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The journal is yearly publication of the institute. It covers technical articles/papers on science and technology, focusing marine field and its application area. It also covers patent abstract and book review.

Tolani Maritime Institute, Induri, Pune

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Address for Correspondence

The Editor
Bulletin of Marine Science & Technology (BMST)
Tolani Maritime Institute
Talegaon Chakan Road
Taluka Maval, Induri
Pune -410507, Maharashtra, India
Tel: 91-2114-669600/01
Web – www.tolani.edu
E-Mail: info@tmi.tolani.edu

Guidelines for Paper Submission

Bulletin of Marine Science & Technology (BMST – ISSN: 0974 – 8474), is the yearly technical journal of Tolani Maritime Institute (TMI).
The journal covers technical articles/papers, marine science and technology abstracts, book reviews, patent abstracts and technological developments, in general engineering or in marine related areas.

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Technical articles discussing various aspects of science and technology including innovations in the marine field, original research work, experimental investigations with results, industrial practices, case studies are invited for publication. The paper may be please be mailed to nitinj@tmi.tolani.edu or vaibhavk @tmi.tolani.edu

Guidelines for paper submission

- Enter manuscript in MS word, Times New Roman, main text - font 12 , subtitle - font 14 and the main title - font 16 , with main text in the single line spacing double column on A4 sheet.
- Provide every article with an abstract not exceeding 150 words.
- Provide 4-6 keywords.
- Organize paper in smooth flow of title, subtitle and sub-sub title.
- Keep length of the paper to the limit of 8 pages approx.
- Provide 1 inch margin on all sides of the paper.
- Provide figures, drawings and graphs in black color on white back ground.
- Submit figures, drawings and graphs in JPEG format with 300 dpi minimum resolution.
- Number the figures and tables as per standard practice.
- Provide mathematical equations and functions in suitable equation editor.
- List the references at the end of the article with serial number.
- Submit hard copy of the full length paper on the address of correspondence mentioned in the journal.
- A declaration to the effect that – the work is original and has not copied or published earlier elsewhere – needs to be submitted along with the paper.
- On behalf of all the co-authors, the corresponding author shall bear the full responsibility for submission and shall provide his/her full address, contact number and email.
- Follow the suggested order for manuscripts: (In some cases all the points may not come in order as suggested)

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- Title, Authors, Affiliations
- Abstract
- Keywords (provide a maximum of five keywords)
- Introduction
- Main text (may include information based / knowledge based/ theory based / experimental based/ model based method)
- Data Collection / Data Analysis (if any)
- Result and Discussion (If any)
- Conclusion
- References

TECHNICAL PUBLICATION COMMITTEE CHAIR-PERSON'S MESSAGE

I am pleased to present 13th issue of **Bulletin of Marine Science and Technology (BMST). Tolani Maritime Institute (TMI)** has completed this year, successful 22 years in imparting Marine Education at pre-sea and post sea level. TMI has created its benchmark in the Marine Education area.

Transform the shipping Industry through technologies and looking forward to 2030, will be right point of everyone's study. The Global Marine Technology Trends (GMTT) aims to shine a light on the transformative aspect of the technologies on ship design, naval power and the use of ocean space. So to ask 'what's next?' in the maritime industry. GMTT , identifies two areas: those that will transform ship design and building, and those that will impact safety, commercial and operational performance. "Shipping is likely to evolve quickly now,". "It's hard to say just one technology will transform the industry. Crucial is the interplay and overlap between the technology areas. We can see how digital technology and smart phones have helped transform how we live our lives and disrupt business models. This transformation has yet to make a significant impact on shipping. We need to be prepared to be surprised, but they would probably be truly amazed by digital technology.

One area of change in material. Changing the materials currently used forms a big part of the new technology. While metals will remain the dominant force for ship structures, there will be an opportunity to refine their characteristics through what is known as microscale or nano-scale manipulation. **Second area of Big data.** With more and more data being collected from sources such as oceanographic data, maritime accident data, and personal information, one question arises that how can this be analyzed and used to improve ship operations. **Third topic that stirs up much discussion is the use of robots.** The prediction is that by 2030 three new types of robots will be used in commercial shipping: a learning robot; one that can handle an asset – styled a practical robot; and a mini-robot, potentially used for inspections in harsh environments, for example to identify and record emissions and pollutants. **Fourth area is a new generation of sensor** technologies will remove the need for regular visits to remote locations. Sensors will be able to collect data autonomously and then relay this information in real time. Capturing this data will allow ship owners to improve overall maintenance cycles of vessels, including condition monitoring and condition-based monitoring. **Fifth area is the growth in communications** – from WiFi to 5G connectivity – will see the birth of the 'connected' ship. This ship will allow operators to access live audio as well as HD and 3D video from on-board recording devices, and remove the need for physical on-board surveys. Real-time decision making in ship management and autonomous operation will also be feasible. **Sixth area is the Power generation.** It will change dramatically, with alternative fuels, energy-saving devices, renewable energy and hybrid power generation all potentially playing their part. The challenges as being two-fold in shipping: environmental and commercial, including rising fuel costs and fleet overcapacity. **Seventh area is of Autonomous vehicles (AV).** These are appearing in many transport-related industries, including the air and automotive sectors. Their use in the maritime sector will continue to increase, to the point where autonomous surface and underwater vessels are viewed as just another aspect of the industry.

Tolani Maritime Institute, endeavors to support the good work in whichever way it is possible. **Bulletin of Marine Science and Technology** provides the platform for the readers and authors to take up the activity of writing and publishing scholarly articles in varied fields of Science and Technology.

I am sure that the issue of the journal will keep interest alive of the readers and writers. Enjoy Reading and Writing!!

Prof. N.D. Junnarkar, Ph.D.
Chairperson - Technical Publication Committee
Tolani Maritime Institute, Pune

Student's Committe Message

INDEX

SHIPCOIN – BLOCKCHAIN TECHNOLOGY IN SHIPPING INDUSTRY

Ranjith Menon D
The Great Eastern Maritime Studies, Lonavala
ranjithmenonnn@gmail.com

Sundhesh M Nagesh
The Great Eastern Maritime Studies, Lonavala
sundheshm24@gmail.com

Neraj Tekwani
The Great Eastern Maritime Studies, Lonavala
tanmaykalyankar@gmail.com

ABSTRACT

Despite the recent technological revolution, shipping still remains a traditional industry and the processes the parties follow in many cases are almost archaic. Whilst Blockchain Technology in shipping industry can simplify your transactions, data entry, by reducing physical paperwork and reduce communication time delays, added costs, and human error that plague today. Thus by connecting all parties to your company's Blockchain via the Internet of Things (IoT) to make your day-to-day task transparent, scalable and secure.

Keywords

Blockchain Technology, Internet of Things, Parties.

Introduction

From generations we are so used to writing forms, invoices, letters, emails and also communicate via telephone, that any other control method seems fanciful, far-fetched even, but, not anymore. Imagine getting instant and personalized information like logistic data updates, voyage course updates, bunkering updates, emergency alerts, provision data, consumables data, seafarer's data and at the same time data processing into the company's block chain server. Meanwhile all of the foresaid being shared and recorded into your company's server which can be viewed only by those particular parties with a unique access key. They can connect to the internet to find out pretty much any piece of information and also connect to your ship and list out your logistic data, your history of voyages, crew's data, future contracts and pretty much all the piece of information both onboard and while ashore. This advancement on- board ships can ease up every crew member's daily work as well as help the offshore managements to keep a track record of each and every individual vessel in its fleet.

What is Blockchain?

Blockchain is a distributed database that holds records of digital data or events in a way that makes them tamper-resistant. While many users may access, inspect, or add to the data, they can't change or delete it. The original information stays put, leaving a permanent and public information trail, or chain, of transactions (Investopedia).

Think of it like this: If the entire blockchain were the history of all the fleet's logistical and functional/ operational/service/maintenance data, an individual vessels data would be a single block in the chain. Unlike most shipping companies, however, there is no single organization that controls the entire vessels logistic, operation or maintenance. It can only be updated through consensus of a majority of participants in the system (Re/code). In short, blockchain is a record-keeping mechanism that makes it easier and safer for businesses to work together over the internet.

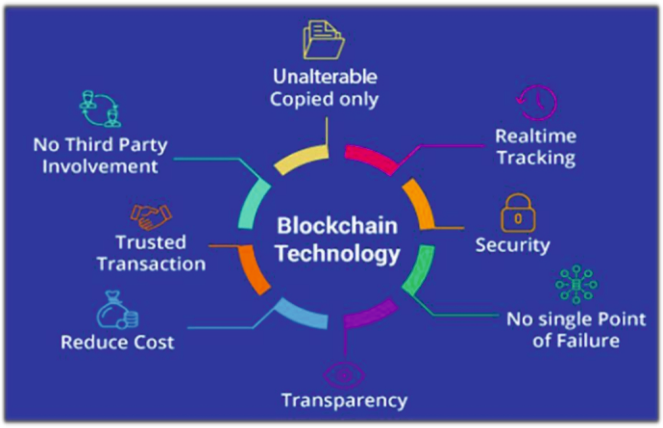

Fig. 1. Block Chain Web

What is Internet of Things (IoT)?

The Internet of Things (IoT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction

How will Blockchain Technology affect the supply chain?

Currently, most of the shipping transactions involve a big number of papers, such as sales contracts, charter party agreements, bills of lading, port documents, letters of credit and others related with the vessel and the cargo. All these documents may need to pass through a long chain of parties since their importance remains high both for various payments to be affected as well as the carriage and delivery of the cargo to take place. Look, for example, into the bills of lading and the long way they follow: Starting from the shippers at load port, they pass through several banks until they reach the receiver. This procedure can be so lengthy and time-consuming that it is very common the vessels to arrive at the discharge port before the bills of lading.

In an effort to simplify the current procedures. The shipping industry has been inspired by the way that the bitcoin payment system works, namely - Blockchain. The bitcoin, which was introduced in October 2008 by Satoshi Nakamoto, was the first digital currency/ payment system that brought the revolution to the financial markets. Blockchain tech is based on open-source peer-to-peer software which is totally decentralized and the management of all transactions or the issuing of new currencies is taking place collectively by the network.

For the management of all these transactions, the Bitcoin or any similar software uses a chain of blocks which is cryptographically secured and which is used as a public ledger that records all the bitcoin transactions; this is the - blockchain. Each of these blocks include a timestamp and a link to the previous block of the chain and the transaction is processed only after several confirmations of the network, so as to ensure that every transaction follows the rules of the network. After the information is stored in the block, it cannot change or be deleted unless the subsequent blocks are also changed and the majority of the network accepts the change/deletion. Therefore, user's interference in the blockchain looks impossible and the system becomes completely waterproofed.

Blockchain technology was initially used to enable trusted financial transactions between the parties without the need for any intermediary, such as a bank. The use of blockchain, as a secured, decentralized and encrypted public ledger, could be used in various applications in shipping and bring a revolution on the way the trade is performed, almost similar to the evolution that Open Sea brought in the industry on the way that ship chartering takes place. Blockchain could turn the whole processes into a paperless paradise by which all the related parties in each transaction (i.e. sellers/buyers of cargo, ship owner, charterer, banks, agents, customs, port authorities etc.) with the use of public and private keys could come in contact with each other, perform physical transactions, exchange and store information in encrypted format and perform their contractual obligations, give and accept instructions and securely exchange payments.

If blockchain technology allows us to more securely and transparently track all types of organizational data and operation, imagine the possibilities it presents across the supply chain. Every time an action is taken on board or a decision is made offshore, the action could be documented, creating a permanent history of all the actions or changes made, from onboard to offshore management.

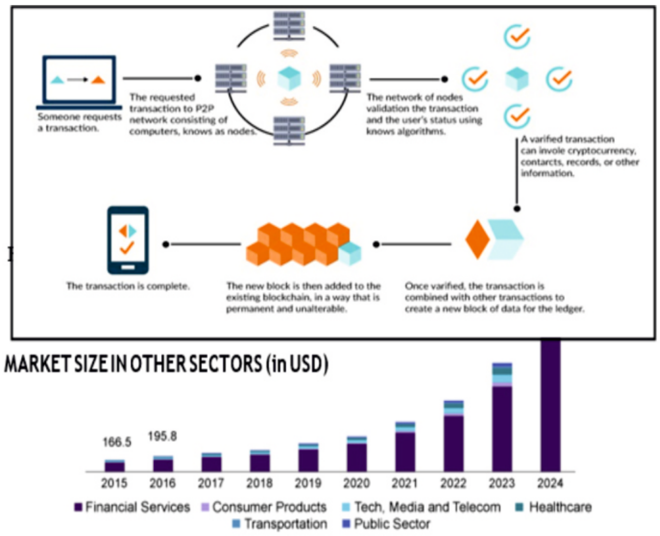

Fig. 2. Blockchain Technology in other sectors

This could dramatically reduce communication time delays, added costs, and human error that plague today.

