compared to the boundary values.

VII. CONCLUSION

Zero emission all-electric ships using renewable energy sources are the future of the marine industry. Fuel cells are one of the cleanest energy sources that are under extensive investigation by researchers for future AESs application.

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Efficiency of the working FC is directly proportional to the cell voltages within the FC stack. Therefore, in an ideal scenario, keeping the FC voltage within a specific range at different operating points (load current) is the key factor to maintain high efficient performance of the FC. In the olden days there is no proper system to identify the border. The fisherman while fishing they cross the border unknowingly and these may lead them to serious effects. It is so because there is no proper identification systems. During those days they use magnetic compass and other natural identification system. Because of the inadequate knowledge of the fisherman, they face serious consequences while crossing the border. These are the problems that are faced in the present system. By overcoming this it is possible to introduce new ideas for identifying the border. On an account to it is able to give warning from the base station that some natural calamities is about to happen. Even after these services provided to fishermen, there are some future enhancements is given here. It is able to intimate the fishermen about the boundary before some kilometers of distance by feeding the latitude and longitude values of places before the boundary into the PIC and an automatic engine disable system can be implemented if the fishermen are going to reach the boundary or the speed of the boat can be gradually controlled depends on their further navigation to boundary. Along with this, an object sensor is placed in the kit, which is used to intimate the fisherman about the overload of the boat though the alarm.

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