Fig. 3. Ship and parties connected

Some supply chains are already using the technology, and experts suggest blockchain could become a universal-supply chain operating system before long.

Fig. 4. Smart Chartering by Blockchain technology

Consider how this technology could improve the following tasks:

- Recording the quantity and transfer of assets—like pallets, trailers, containers, etc.—as they move between supply chain nodes (Talking Logistics).
- Tracking purchase orders, change orders, receipts, shipment notifications, or other trade-related documents.
- Assigning or verifying certifications or certain properties of physical products; for example, determining if a food product is organic or fair trade (Provenance).
- Linking physical goods to serial numbers, bar codes, digital tags like RFID, etc.
- Sharing information about utilizing shop spares, assembly, delivery, and maintenance of products with suppliers and vendors.

Smart Contracts by Blockchain Technology

Except of its use as a public ledger, one of the biggest revolutions that the blockchain could bring in the shipping industry is the - smart contracts.

These are contracts in the form of a computer program which is run and self- executed in blockchain and which shall automatically implement the terms and conditions of any agreement between the parties. These charter-party and bill of lading terms and conditions will be standard part of the software and will not be able to change by the parties. This way, we are moving to a digital market where a contract will be published by the Owner or the Charterer and the other party will negotiate the price/freight directly via the blockchain network.

The smart contracts will be executed by a computer network that uses consensus protocols to determine the sequence of actions which result from the contract's code and this way to automate calculations, approvals and other transacting activities. Before the use of blockchain, this type of smart contract was impossible to happen because parties to an agreement would maintain separate databases. With a shared database that runs a blockchain protocol, the smart contracts auto-execute, and all parties validate the outcome instantaneously, without wasting time on further exchanges and without the need for a third-party intermediary.

Chartering by Blockchain Technology

A digital chartering marketplace can provide strategic operating and financially efficient benefits for charterers and vessel owners by enabling them through the Blockchain platform to instantaneously identify the best possible counterparty whilst utilizing the least possible company resources at a significantly lower cost than the traditional chartering houses

Dry Docking by Blockchain Technology

Dry Dock is all about, choosing a shipyard that best suits your requirements is a decision that requires evaluation of multiple parameters.

- Trading Area.
- Cost.
- Time.
- Safety record.

- Technical Ability.
- Local infrastructure.
- Financial situation.
- Weather/season in the area.
- Operational restriction- tide.

All this above fore said actions and decisions can be incorporated in blocks and thus, the ship management can plan the dry dock according to their feasibility. This will eventually reduce the over stay charges or delay charges also schedule or reschedule any dry dock, hassle free.

Major Advantages

Adapting a Blockchain technology, such as the Smart Contracts, could have the following advantages for the shipping industry.

- Quick processing time and real-time updates: Instead of mailing the documents to various parties, the exchange of information can become instantly and procedures which currently take weeks to be completed even within a few minutes. The software code of blockchain will also automate tasks that are typically accomplished manually.
- Higher accuracy: Since all the execution of contracts and other processes are automated, the errors are much less possible.
- Full Transparency: The information is stored in a place where everyone can have access provided that he has the required access key. This gives full transparency to market participants and also the counter-party risk is easier evaluated when anyone can have access to the transactions previously performed by each party.
- Increased security: All information is encrypted, something which adds security by its own. Also, the fact that the users can not interfere with the system and change the information stored in the blockchain protects the market from fraudulent activities and various documentary manipulations.
- Cost Saving: A big part of the trade financing costs is related to documentation, procedural delays, discrepancies or errors. These costs can be omitted and total cost currently spent to various intermediaries will be avoided and replaced by a much cheaper cost of the blockchain.
- Easier access to the market: Everyone can have access to the blockchain technology and therefore the entry barriers will be less and the market will become more competitive. Furthermore, the parties will be able to develop direct communication without the need of intermediaries and the overall chain will become lighter.

Main Challenges

Not-withstanding the advantages of such a technology for the shipping industry, there are a few issues which should be addressed before a full blockchain system is established in the dry bulk and tanker shipping.

- Special contractual terms: The contractual terms of the ship chartering and the sale & purchase of commodities are unique and very specific. These terms should be adapted by the blockchain network which should be able to recognize, for example, what the lien is and how it works, the lay time and demurrage and their exceptions, the Notice of Readiness and when the vessel is actually considered arrived at port etc.
- Higher flexibility: It is very usual in shipping, the parties to come across situations where they can only solve through a commercial approach. This will not be easy to take place when the transactions are taking place through a sealed system which does not allow any interference from the parties. Furthermore, it is very usual the parties involved in a transaction to have their own contractual terms which are usually subject to the negotiation of the parties. Will it be possible in a universal system? So, the blockchain technology must be configured to include special terms and conditions at inception, otherwise the parties' liability exposure will be even higher than the liability saved by the system's use.
- Global adoption: The blockchain is not adapted or it is not yet allowed by all jurisdictions around the world. However, since various governments and agencies are involved around the globe, in order for such technology to be used in trading and shipping services, all these parties should be brought into a common platform and a universal adoption should be achieved.

Recent Developments

The shipping industry has not yet adopted the blockchain

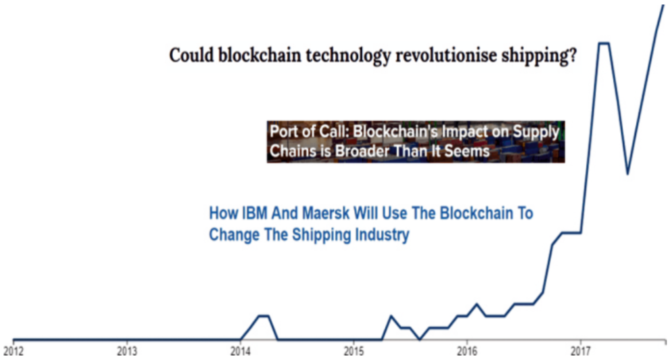

Fig. 5. Stats showing IBM and MAERSK using Blockchain Technology in SCM

technology and whether its traditional practices will be replaced within the next years from such a technology it remains to be seen, however the first steps have already been made:

- Earlier this year, Mercuria, a shipping and trading conglomerate, announced that they are working with their two financial institutions, ING and Society General, so as to adopt a blockchain technology for its trading and shipping business. According to Mercuria, the current process followed in shipping is archaic and it is expected that the trading and shipping industries will be digitalized more and more within the next couple of years.
- Another large shipping company which explores the possibility of investing into the blockchain is Maersk who have commenced a cooperation with IBM in order to build a blockchain system utilized in the container market, where Maersk maintains a leading position. In this case, the blockchain will be used to manage and track the millions of shipping containers, by digitizing the supply chain process to enhance transparency and security of sharing information among the company's stakeholders. Maersk says the software is expected to be online by the end of 2017 and could save the industry billions of dollars each year.
- Open Sea is a leading company in the digitalization of shipping services and they follow all the recent developments in this field so as to continue offering unique services to their clients and make the shipping industry more transparent, technologically advanced and more efficient.
- Singular Point is currently developing MARiS, the award-winning chartering and shipping solution, which will be blockchain enabled and launched in Geneva on September 20th, 2018. MARiS will make sure that vessel owners and trading companies benefit of the advantages coming along with the blockchain technology such as high data quality, process integrity, configurable smart contracts, lower transaction costs, empowered network, ecosystem simplification and many more.

Conclusions

Applying Blockchain technology in shipping industry to improve global trade and digitise the supply chain management is still a vision for some, most of the shipping companies have already started venturing it. There might be various obstructing aspects in implementing this technology and globalizing it, but initially every technology faces a setback and gradually over a period of time gets recognized and adopted. To conclude Blockchain technology is transparent thus decentralized power, it is open to all parties hence it is a Public ledger, it is one of the safest mode in transactions and data sharing thus immutable to hacks. Though initial investment is high the instant future returns can be reaped.

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- https://blockgeeks.com/guides/what-is-blockchain-technology/

LNG AS AN ALTERNATIVE FUEL TO REDUCE POLLUTION

Divakar Trivedi
The Great Eastern Maritime Studies, Lonavala
divakar.trivedi95@gmail.com

Abhishek Renukappa
The Great Eastern Maritime Studies, Lonavala
abhishekrenukappa@gmail.com

Jashrajsinh Jadeja
The Great Eastern Maritime Studies, Lonavala
jashjadeja13@gmail.com

ABSTRACT

Among the various challenges faced by the shipping industry from low freight rates to fuel prices, the major obstacle still being to comply with the regulation of MARPOL Annex-6 and decrease the air pollution from shipping industry. The preferred solution of using LNG as an alternative fuel, is increasingly becoming popular as it eliminates the problem from its root cause i.e. air pollution.

This paper reviews several recent studies on the topic and discusses the suitability of LNG as an alternative fuel in international shipping for regulatory compliance as well as savings in fuel cost that has increased substantially in the last few years and expected to follow the same trend.

Keywords

Marine Diesel Oil (MDO), LNG (Liquefied Natural Gas)

Introduction

Since 2008 the shipping industry has been facing various challenges after the economic meltdown, but dealing with the upcoming emission requirements of MARPOL Annex-VI, compulsion for the use of expensive low sulphur fuel (LSF), certainly comes on the top of the priority list. Now low freight rates due to overcapacity, likely to continue for longer than expected, is a real concern but high fuel price has already pushed many shipping giants globally towards their financial threshold limit and LNG (Liquefied Natural Gas) as an alternative fuel is a real promise today.

"There are compelling reasons for LNG to become the future fuel for shipping but there are also a good number of reasons why it may not become the future fuel for shipping for some time" Chairman, International Bunker Industry Association. Bunker spot LNG Asia conference, April-2012

With the aim being emission control as per the MARPOL Annex VI, there are various methods available which can be adopted by the shipping companies depending on their suitable requirement in order to achieve the goal of reducing the pollution cap to the level laid down as per MARPOL Annex-6 (NO_x and primary PM emissions are mainly linked to the performance of the vessel engine whereas the SO_x emission is related to the Sulphur content in the fuel.) There are different emission reduction possibilities: Fuel type; use distillate fuel or low Sulphur HFO or LNG Emission Control methods –

SO_x:

- Wet scrubbers (NaOH Solution)
- Dry scrubbers Ca(OH)2, granulated limestone

NO_x:

- GR (Exhaust Gas Recirculation)
- SCR (Selective Catalyst Reduction) using urea

The established abbreviation when cleaning the SOx exhaust gas is EGC, Exhaust Gas Cleaning.

Main Work

Different prime options currently available to meet the requirements set by MARPOL ANNEX 6:

Scrubbers

Scrubbers are air pollution control devices that use liquid to remove particulate matter or gases from an industrial exhaust or flue gas stream. This atomized liquid (typically water) entrains particles and pollutant gases in order to effectively wash them out of the gas flow.

Advantages

- Can handle flammable and explosive dust with little risk.
- Provides gas absorption and dust collection in a single unit.
- Provides cooling of hot gases.
- Compact, can often be retrofitted into existing collection system.

Disadvantages

- High potential for corrosion problem
- Collected particles may not be recyclable
- Disposal of waste sludge is very expensive
- Requires makeup water to replace purged liquid.

Using low Sulphur fuel

As per the new regulation brought up by Marpol 73/78 all ships need to control Sox and NOx. In order to do that the ships can shift to low Sulphur fuel as the Sulphur content. The prime disadvantage of using this fuel is the cost and subsequently the refineries are also not prepared to deliver this fuel at every location in needed quantity.

Using LNG as marine fuel

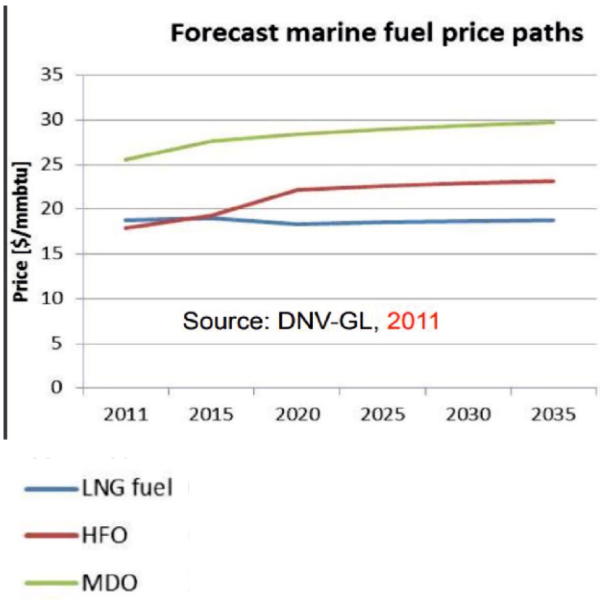

Fig. 1. Forecast marine fuel price paths

LNG is already a preferred option for SSS (Short Sea Shipping) in Europe and USA. There is no strict taxonomy of SSS but refers to the historical term coastal trade which encompasses the movement of cargo and passengers mainly by sea, without directly crossing an ocean. LNG is not only a clean fuel but economical also.

While the price of bunker fuel varies in close tandem with the global crude price, the cost of LNG is relatively independent. In the last two years bunker cost has become almost double but LNG price has gone down in many countries due to high production. Switching to distillate fuel or installation of exhaust gas scrubber are options suitable for existing ships depending upon their exposure in ECAs (Emission Control Areas) but for new building LNG definitely holds merit.

Despite all the challenges being faced in the path to achieve the goal of pollution control in Marine Industry, all the mega shipping giants are applying various ways to satisfy the requirements laid down by MARPOL-Annex 6 and initiate a new era of clean shipping. Most of the old ships as being equipped with the scrubbers while the question still remains what will be the shipping like in next decade?

To meet the green shipping aim, the prime focus is being laid on using the environment friendly fuel, and LNG is the prime candidate for this. Both the availability and cost of LNG are feasible for the shipping industry. Today gas technology is well matured but a recent analysis of fuel choices by a reputed classification society shows that only 10 -15 % of the new buildings delivered up to 2020 will have the capacity for burning LNG. The largest obstacle to wide-spread take-up of LNG is the lack of bunkering network globally. In fact, gas suppliers have business plans ready but what is missing is a real demand of the maritime market. Indeed, ship-owners are afraid not to be able to find LNG everywhere, so they do not command LNG fueled ships for the international shipping. Now the dilemma is which come first LNG bunkering infrastructure or LNG fueled vessels. Some of the current bunkering infrastructure, available around the world are shown in the figure below:

Fig. 2. Bunkering infrastructure

The vital LNG bunker locations in India are as follows

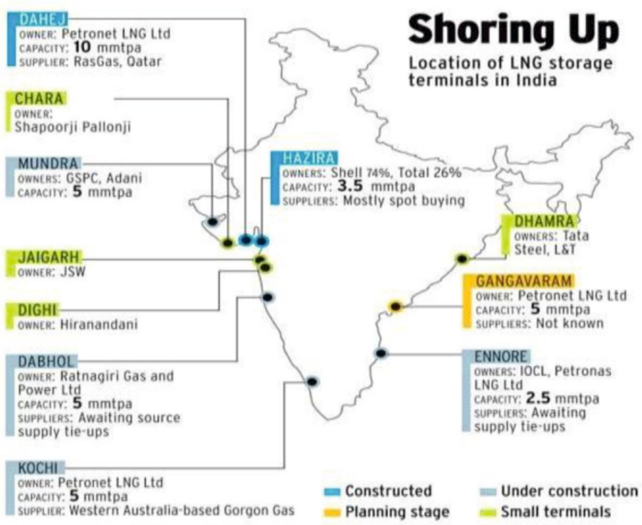

Fig. 3. LNG bunker locations in India

Factors Leading to Change in fuel

- Today the choice of LNG as an alternative fuel is surely a viable option to comply requirements of MARPOL Annex-VI, the control of NOx (Regulation-13), SOx (Regulation-14) and CO_2 (Chapter-4). The mandatory Sulphur limit of fuel is 0.1% within ECA by 2015 and 0.5% globally.

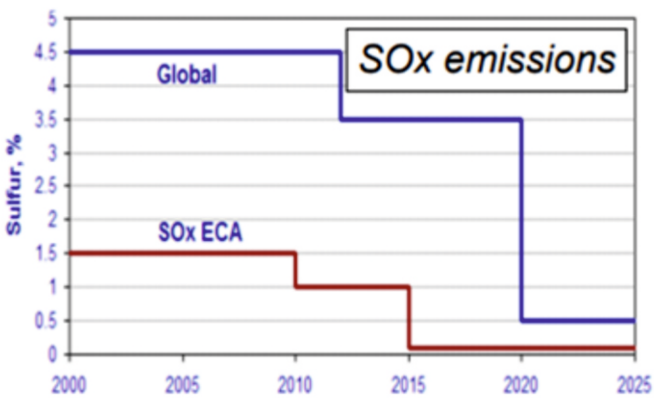

Fig. 4. SOx emissions

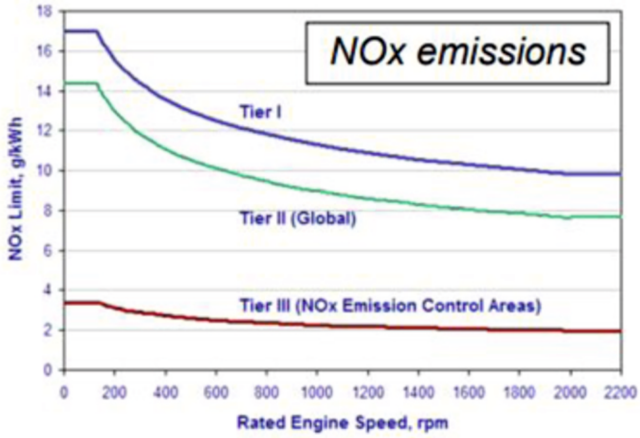

Fig. 5. NOx emissions

- The carbon content (CF = t-CO_2/t-Fuel) of LNG is the least (2.75) compared to diesel oil (3.20) or heavy fuel oil (3.11) that improves the EEDI. LNG can reduce CO_2 by 20%, SOx and NOx about 95% and 80% respectively. So, it is the most suitable fuel option for new ships and additional investment cost for LNG tank system can be recovered between 2 to 5 years depending upon its ECA exposure.
- During the combustion of fossil fuels, the Sulphur in the fuel is released in form of Sulphur oxides (SOx), other pollutant are primary particle matter (PM) and nitrogen oxides (NOx).
- It is well known that air pollution seriously impacts people's health and the environment. Sulfur dioxide and nitrogen oxides are the major precursors of acid rain, which causes acidified soils, lakes and streams, accelerated corrosion of buildings and monuments, and reduced visibility.
- Sulfur dioxide is a major precursor of fine particulate soot; also, NOx forms related particles when reacting with ammonia, moisture, and other compounds. Small particles can penetrate deeply into sensitive lung tissue and damage it, causing premature death in extreme cases.
- NOx reacts with volatile organic compounds in the presence of sunlight to form Ozone. Ozone can cause adverse effects such as damage to lung tissue and reduction in lung function mostly in susceptible populations (children, elderly and asthmatics). When NO_2 is dissolved in water, a series of reactions occur which finally result in formation of nitrate. Too much

- addition of nitrate in the sea will cause unnatural algal bloom, especially near-shore areas are sensitive where the phosphorus from the agriculture together with nitrate may lead to enhanced biomass production.

Comparison of HFO, MDO and LNG

- The decision to use LNG as ship's fuel as opposed to using a scrubber system would depend on the price differential between LNG and HFO (Heavy Fuel Oil), the proportion of time spent operating within ECAs and the construction year for the new vessel. LNG will also meet the Tier-III NOx requirement when SCR (Selective Catalytic Reduction), an emerging technology, is the only alternative. The current annual demand for distillate fuels is around 30 million tons. This is expected to rise up to 45 million tons when the 0.1 percent limit comes into force in ECAs and may be around 200-250 million tons by 2020. At this juncture an "Incorrect investment decisions could be devastating for individual ship-owners and collectively they could impact negatively on the environment as well.
- So far LNG fueled cargo ships, have been delivered only for round trip and bunkering at a single port. Norway is the leading country to acquire such vessels but countries under EU and USA are going ahead for such vessels in SSS. European ports such as Netherlands, Sweden, Finland, Poland and Germany are making huge investment in LNG bunkering facilities and for three Belgian ports a feasibility study is underway. Now the oil major Shell is guaranteeing the availability of LNG in the US Gulf Coast region and the scope of service will be extended to other key North American shipping region in due course of time.MPA (Maritime and Port Authority) of Singapore, world's largest bunkering port, is also investigating the feasibility of LNG bunkering in Singapore in collaboration with DNV and 21 industry partners.
- The EU (European Union) has already introduced 0.1% Sulphur as a maximum level for ship's fuel when in ports and on inland waterways. Now a vast region of North America is under ECA from 1st Aug 2012 which means all ships within 200 nautical miles of US and Canada coast line must use expensive fuel, present price difference is about $200/t, with maximum 1% Sulphur content, the present ECA limit till 1st January-2015. As per US Coast Guard non-compliance will attract fine up to $25,000 per day. Cheaper price of LNG in Europe and USA is making it more attractive for SSS.
- Today gas engines (Dual-Fuel) are well matured and all leading engine manufacturers are producing such engines with very low methane slip. This is the release of unburned natural gas through the engine exhaust. LNG is predominantly methane which is a substantially worse greenhouse gas than CO2 although safe for marine use due to high ignition temperature and lighter than air. Now gas at a pressure of 300 bar is injected in the air compressed by the cylinder stroke that gives a more responsive solution than pre-mixed combustion method in which low-pressure gas is mixed with air and then compressed. Modern DF engines can burn gas and oil at any ratio depending upon the availability and cost. Although four-stroke gas engines are common in the market but Wartsila, MAN Diesel and Mitsubishi, all are now developing a range of slow-speed two-stroke engines to run on natural gas as well as oil. Burning gas within ECAs and liquid fuel elsewhere is an obvious solution today.
- LNG is gaining popularity globally. However, findings of the Dutch research organization TNO suggests that due to methane slip there could be less of a reduction in overall greenhouse gases than many supporters of LNG claim.
- The last thirty years have seen a shift in the global energy fuel mix towards an increased role for natural gas. Since last 5 years global LNG production increased by 40% and the number of countries exporting and importing LNG are increasing every year. As per statistics oil continues to suffer a long run decline in global market share, while gas is gaining steadily and expected to be same as oil, 26% to 27% by 2030.The rise in freight rates of LNG carriers in the recent past, the only shipping sector which is not at a loss now, is a reflection of the increased demand for LNG shipment in many countries. When the freight of

- a capsize bulk carrier in the spot market is languishing at an average of a mere $5,000 per day, the LNG spot and short-term rates are sky high at around $150,000 per day. This trend is likely to continue in foreseeable future and ship owners should review options considering the pace LNG is gaining popularity globally. However, findings of the Dutch research organization TNO suggests that due to methane slip there could be less of a reduction in overall greenhouse gases than many supporters of LNG claim.
- LNG is about to establish its presence as a major marine fuel? Probably the answer is yes, driven by the dual impacts of increasing legislation on exhaust gas emissions from ships and high oil prices. While the former is dictated by public opinion and expected to be more and more stringent in the era of high environmental awareness but the latter is guided by the law of supply and demand where contradictory views are emerging. An interesting report of the Harvard Kennedy School of USA published in June 2012 has challenged the long-established notion that oil will run out soon is far from the truth. It suggests that so far mankind has extracted only 1trn tons of crude oil out of a total of over 8trn tons what is known as original oil in place. Also, there is no SOLAS regulation for burning LNG as a fuel in international waters, with the exception of gas carriers. At present, the IMO Sub-Committee on BLG (Bulk and Liquid Gases) is working on the IGF Code (International Code of Safety for Gas-Fueled Ships) which is likely to miss the adoption deadline of 2013. This may be the immediate hurdle for the wider use of LNG to fuel ships.

Conclusions

In conclusion it can only be inferred that if economy and environment are not conflicting, LNG will create a wonder for the shipping industry. Price difference between LNG and HFO is a key factor for LNG to appear soon as an alternative fuel in international shipping.

"It takes 100 years to create a revolution in shipping. Steam power came 200 years ago then diesel power 100 years ago and gas power is tomorrow."

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IDENTIFICATION OF NAVIGATIONAL STARS

Niranjan Pal
Tolani Maritime Institute, Pune
niranjanp@tmi.tolani.edu

ABSTRACT

Celestial navigation is a process to find the ship's position at high sea. It can be a tool to check the position obtained by GPS and other electronic devices including ECDIS. When the Sun is below the horizon, the navigational stars are used to find the position. Therefore, the identification of navigational star is of paramount importance.

Keywords

Sky measure, Constellations, signposts, Orion, Great Bear, Deneb, Carina

Introduction

Star gazing is an uncommon activity in the present scenario. The reasons may be want of awareness, lack of interest or the cluster of stars in the sky make identification difficult. Though the stars seem spread out in chaotic manner, it takes surprisingly little time to find one's way about.

This article aims at suggesting simpler ways and guide the readers to identify the navigational stars. Interestingly, almost everyone knows about two constellations, namely Orion and Great Bear. These along with a few more constellations will act as signposts to identify the navigational stars and will be illustrated with the diagrams to make identification simpler.

Night sky

Night sky is a vista of stars. The stars are many light-years away. They are estimated to be many times bigger and massive compare to our sun. If one faces north, the stars appear to move slowly from right to left. If one faces south, the stars appear to move slowly from left to right. If one faces west, the stars appear to dip down toward the horizon on an angle from upper left to lower right. The effect will be reversed if facing east.

Handy sky Measure

The human hand is a convenient sky measuring device and measures the angular distances in degrees without much error. Extending the arm out in front, the finger and combination of fingers give the angular distances in degrees. The diagram given below is self-explanatory.

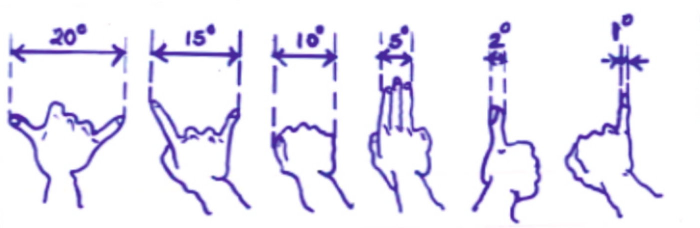

Fig. 1. Handy Sky Measure

Constellations

The stars in the sky are grouped into patterns known as constellations and given attractive names. The names depict gods, demigods, heroes, birds, animals. The most famous of all constellations are Great Bear & Orion.

Orion

It is a magnificent signpost and many navigational stars can be identified with respect to it. Orion is depicted as a hunter brandishing a club in one hand and raising his shield towards the charging bull, Taurus. The Orion's belt is marked by a line of three stars: from left to right - Alnitak, Alnilam and the Mintaka. Alnilam is a navigational star. The belt is inside a quadrilateral. Three corners of the quadrilateral are three navigational stars. The stars above the belt to the left is orange Betelguese and to the right of it is Bellatrix. The star below the belt to the left is Saiph and to the right is white Rigel, a navigational star. The brightest star Sirius of constellation Canis Major is about 15 ° to the left of Saiph and the red star Aldebran in Taurus, lies about 15 ° to the right of Bellatrix. The line joining from Sirius to Rigel leads to

Menkar. The line joining from Rigel to Betelguese if extended, points towards Gemini twins Castor & Pollux. Pollux is a navigational star and is to the left of Castor. They are just 5 º apart, making for a very good celestial yardstick in the sky. Elnath, Betelguese and Bellatrix form an isosceles triangle with the base angles at Betelguese and Bellatrix. A line from Rigel to Bellatrix points towards Elnath and then almost in a straight line to Capella in Auriga. The line joining from Bellatrix to Betelguese points towards Procyon. Betelguese, Procyon and Sirius form an equilateral triangle. It is referred to as the Winter triangle. The line south of Sirius leads to Canopus, the second brightest star. Three stars to the left of this line form a triangle. The star closest to the line is Adhara. The arc through Aldebran and Menkar curves towards Diphda. The line joining Betelguese & Procyon points to Regulus in Leo.

Navigational stars as numbered in the diagram

1. Alnilam
2. Betelguese
3. Bellatrix
4. Rigel
5. Sirius
6. Aldebran
7. Menkar
8. Pollux
9. Elnath
10. Capella
11. Procyon
12. Adhara
13. Towards Canopus
14. Towards Diphda
15. Towards Denebola

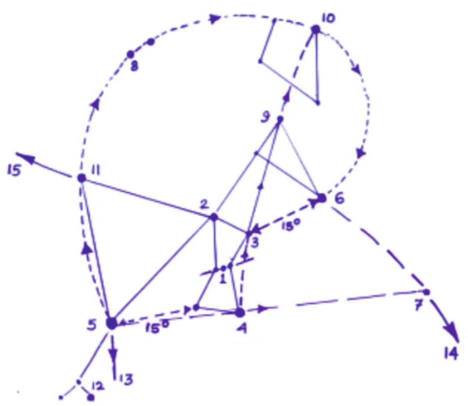

Fig. 2. Navigation stars

Great Bear or Ursa Major

It is another signpost and comprises of seven stars out of which three are navigational stars namely Dubhe, Alioth and Alkaid. Merak and Dubhe are referred to as pointers as they point towards Polestar in Ursa Minor. Ursa Major is also known as Big Dipper of length about 30 º. The handle of the ursa Major extended to one full dipper length leads to orangish Arcturus and another dipper length meets at Spica. Further 15 º leads to Gienah in Corvus. A line from Antares of Scorpius through the middle star goes directly in a curve to Spica. Spica is a part of an equilateral triangle with Arcturus and Denebola in Leo. The sickle shape of the stars which form the lion's head and mane cannot be missed. It forms a part of constellation Leo. The brightest star in Leo is Regulus. Denebola and Regulus point towards Procyon. Extend a line joining Megrez and Phecda to 45 º points to Regulus. Furthur 25 º leads to Alphard. The constellation Corona Borealis, popularly known as the Northern Crown is left of Arcturus. Alphecca is the only navigational star of this constellation.

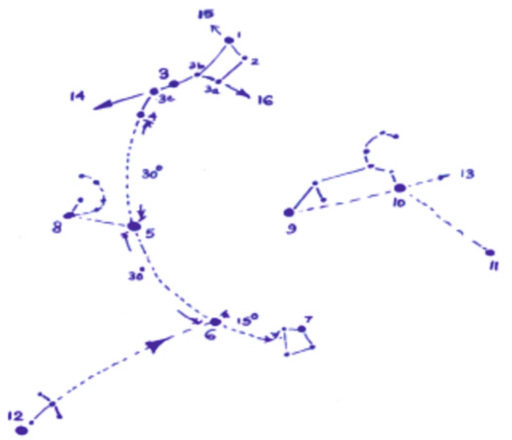

Fig. 3. Navigation stars

Navigational stars (except numbers 2,3a,3b and 3c) as numbered in the diagram

1. Dubhe
2. Merak
3. Alioth - 3a. Phecda 3b.Megrez 3c. Mizar 4. Alkaid
5. Arcturus
6. Spica
7. Gienah
8. Alphecca
9. Denebola

10. Regulus
11. Alphard
12. Antares
13. Towards Procyon
14. Towards Vega
15. Towards Polestar
16. Towards Regulus

Deneb connection

Deneb is the brightest star in Cygnus, the Northern Cross. The Summer Triangle is a stellar configuration consists of Deneb, Vega and Altair. Join Deneb, Altair and Enif to form Zaydeh's triangle opposite the Summer triangle. Move from Altair through Enif in an upward curve to find the square of Pegasus. Markab and Alpheratz are the two navigational stars in Pegasus. Line through Deneb and Enif leads to Fomalhaut.

Cassiopeia

It is easily recognized by its W-shape, lying in the far northern part of the sky. Its navigational star is Schedar.

Little Dipper

It is also referred to as Ursa Minor. Polestar and Dubhe are the tw

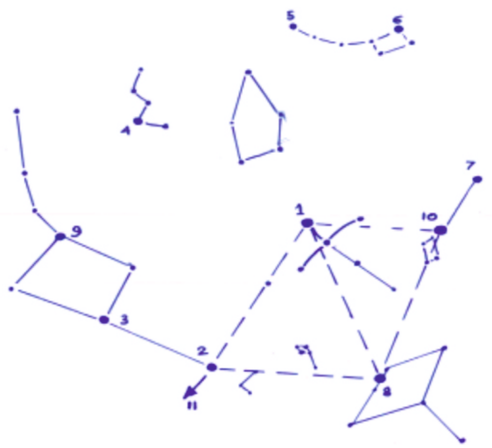

Fig. 4. Navigation Stars

Navigational stars as numbered in the diagram
1. Deneb
2. Enif
3. Markab
4. Schedar
5. Polaris
6. Kochab
7. Eltanin
8. Altair
9. Alpheratz
10. Vega
11. Towards Fomalhaut

Carina

It is popularly known as the keel. Canopus is the brightest star in the southern constellation of Carina and is the second brightest star next to Sirius. It is located near the western edge of the constellation and is south of Sirius. The stars Iota and Avior together with Kappa and Delta Velorum form false cross sometimes mistaken for the Southern Cross. South of False cross lies Miaplacidus, the second brightest star of Carina. North of False cross lies the star Suhail in Vela. The Southern Cross comprising of four stars, actually lies west of the False Cross. The north and the south stars are Gacrux and Acrux respectively. The line joining east –west stars of this cross, extended westwards, leads to constellations Centaurs. Hadar and Rigil Kent are two bright stars of Centaurs. Southern Triangle or Triangular Australe lies south- west of Centaurs. Atria is the only navigational star.

Fig. 5. Navigation stars

Navigational stars as numbered in the diagram
1. Canopus
2. Avior
3. Suhail
4. Miaplacidus
5. Acrux
6. Gacrux
7. Hadar
8. Rigil Kent

9. Atria
10. Towards Sirius
11. Towards Achernar
12. Towards Antares

Conclusions

Identifying the stars seems difficult at the beginning. It will be worth trying to follow the tips and guidance given in this article. Look for the signposts and correlate with the diagrams. The handy sky measure is really very handy. So, wish you all "happy star gazing with success".

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NUMERICAL ANALYSIS OF THERMAL INSULATION GLASS-FIBRE REINFORCED POLYESTER COMPOSITEFOR MARINE APPLICATION

Jitendra Singh Pal
Tolani Maritime Institute
jitendrap@tmi.tolani.edu

Dnyaneshwar N. Godse
Tolani Maritime Institute
godsebosun@gmail.com

Sanjeet Kanungo
Tolani Maritime Institute
sanjeetk@tmi.tolani.edu

ABSTRACT

The thermoset plastic with glass fiber was used for the formation of the test material of the desired strength of composite. In this study the thermal insulation test is carried out in a box made up of a FRP material by diffusion flame. The experimental results were validated by heat transfer simulation through the ANSIS Code 13.2. In this paper the results from the fire tests are presented and a discussion on the possible application of composite material to be used for the construction of ship cabin is carried out and found that the temperature across the FRP cabin wall was reduced to 125 C0 from 620C0.

Keywords

Diffusion flame, Thermal insulation, Numerical analysis, Fire resistance, Composite material.

Preamble

The aim of this study is to provide background information and give a thermal insulation achieved by these walls made of FRP. The use of FRP structures for high-speed craft and for air craft had increased. As per SOLAS regulation II-2/17 the use of composite is possible for application. The various tests to ascertain the safety, reliability and integrity of structure is to be evaluated. This study was carried out in accordance with resolution MSC 45(65) and the international code for application of Fire Test Procedures (FTP code). Several research projects at national and international level, are focused on the use of FRP structures in major ship components, have been carried out where SOLAS regulation II-2/17 was used as a baseline for possible approval.

The International Maritime Organization has proposed the new set of guidelines regarding fibre reinforced plastic for ships and give a proposal for the continuing work with development of guidelines for the fire testing of FRP materials.

Literature review

Anders Dragsted in the COMPASS project demonstrated that the passenger ferry may be refurbished with polymer composite materials.

Preparation of test specimen is in accordance with the practice outlined in resolutions A. 653 (16), A.687(17), A. 754 (18) is carried out.

Suhas V. Patankar has discussed the nature of numerical methods. A discretization equation is an algebraic relation connecting the values of variation for a group of grid points. Such an equation is derived from the differentials equation governing variation and thus expresses the same physical information as the differential equation.M. Necati Ozisik given the one-dimensional time dependent heat conduction equation

$$\partial^2 T/\partial X^2 = 1/\alpha\, \partial T/\partial t \qquad (1)$$

Equation (1) is a second-degree derivative in the x –variable and a first degree partial derivative in the time variable. The conditions at any given location x are influenced by changes in conditions at both sides of that location, hence the equation is regarded elliptic in the x-variable. However, in the time variable t, the conditions at any instant are influenced only by changes taking place in conditions at times earlier than that time; hence the equation is parabolic in time and called parabolic.

Incopera explained that in the Finite-Difference form of the heat equation Refer to figure 1. In numerical solution the determination of temperature is done at the discrete points (m, n) which is at its centre. The reference point is frequently termed a nodal point, and the aggregate of points is termed a nodal network, grid or mesh.

$T_{m,n+1}+T_{m,n-1}+T_{m+1,n}+T_{m-1,n}-4T_{m,n}=0$ ....(2)

Hence for the m, n node the heat equation, which is an exact differential equation, is reduced to an approximate algebraic equation.

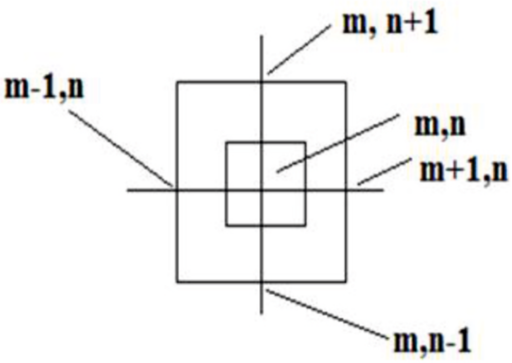

Fig.1. Two-dimensional conduction, Nodal network

Materials

Following materials are used for making FRP product:

a) Filler: Gel coat, Aerosol powder
b) Catalyst (Hardener)
c) Accelerator (cobalt, naphtha, cobalt octet)
d) Realizing Agent (Wax P.V.A. (Polyvinyl Alcohol)

Proposed test cabin made by FRP

The proposed cabin dimension length: 16 inch and width: 16 inch, total: 256 Square inch = 1.78 Square feet. (Refer to figure 04)

This chemical is mixed with each other & put into mold.

Gel coat required: 83.66 gm/ft^2 for one layer

Gel coat used: 251 gm/ft^2

Accelerator: 0.75 to 1% of gel coat

Accelerator used: 2.60 ml

Catalyst used: 2.60 ml

Pigment ratio 5% of gel coat

Pigment required: 16 gm

CSM = 450 GSM = 450 gm/m^2

Each feet area = 74.76 gm

Resin required for CSM mat

202 times the weight of mat = 74.76x2.2 = 165 gm

Accelerator at the rate of 0.75% = 1.25 ml

Catalyst = 1.25 ml

Methodology of Test of FRP cabin

a) Parametric analysis on FRP test cabin was carried out to validate the results with computational fluid dynamic for thermal dissipation.
b) Fire test was performed to calculate temperature loss through the walls of a cabin made of FRP.
c) Measurement of temperature with respect to time was recorded with data logger.

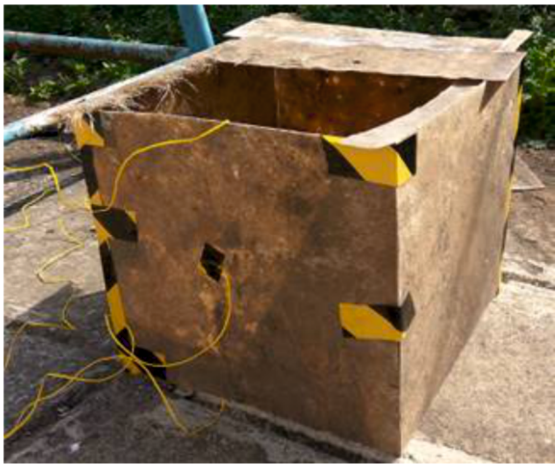

Fig.2. FRP test cabin observations

Experiments were conducted on the cabin made by the FRP (refer to figure 04) and with varying input parameters such as time and temperature of the cabin wall. The various temperature after the experimental investigation are shown in table 01: -

Table 01. Temperatures on all sides of test cabin

Sr.	Wall	Inside wall Temp	Outside wall Temp
1	Front	616^0C	125^0C
2	Back	615^0C	123^0C
3	Left	620^0C	125^0C
4	Right	617^0C	124^0C
5	Top	615^0C	118^0C
6	Bottom	612^0C	116^0C

Fig. 3. FRP test cabin top covered

Fig.4. Data logger FALCON 1600 DL

Parametric analysis

Temperature was varied in the FRP test cabin with respect to time and monitored by data logger Falcon 1600 DL (figure 06). The temperature was found to be varying exponentially from initial 05 Sec to 1080 sec.

Falcon 1600 DL is a defined type analogue input scanner and data logger. It had maximum 16 channels in steps of 4 channels. In this study the 04 channels were used to measure the temperature of the cabin walls. The thermocouples are having 4-20 mA DC RTD pt. 100 with 03 wire with accuracy of 0.5% of FSR over the range.

Table 02. Test parameters temperature with time

Sl	Time Second	Inside temperature C	Outside temperature C
1	1	33	33
2	3	53	51
3	6	105	64
4	9	218	77
5	12	332	94
6	15	457	109
7	18	620	125

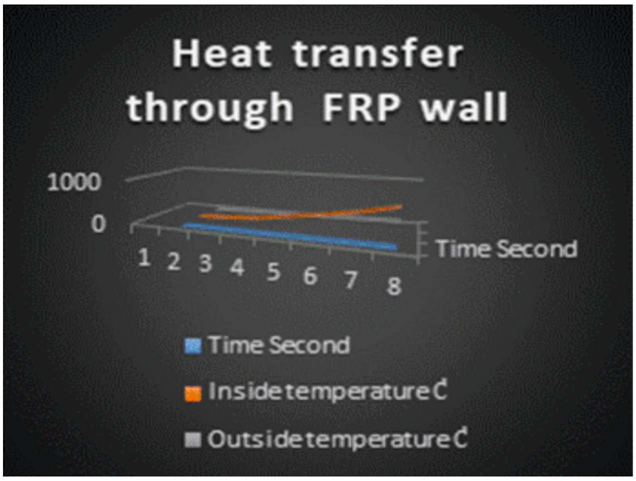

Fig. 5. Test parameters of temperature in degree centigrade with time in seconds

CFD Pre-processing of FRP cabin

Numerical computations were carried out by using Ansys 13.2 code. This code solves the heat transfer in transient for three transfer modes: conduction, convection, and radiation. During the model development it was found that the use of radiation and convection model for heat transfer in the expansion of fire was more suitable. We had created two-dimensional computational domain of cabin wall and generated 50000 nodes with 45619 elements in 04 groups with 45618 hex element. (refer to figure 06)

Table 03.Boundary condition of cabin wall

Boundary	B.C. Type	Parameters
INLET	Temperature	33^0 C
OUTLET	Temperature	33^0 C
TOP	Fixed Wall	No slip
CYLINDER	Fixed Wall	No slip

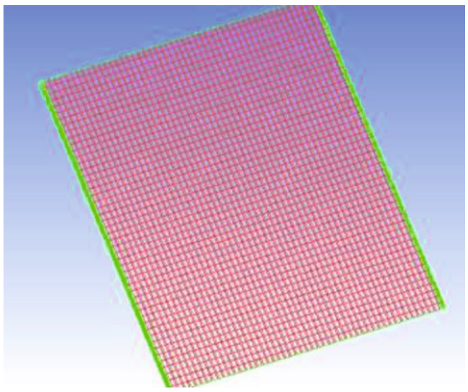

Fig. 6.Hex element in the meshing of cabin wall

CFD Solver of FRP cabin

The prerequisite processes in the solution procedure of this computational solutions are initialization, solution control, monitoring solution, CFD calculation, and checking for convergence. In this study the second order upwind discretization (interpolation) with solution procedure pressure-velocity coupling is chosen. The solution was converged at 14 steps with flow time 1 second and time step is 1.

CFD result report in contour plots

A contour line can be described as a line which indicate of some property (here it is temperature in degree centigrade of cabin wall) is constant in space. The contours are plotted such that the difference between the numerical value of the dependent transport variable from one contour line to an adjacent contour line is held constant. Figure:07,08,09 and 10 indicate the variation of temperature across the Steel plate.

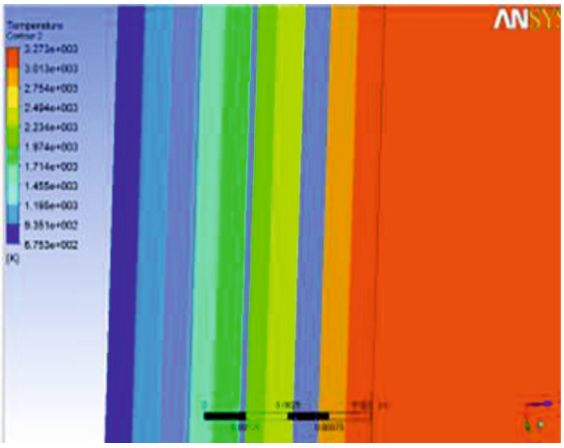

Fig. 7. Temperature contour of steel wall

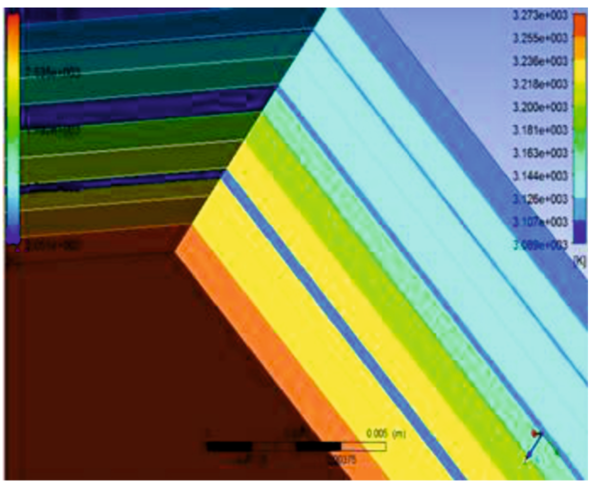

Fig. 8. Temperature contour of FRP wall

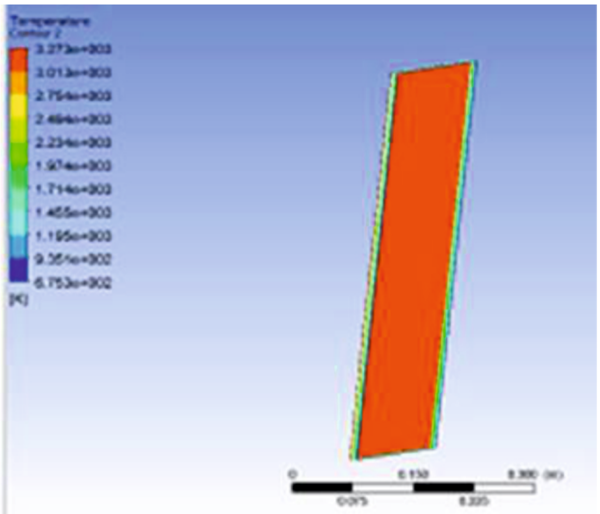

Fig. 9. Temperature of outer wall of steel

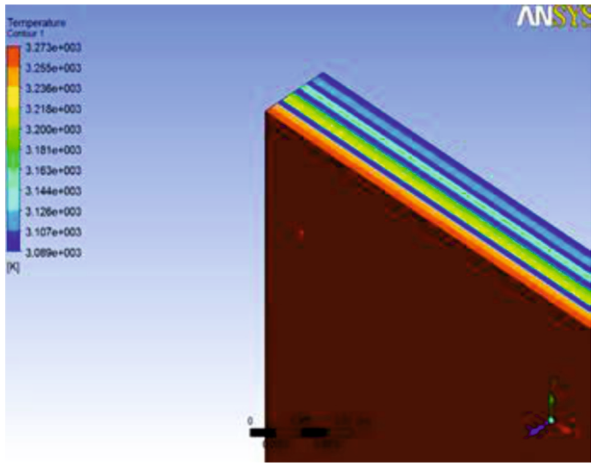

Fig. 10. Wall made by steel temp is 3273 C^0

CFD result data report and output

A curve between the heat transfer with time step shown in figure 11 and 12 attained numerical solution and extract the quantitative results for post analysis purpose.

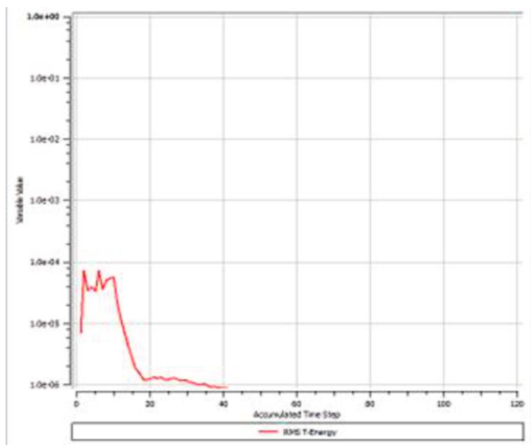

Fig. 11. Curve of heat transfer with time step of cabin made by steel

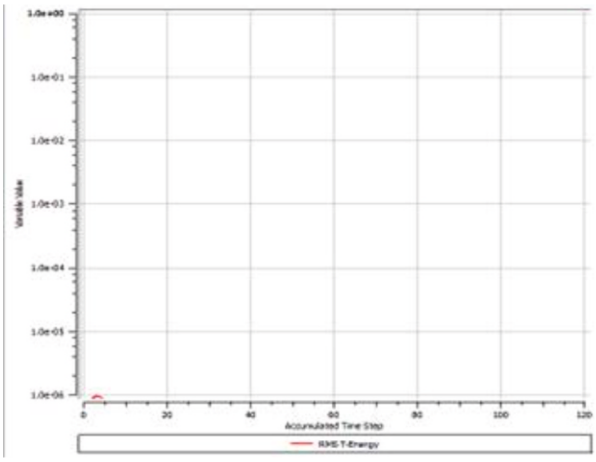

Fig. 12. Curve of heat transfer with time step of cabin made by FRP

Conclusions

In this study the thermal insulation testing of FRP made cabin was carried out. Experiments were conducted at different time interval with temperature distribution across the wall thickness made by the FRP. This experiment and numerical technique data of a number of pertinent transport variables can be tracked and analyses to describe the time-development response of the heat flow process. The conclusion is as follows: -

a) The results showed that temperature across the FRP cabin wall was reduced to 125^0 C from 620^0 C.

b) The simulation of heat flow revealed that the heat loss across the cabin wall was 20.16%.

c) The numerical analysis showed that as the time increased, the heat content in the cabin increased exponentially.

d) The transient heat flow with time step showed that FRP wall needed time step of 1.240 E + 02 seconds with compared to steel made wall which were taking longer time step of 4.690E + 02 seconds.

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REVIEW OF MULTIBODY SIMULATION MODELLING OF GEAR SYSTEMS SUBJECTED TO UNCERTAINTIES

C V S R Subrahmanyam
Tolani Maritime Institute, Pune.
subrahmanyamc@tmi.tolani.edu

ABSTRACT

Review of the capabilities of multibody simulation models and their short comings are discussed in this article. Finally, an attempt was made to evolve a methodology which leads to dynamically efficient robust design of mechanical systems like gear box.

Keywords

Multibody Systems, Simulation, Robust Design, Gear box.

Introduction

Generally speaking, multibody systems can be classified as rigid multibody systems or flexible multibody systems. Rigid multibody systems are assumed to consist only of rigid bodies. These bodies, however, may be connected by massless springs, dampers, and/or actuators. This means that when rigid multibody systems are considered, the only components that have inertia are assumed to be rigid bodies. Flexible multibody systems, on the other hand, contain rigid and deformable bodies. Deformable bodies have distributed inertia and elasticity which depend on the body deformations. As the deformable body moves, its shape changes and its inertia and elastic properties become functions of time. For this reason, the analysis of deformable bodies is more difficult than rigid body analysis [1].

There is plenty of software tools specialized in the field of multibody dynamics, which can be currently used for the solution of the engineering or research problems (ADAMS, SIMPACK, Alaska,...) The equations of motion while working with these tools are created on the basis of so-called multibody formalisms. They are special proposed algorithms for the automatic generation oequations of motion of the coupled rigid body systems. Also, flexible bodies can be incorporated in computational models. The software tools integrate more or less comfortable pre- and post-processing environment with efficient solvers developed by groups of mathematicians and engineers. On the other hand, it is sometimes more advantageous to formulate and to solve the equations of motion of a studied multibody system without usage of the commercial software tools. The main reason is the black-box-like behaviour of the commercial tools and the limited possibility of introducing some special features and special model elements as well as some non-standard solution or optimization methods [2].

Computational methods are used extensively for the analysis and design of engineering dynamic systems such as automobiles, aircrafts and wind-turbines. Credible computational methods can lessen the need for expensive experimental analysis and prototype building and reduce the cost of development of these products. Some engineers believe that the credibility of computational predictions can be enhanced only by using intensive numerical approaches, e.g., by increasing the mesh density in the finite element model of a structure. While this may be necessary for some applications (e.g., modelling the tip of a crack) it is not sufficient to improve the credibility of computational prediction. This is due to the fact that several types of uncertainties exist in the whole process of science-based computational predictions as shown in the figure below. Such uncertainties include (a) parametric uncertainty (e.g., uncertainty in geometric parameters, friction coefficient, viscosity, strength of the materials involved), and (b) nonparametric uncertainty such as those arising from model inadequacy (e.g., using linear law when it is actually nonlinear) and low fidelity models (e.g., damping, multi-scale issues, damage mechanisms). These uncertainties must be assessed and managed for reliable computational prediction.

Sources of parametric uncertainties

(i)- Uncertainties for the spatial mass distribution inside a body. For instance, such a type of uncertainties can be encountered for a vehicle in which the passengers have a mass and a position that are variable. For each body, this type of uncertainties yields a random mass, a random position of the center of mass, and a random tensor of inertia.

Consequently, the mass matrix [M] and the Coriolis forces K are random. The probability density functions (pdf) of these random masses, random positions of the centers of mass, and random tensors of inertia have been constructed1 using the Maximum Entropy Principle, in which a special care has been devoted to the probabilistic modelling of the random tensor of inertia in following the methodology of the nonparametric probabilistic approach of uncertainties introduced in 23,24 for the construction of random matrices.

(ii)- Uncertainties in the joints. For the ideal joints, the directions and the points defining the joints can be uncertain.

These uncertainties may be due to manufacturing tolerances, or due to the natural wear during the life cycle of the multibody system. Such uncertainties have to be taken into account in order to ensure a good accuracy for the prediction of the dynamical response of the multibody system. For non-ideal joints the friction coefficients can also be uncertain. The randomness in the joints between the bodies yields a random constraint vector.

(iii)- Uncertainties in internal forces. Concerning internal forces, there may be uncertainties in the constitutive laws of the multidimensional springs and dampers. In such a case, uncertainties may be taken into account in the parameters of the constitutive laws, or directly in the stiffness and damping matrices using the nonparametric probabilistic approach of uncertainties. [3]

Model Uncertainty Questions

What is the most appropriate approach to consistently represent and reason about uncertainty in complex systems consistently? What is the best approach to characterizing the uncertainty associated with a simulation model in order to enable and facilitate reuse?

How should one aggregate knowledge, expertise, and beliefs of multiple experts across different domains?

What is the best approach to take advantage of the large and diverse datasets for characterizing uncertainty and for improving model accuracy?

What are the most promising approaches to accelerate the validation of models for specific application contexts?

Research Challenges

A common problem in the numerical simulation of real-world systems is the fact that exact values for the parameters of the models can exhibit a high level of uncertainty. This non-determinism in numerical models may arise as a consequence of different sources, motivating some categorization of uncertainties.

Although other classifications are possible in almost the same manner, the following categorization proves to be well-suited in this context: aleatory uncertainties, such as natural variability or scatter, on the one side, and on the other side, epistemic uncertainties, which arise from an absence of information, rare data, vagueness in parameter definition, subjectivity in numerical implementation, or simplification and idealization processes employed in the modelling procedure.

All these conditions manifest as uncertain model parameters and in some situations as uncertain initial or boundary conditions. Consequently, the results that are obtained for simulations that only use one specific set of values as the most likely ones for the model parameters cannot be considered as representative of the whole spectrum of possible model configurations.

Furthermore, this fake exactness provided by the numerical simulation of models with uncertain but exact-valued parameters can significantly affect the comparison between numerical simulations and experimental testing.

Namely, such a comparison may be rated as unsatisfactory if the crisp-valued simulation results do not well match the experimental ones, even though it might be absolutely satisfactory, if the uncertainties inherent to the models would have been appropriately taken into account in the simulation procedure

Approaches for Analysis

Stochastic analysis: the stochastic approach to uncertain problems is to model the structural parameters as random quantities. Therefore, all information about the structural parameters is provided by the probability density functions. This probability density function is then used to determine an estimate of the system's behaviour.

Fuzzy analyses: The fuzzy approach to the uncertain problems is to model the structural parameters as fuzzy quantities. In conventional set theories, either an element belongs or does not belong to set. However, fuzzy sets have a membership function that allows for "partial membership" in the set. Using this method, structural parameters are quantified by fuzzy sets.

Interval analysis: The interval approach to the uncertain problems is to model the structural parameters as interval quantities. In this method, the uncertainty in the elements is viewed by a closed set-representation of element parameter that can vary within intervals between extreme values. Then, structural analysis is performed using interval operations.

Case Study: Proposed Methodology to fix uncertainty in Multibody Simulation Model of Gearbox.

Industrial gear systems produce noise when they are subjected to different operating conditions. That is to say that the final design of gear box is validated for a set of given operating conditions. When the gear box is subjected to any other operating condition it gives rise to noise signatures.

Now a day many attempts were made to make the design robust. In order to make the final design of the gear box robust, consider the final design of gear box. Collect the noise signature while testing.

Generate a multibody simulation model with the help of software like Pro Engineer/Ansys. Estimation of effect of parameters like mass, stiffness and damping on dynamic performance of the simulation is to be conducted. Sensitivity analysis was then conducted to identify critical parameters, with ranking of their contributions to the variability in the performance parameter. This information is useful to improve the efficiency of probabilistic analysis and to guide efforts in data collection. Further analysis to identify an approximation function, called a Response Surface Function (RSF) was carried out.

Compare the noise signature of the gear box with expected dynamic performance characteristics.

The difference in the two signatures is to be considered as Model Based Epistemic Uncertainty.

Now Consider the parameters of the simulation model: mass, stiffness and damping.

Set the variation ranges for these parameters.

Research techniques like Design of Experiments can be applied for conducting and concluding the possible ranges for the above parameters to fix the noise signatures and arrive at robust dynamic performance characteristics. Software MSC.ADAMS has probabilistic design capabilities such as Design of Experiments (DOE) and Monte Carlo simulation (MCS). These models were used to predict how the variability in the input parameters affects the variability

Then between the concluded ranges of the parameters optimization study can be conducted to make the simulation model dynamically efficient.

By adopting the above methodology and using MATLAB software, it is possible to achieve dynamically efficient robust design of the gear box.

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CYBER SECURITY ONBOARD SHIP

Manthan Dabadgaonkar
Computer Engineering,
Vishwakarma University, Pune.

Milind Kulkarni
Dean, Science & Technology,
Vishwakarma University, Pune.

ABSTRACT

Today´s marine industry depends much more on automation, digitalization, integration of operations. The widespread application of IOT for ships at sea in every part of the world brings a novel and crucial requirement for sustaining the operational safety of those critical systems.

Cybersecurity is today having an importance in the international maritime world. We need to appear closely at new necessities that all those operating within the maritime trade should currently develo-ped. Also, we offer direction on the way to implement cybersecurity in maritime operations.

In the expression of developing cybersecurity threats to the trade and with the Maritime Safety Committee's resolution in mind, IMO has taken the choice to include necessary cybersecurity requirem-ents into the International Safety Management Code, ISM.

Primarily cybersecurity must be address issues like, what is the importance of these developments for the worldwide maritime sector? More specifically, what does the ISM Code and SOLAS requirement etc. This is required to ensure best industry practice, when it comes to preventing cybercrime at sea?

Keywords

Cybersecurity, Maritime safety, SOLAS

Introduction

The International Maritime Organisation, IMO, have not established cybersecurity guidelines specific to the marine segment. This will change in the very near future. As of January 1st 2021, cybersecurity regulations will be mandatory as per Chapter IX of the International Convention for the Safety of Life at Sea , SOLAS, Regulations 1-6, Management for Safe Operation of Ships.

The crucial necessity to improve cybersecurity regulations for the maritime sector has, in fact, been a part of worry in recent years.

In June 2017 the IMO´s Maritime Safety Committee, MSC, decided procedures for cyber risk management. These, in turn, became the basis of high-level endorsements for the entire marine industry. The rules place an obligation on ship-owners, operators, and stakeholders to accept a risk management attitude with three objectives: reducing the danger to crew, to ecological safety, and to the monetary penalties of a full or partial loss of availability, integrity and confidentiality of sensitive data [4].

ISM Code

The ISM Code needs revision to a company's SMS and should now include the following [3].

- Cybersecurity actions to be accepted in the company´s Health, Safety & Environment, Security & Equality / Policy Statement.
- Risk assessments of all OT and IT systems onboard and on to land.
- Procedure in place for the usages of transferrable storage.
- Procedure and practice in place about network communications and Wi-Fi for vessel crews.
- Procedure and system in place for watch keeping and updating navigation and communication systems.
- Procedure in place regarding authorization criteria for remote connections.
- Inventory of all OT systems.
- Internet access procedure in place outlining limitations relating to actions presently being performed on ship.
- Eventuality Plans for Emergency Response established and in place.

TMSA Cybersecurity Necessities

(Tanker Management and Self-Assessment) Actions in place about patch management for software.

Methods and supervision in place for the documentation and removal of cyber threats.

Readiness of strategies for cybersecurity set by marine sector and classification societies.

Password management regulations to be implemented.

A Cyber Knowledge Proposal to encourage security awareness amongst all crew, established and applied.

ISM Code will cover the following processes of all vessels on international operations, specifically:

Passenger ships including high-speed passenger craft. Oil tankers, chemical tankers, gas carriers, bulk carriers and cargo high-speed craft of 500 GRT and above. TMSA version-3 also relates to business procedures under the Ship Inspection Reporting Program / SIRE.[1]

Fig. 1. Deck officers control room

IMCA Recommendations

International Maritime Contractor's Association, IMCA, embodies the offshore support and construction (vessels) industry globally has also updated its advice on cyber threats. Its endorsements include twenty controls, and sub-controls, that focus on several technical methods and actions. The principal objective is to help establishments prioritize defence against most damaging forms of attack on IT systems and networks.

1. Account of Authorized and Unauthorized Devices vigorously accomplished. It includes drawing up an inventory, tracking and handling all hardware devices on the network. To identify location of unmanaged devices to prevent network access to these devices.
2. Secure Configurations for Hardware and Software on Mobile Devices, Laptops, Workstations and Servers. Determine, implement and actively manage, by tracking reporting and correcting the security configuration of all laptops, servers and workstations. This should be done using a rigorous configuration management and change control process in order to prevent attackers from exploiting vulnerable services and settings.
3. Continuous Vulnerability Assessment and Remediation. Continuously acquire, assess and take action on new information in order to identify all vulnerabilities. Remediate same and by so doing minimize the window of opportunity for attackers.
4. Protection against Malware. Maintain a watch 24/7 against the installation, spread and execution of malicious code at multiple points in the institution and optimizing use of automation for rapid defence, gathering of data and corrective action.
5. To Manage the security all software applications, in order to prevent, detect and correct security vulnerabilities.
6. Deploy and implement the processes and tools used to track, control, prevent abuse of and correct the secure use of Local Area Networks and systems.
7. Information Recovery Capability. Plan and convey all procedures and instruments for sufficiently backing up basic data, with a demonstrated strategy for its convenient recuperation following a security rupture.
8. Security Skills Assessment and Appropriate Training to Fill Gaps. This alludes to every single useful job in the association, organizing those which are mission basic for business activities and security prerequisites. Distinguish the particular mastery, aptitudes and capacities expected to help guard of the endeavor. Create and execute a coordinated arrangement to survey and distinguish loopholes in digital protection.
9. Secure Configurations for Network Devices, for example, Firewalls, Routers and Switches. Build up, execute and effectively oversee, by following, giving an account of and remedying, the security design of system framework gadgets.
10. Data Protection. Convey and actualize procedures and

apparatuses used to avoid information exfiltration, to moderate the impacts of exfiltrated information and to guarantee the security and respectability of delicate data.[2]

IMO Strategies on Cybersecurity Onboard Ship

It was formed and endorsed by the world's driving global exchange relationship for the oceanic business. Individuals are dispatch proprietors, administrators, dry and tanker payload shipping industry accomplices and worldwide oceanic industry associations [1].

Version 2.0 incorporates significant updates concerning explicit dangers and the risk condition presently confronting the business. Among these things are the accompanying.

Assimilation of cyber threats into ship´s safety management system / SMS.

Upgrades to direction identifying with chance evaluations performed on operational innovation/OT to incorporate route and motor control frameworks.

Extra direction for overseeing hazard related with outsider providers and sellers.

The reason for the IMO rules is to address the particular and one of a kind needs of the oceanic, transportation and business traveler ventures in connection to digital hazard the executives. The IMO rules depend on best-practice as created by the cybersecurity division, with additional items identifying with the particular prerequisites and useful territories of the sea business.

Receiving best-practice principles is a vital advance yet insufficient. The oceanic business has explicit difficulties that must be met. These incorporate, above all else, the connection to security issues just as its entrapment and Operational Technology /OT. [3]

IMO Guidelines center around the nearby connection among wellbeing and security. In any case, the rules additionally feature significant distinctions.

Cyber security is centered around the danger of loss of accessibility, or uprightness, of information and OT that are basic for the wellbeing of work force just as vessels and different offices.

Frameworks that fall under Cyber Safety would incorporate ECDIS, GNSS or other outer sensor information or OT frameworks, for example, Dynamic Positioning or motor control frameworks.

Information Technology systems process information and/or transmit data. Operational Technology systems control physical machines.

Elementary Ideas of Info Security

Data security in plain language alludes to those means taken to guarantee that data doesn't fall into an inappropriate hand.

A decent beginning stage for anybody trying to comprehend Information Security is an approach apparatus known as the CIA Triad. CIA for this situation represents Confidentiality, Integrity and Availability of Information.

The CIA Triad is a manual for the execution of approaches, security controls, and systems in any association.

Uprightness alludes to confirmation that the data is liberated from unapproved altering or alteration in any capacity. Furthermore, there ought to be a method for testing the uprightness of the data. [4]

Cyber Risk Management

Creating and actualizing a digital hazard the board procedure fusing both Cybersecurity and Cyber Safety should start with correspondence and arranging workshops.

The one of a kind casing of reference and subject matter in every one of these two ranges of abilities help to decide the correct harmony among Cybersecurity and Cyber Safety. The initial step ought to be a general Threat Risk Assessment/TRA with an oceanic core interest.

Regarding Cyber Risk Management there are four potential activities. These are as per the following [2].

Risk Avoidance

Much of the time this is anything but an achievable answer for hazard the executives as the inter-connectivity and correspondence of organizations depends on the web, web confronting servers and cloud arrangements. In this unique circumstance, a choice to maintain a strategic distance from hazard implies returning to pen and paper for each communication. Plainly this decision will put the organization at a colossal weakness to their rivals who will probably want to alleviate, move and acknowledge a portion of the leftover hazard.

Risk Transfer

This option depends on the developing business sector for cybersecurity protection
suppliers. Much like car or different kinds of term protection, a higher hazard caused by not performing restorative upkeep or having a past filled with "mishaps" signifies higher protection premiums. At times it might be financially savvy contrasted with the option of Risk Acceptance.

Risk Mitigation

This is the place where the best exertion is required by the association under danger yet in addition where we see the best organization brand, client trust, and other non-quantifiable resources are not effectively obtained. Nor can the consequences of lost those benefits be effectively moved. You can't purchase notoriety protection.

Risk Acceptance

Here we have two other options. We can acknowledge hazard all things considered or we can acknowledge the lingering hazard after a moderating element has been included. A level of remaining danger will, in any case, keep on being available considerably after alleviation. Thus, every data security the executives framework and hazard the board technique involves the acknowledgment of a level of hazard.

Fig. 2. Cyber security check

The first steps in cybersecurity concern the Identify Function in the cybersecurity framework. The Identity Function covers identification of the following.

This refers to both information assets as well as physical devices and systems. This includes all parties presenting a threat, existing or potential. This refers to all known weak points where an attack would be most likely to penetrate our defences.

Data from the three zones above ought to be applied to the evaluation of dangers and the degree and nature of business sway in a hazard appraisal workshop. Also, tweaked digital hazard appraisals ought to be performed for every remarkable sort of ship so as to precisely recognize the hazard design for that ship.

Based on the results from the Threat Risk Assessment / TRA the next step is to select appropriate controls to mitigate risks.

Structure of A Cyber Attack

What exactly happens in a cyber-attack? Let´s look at the phases of a typical cybersecurity violation.

Gathering information on the targeted organization or entity: Utilizing instruments to test the objective and recording the reaction. The expectation is to distinguish forms of working frameworks and programming running on frameworks so as to home in on vulnerabilities that might be available on those equivalent frameworks.

Data on the focused on association or element: Utilizing instruments to test the objective and recording the reaction. The expectation is to distinguish renditions of working frameworks and programming running on frameworks so as to home in on vulnerabilities that might be available on those equivalent systems. [5]

Getting a foot in the door to systems: This can mean either remotely or physically. A programmer enters a framework and heightens benefit, they intend to keep up that degree of access, so the assailant may leave an "indirect access" or rootkit, for example, a remote access trojan/RAT so they can without much of a stretch come back to a framework for some odious reason, for example, exfiltrating information or to "turn" to another framework on the system.

Fig. 3. Hackers in shipping

Endorsements from the IMO Rules

The main purpose is to, “Offering Guidance to Ship-owners and Operators on Effective Cyber Risk Management”

The Guidelines are not proposed to be a call for outer checking or evaluating the same number of littler associations may not really profit by a review of strategies.

An association that has unwritten and casual strategies and arrangements for digital hazard the executives would profit more from beginning with nuts and bolts instead of framing an advisory group contained key individuals from the board, account, HR legal and IT to talk about and compose formal approaches and methods for digital hazard the board in their own association.

These arrangements might be founded on a few casual systems previously being led in the association just as adjustments from industry best practice just as "Rules on Cybersecurity Onboard Ships".

Conclusions

Ships are progressively utilizing systems that depend on digitisation, digitalisation, joining, and robotization, which call for digital hazard the executives ready. As innovation keeps on creating, data innovation (IT) and operational innovation (OT) locally available ships are being organized together and all the more much of the time associated with the web. This brings the more serious danger of unapproved get to or vindictive assaults to ships systems. To relieve the potential wellbeing, ecological and business outcomes of a digital occurrence, a gathering of global transportation associations, with help from a wide scope of partners, have taken an interest in the improvement of these rules, which are intended to help organizations in detailing their own ways to deal with digital hazard the executives installed ships.

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AN IMPLEMENTATION ON VEHICULAR ADHoC NETWORK QoS ENHANCEMENT USING VARIOUS ROUTING PROTOCOL

Chetan Sharma
Tolani Maritime Institute, Induri.
chetansharma.tmi@gmail.com

ABSTRACT

Driving means changing location constantly, this means a constant demand for information on the current location and specifically for data on the surrounding traffic, routes and much more. This information can be grouped together in several categories. A very important category is driver assistance and car safety. This includes many different things mostly based on sensor data from other cars. We could think of brake warning sent from preceding car and collision warning, information about road condition and maintenance, detailed regional weather forecast, premonition of traffic jams, caution to an accident behind the next bend, detailed information about an accident for the rescue team and many other things. We could also think of local updates of the cars navigation systems or an assistant that helps to follow a friend's car.

Keywords

Vehicular Adhoc Network, QoS, Routing Protocol, VANET, MANET, DSDV.

Introduction

Another category is infotainment for passengers. For example, internet access, chatting and interactive games between cars close to each other. The kids will love it.
Next category is local information as next free parking space (perhaps with a reservation system), detailed information about fuel prices and services offered by the next service station or just tourist information about sights. A possible other category is car maintenance. For example, online help from your car mechanic when your car breaks down or just simply service information. So far no inter vehicle communication system for data exchange between vehicles and between roadside and vehicles has been put into operation. But there are several different research projects going on. VANET is one of those.

In 1999, the Federal Communications Commission of the United States allocated 75 MHz of bandwidth in the 5.9-GHz band for the new generation of a nationwide VANET. This wireless spectrum is commonly known as the dedicated short-range communication (DSRC) spectrum, which has been used for vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications. In August 2006, the European Telecommunications Standards Institute has also allocated 30 MHz of spectrum in the 5.8-GHz band for ITS.

IEEE 802.11p is a new upcoming standard using the DSRC spectrum. It extends the IEEE 802.11 standard for a high-speed vehicular environment, which covers the data link layer and the physical layer of the wireless access in vehicular environments (WAVE) protocol stack. Meanwhile, IEEE 1609, which is a family of standards, has been developed to define the five upper layers of the WAVE. The latest version of IEEE 802.11p has been approved and published in July 2010

IEEE 802.11p supports data communication between vehicles, in turn supports Intelligent Transportation Systems (ITS) applications. The channel capacity is 10 MHz, and there are two safety channel, one control channel and six service channels. Radio communication range is about 300 to 1000 meters and data rate is 6 to 27

Mbps. This paper deals with study of different types of routing protocols for VANET.

An VANET system architecture consists of different domains and many individual components as depicted in Figure1.

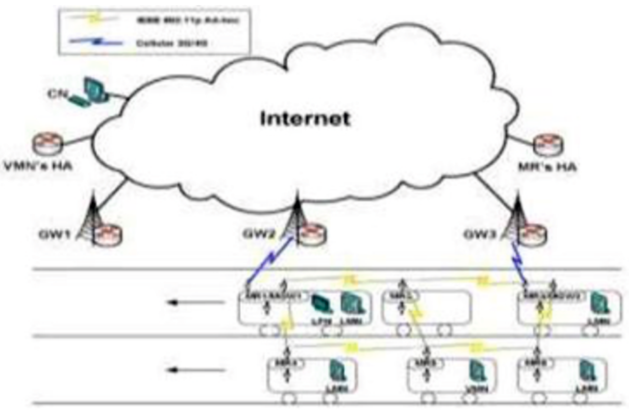

Fig. 1. VANET Architecture

In-vehicle domain

This consists of an on-board unit (OBU) and one or more application units (AU) inside a vehicle. AU executes a set of applications utilizing the communication capability of the OBU. An OBU is at least equipped with a (short range) wireless communication device dedicated for road safety, and potentially with other optional communication devices (for safety and non safety communications). The distinction between AU and OBU is logical; they can also reside in a single physical unit.

Ad Hoc Domain

An Ad Hoc domain is composed of vehicles equipped with OBUs and road-side units (RSUs), forming the VANET. OBUs form a mobile ad hoc network which allows communications among nodes without the need for a centralized coordination instance. OBUs directly communicate if wireless connectivity exists among them; else multi-hop communications are used to forward data.

Infrastructure domain

The infrastructure consists of RSUs and wireless hotspots (HT) that the vehicles access for safety and non-safety applications. While RSUs for internet access are typically set up by road administrators or other public authorities, public or privately-owned hot spots are usually set up in a less controlled environment. Easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

Ad Hoc Routing Protocols

VANET has some special characteristics that distinguish it from other mobile ad hoc networks; the most important characteristics that differentiate VANETs from MANETs are: high mobility, self-organization, distributed communication, road pattern restrictions, and no restrictions of network size. All these characteristics made VANETs environment a very challenging task for developing efficient routing protocols. We have a number of ad hoc routing protocols for MANETs but when we are dealing with a VANET then we require ad hoc routing protocols which must adapt continuously according to the unreliable conditions. MANET routing protocols are not suited for VANET because it is difficult for MANET routing protocols to find stable routing paths in VANET environments. Many routing protocols have been developed for VANET environments, which can be classified in many ways, according to different aspects; such as: protocols characteristics, techniques used, routing information, quality of services, network structures, routing algorithms, and so on.

VANET routing protocols can be classified into five classes based on the routing protocols characteristics and techniques used: topology-based, position-based, multicast-based, broadcast, and cluster-based protocols. Also, these routing protocols can be classified according to the network structures, into three classes: hierarchical routing, flat routing, and position-based routing. Moreover, according to routing strategies these protocols can be categorized into two classes: proactive and reactive. On the other hand, geographic based and topology-based are the two categories according to the routing information used in packet forwarding. Based on the quality of services, there are three types of protocols that are dealing with network topology (hierarchical, flat, and position aware), that concerning with route discovery (reactive, proactive, hybrid and predictive), or based on the MAC layer interaction. We are hereby considering the classification based on routing information used in packet forwarding.

Topology Based Routing

Several MANET routing protocols have used topology-based routing approach. Topology based routing protocols use link's information within the network to send the data packets from source to destination. Topology based routing approach can be further categorized into three groups:

- Proactive routing
- Reactive routing
- Hybrid routing

Proactive Routing

Proactive routing protocols are mostly based on shortest path algorithms. They keep information of all connected nodes in form of tables because these protocols are table based. Furthermore, these tables are also shared with their neighbours. Whenever any change occurs in network topology, every node updates its routing table. Strategies implemented in proactive algorithms are Link-state routing (e.g. OLSR) and distance-vector routing (e.g. DSDV). The working details for proactive routing protocols are as follows: Destination Sequence Distance Vector Routing (DSDV) use Distance Vector shortest path routing algorithm, it provides loop free single path to the destination. DSDV sends two types of packets - full dump and incremental. In full dump packets, all the routing information is sent while in incremental only updates are send. It decreases bandwidth utilization by sending only updates instead of complete routing information. The incremental still increases the overhead in the network, because these incremental packets are so frequent that makes it unsuitable for large scale networks.

Optimized link state routing (OLSR) maintains routing information by sending link state information. After each change in the topology every node sends updates to selective nodes. By doing so, every node in the network receive updates only once. Unselected packets cannot retransmit updates; they can only read updated information. Source-Tree Adaptive Routing (STAR) is another link State protocol. In STAR, preferred routes to every destination are saved in each router. It reduces overhead on the network by eliminating periodic updates. There is no need of sending updates unless any event occurs. This protocol can be suitable for large scale networks but it needs large memory and processing because it has to maintain large trees for whole network. Proactive based routing protocols may not be suitable for high mobility nodes because distance vector routing takes much bandwidth to share routing information with neighbours. Furthermore, size of the table is also quite big while discussing about large networks and in case of link state routing a lot of memory and processing may also be required. As in VANET, nodes (vehicles) have high mobility and moves with high speed. Proactive based routing is not suitable for it. Proactive based routing protocols may fail in VANET due to consumption of more bandwidth and large table information.

Destination Sequence Distance Vector Routing (DSDV)

This protocol is based on classical Bellman-Ford routing algorithm designed for MANETS. Each node maintains a list of all destinations and number of hops to each destination. Each entry is marked with a sequence number. It uses full dump or incremental update to reduce network traffic generated by rout updates. The broadcast of route updates is delayed by settling time. The only improvement made here is avoidance of routing loops in a mobile network of routers. With this improvement, routing information can always be readily available, regardless of whether the source node requires the information or not. DSDV solve the problem of routing loops and count to infinity by associating each route entry with a sequence number indicating its freshness. In DSDV, a sequence number is linked to a destination node, and usually is originated by that node (the owner). The only case that a non-owner node updates a sequence number of a route is when it detects a link break on that route. An owner node always uses even-numbers as sequence numbers, and a non-owner node always uses odd-numbers. With the addition of sequence numbers, routes for the same destination are selected based on the following rules: 1) a route with a newer sequence number is preferred; 2) in the case that two routes have a same sequence number, the one with a better cost metric is preferred.

Reactive Routing

On demand or reactive routing protocols were designed in such a manner to overcome the overhead that was created by proactive routing protocols. This is overcome by maintaining only those routes that are currently active. Routes are discovered and maintained for only those nodes that are currently being used to send data packets from source to destination. Route discovery in reactive routing can be done by sending RREQ (Route Request) from a node when it requires a route to send the data to a particular destination. After sending RREQ, node then waits for the RREP (Route Reply) and if it does not receive any RREP within a given time period, source node assumes that either route is not available or route expired. When RREQ reaches the particular destination and if source node receives RREP then by using unicasting, information is forwarded to the source node in order to ensure that route is available for communication. Reactive routing can be classified either as source routing or hop-by- hop routing. In source routing complete route information from source to destination is included in data packets. When these data packets are forwarded to other intermediate nodes in the network, each node takes route information from the data packet and stores it in the header of data packet.

In reactive routing protocol, each intermediate node does not need to update all route information in order to send packet to the particular destination. The main drawback of source routing is that it may not be suitable for large scale networks, where numbers of nodes are quite high and their behaviour is highly dynamic such as VANET. The first reason is that as numbers of nodes are larger in large scale ad hoc networks hence it may result in route failure. The second reason is that as numbers of intermediate nodes are increasing, thus network overhead may occur and route information in the header of each node may also increase. Hop-by-hop reactive routing is better than on demand source routing as each data packet in it contains next hop and destination addresses. Thus, intermediate nodes from source to destination contain the routing table information in order to send data packet to a particular destination. This can be quite helpful for accommodating sudden changes in network topology. Thus, when topology changes nodes receive fresh routing table information and selects new routes accordingly. As a result, these selected routes are now used to send data packets to destination. These types of routing protocols continuously update their routing information and carried knowledge of each neighbouring node Therefore this type of reactive routing can be adopted in highly mobile ad hoc networks such as VANET. Many reactive routing protocols have been proposed so far but, in this section, we briefly described about Ad Hoc On Demand Distance Vector Routing (AODV) and Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV). Moreover, we check the suitability of these protocols for VANET.

Ad Hoc on Demand Distance Vector Routing- AODV

Ad Hoc on Demand Distance Vector Routing (AODV) is an example of pure reactive routing protocol. AODV belongs to multihop type of reactive routing. AODV routing protocol works purely on demand basis when it is required by network, which is fulfilled by nodes within the network. Route discovery and route maintenance is also carried out on demand basis even if only two nodes need to communicate with each other.

AODV cuts down the need of nodes in order to always remain active and to continuously update routing information at each node. In other words, AODV maintains and discovers routes only when there is a need of communication among different nodes. AODV uses an efficient method of routing that reduces network load by broadcasting route discovery mechanism and by dynamically updating routing information at each intermediate node. Change in topology and loop free routing is maintained by using most recent routing information lying among the intermediate node by utilizing Destination Sequence Numbers of DSDV.

Hybrid Routing

Hybrid routing combines characteristics of both reactive and proactive routing protocols to make routing more scalable and efficient. Mostly hybrid routing protocols are zone based; it means the number of nodes is divided into different zones to make route discovery and maintenance more reliable for MANET. Haas and Pearlman proposed a hybrid routing protocol and named it as ZRP (Zone routing protocol). The need of these protocols arises with the deficiencies of proactive and reactive routing and there is demand of such protocol that can resolve on demand route discovery with a limited number of route searches. ZRP limits the range of proactive routing methods to neighbouring nodes locally, however ZRP uses reactive routing to search the desired nodes by querying the selective network nodes globally instead of sending the query to all the nodes in network.

ZRP uses - Intrazone and - Interzone routing to provide flexible route discovery and route maintenance in the multiple ad hoc environments. Interzone routing performs route discovery through reactive routing protocol globally while intrazone routing based on proactive routing in order to maintain up-to-date route information locally within its own routing range. The overall characteristic of ZRP is that it reduces the network overhead that is caused by proactive routing and it also handles the network delay that is caused by reactive routing protocols

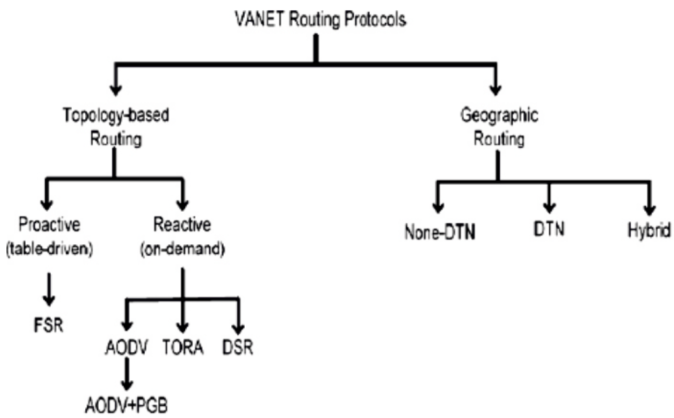

Fig. 2. VANET Routing Protocols

and perform route discovery more efficiently. The drawback of ZRP is that it is not designed for such environments in which the nodes behaviour is highly dynamic and rapid changes in topology such as VANET. In other words, we can say this routing protocol is specifically designed for such networks where nodes are not highly mobile and network size is depending on limited number of nodes. Pure proactive or reactive routing protocols can be suitable to some extent in a highly dynamic environment like VANET as compared to Hybrid routing.

Conclusions

MANET routing protocols are not suited for VANET environment because of their high mobility, distributed communication, road pattern restrictions and self-organization and no restrictions of network size. Also, we have reviewed the criteria on which different VANET protocols are categorized. The classification based on routing information used in packet forwarding is Topology based routing and Geographic routing and this has been discussed here.

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SHIP's SQUAT

Rajkumar Goel
Tolani Maritime Institute
rajkumarg@gmail.com

ABSTRACT

Ships has been handled by mariners since the inception of ship building.

From the time I started to learn about ship handling during mates/masters preparation and even before for earlier sailors, we have been learning this by relating it to the Bernauli's principle by Daniel Bernoulli (1700-1782)

In this paper, I have explained certain terms used in ship handling the same by following certain basic principle of nature (like water always flows from higher to lower level) which is well known to everyone and thus is easier to understand and helps sailors to think in the same direction to understand other aspects of ship handling.

Keywords

Banking Effect; Bank Cushion Effect

Introduction

We know squat at present as, "When a ship proceeds through water, it pushes the water ahead. This volume of water returns down the sides and under the bottom of the ship. The streamlines of return flow are speeded up under the ship, causing a drop in the pressure and resulting in the ship dropping vertically in the water. When the ship drops vertically in the water, it trims both forward and aft. This overall decrease in the static under keel clearance, both forward and aft, is called Ship's Squat."

By picking up one line from above 'Moving ship pushes the water in the direction of the movement', that means for certain duration the level of water is lesser on the end of the ship which is opposite to the direction of the movement. And it is a continuous process as long as ship is moving.

If you imagine ship to be in open deep sea, imagining the same would be difficult but considering the ship in shallow and narrow channel, it becomes quite easy. Taking clue from the narrow channel, it does happen in deep sea too, albeit at a lesser extent as there is lot of water around to fill up the space fast.

Now let's learn about displacement. Displacement is the amount/volume of the water displaced by the ship's hull at any given time. This amount of water displaced is equal to the weight of the ship in water and thus it is called Displacement.

As long as there is no change (addition or removal) in the weight of the ship, the displacement remains same. Also, as long as there is no change in the distribution of the weight inside ship, the underwater shape and volume of the ship won't change.

With these, we can comfortably assume that the displacement and under water volume of the ship does not change (Ignoring small changes due to consumption of fuel)

Now combining both the above observations, when there is drop in sea level at the stern part of the ship (because of the ship's movement ahead), the stern part of the ship is bound to sink a little to displace the same amount of water which is equal to the displacement of the ship.

This partial sinking of ship is Squat.

Banking Effect

We know banking effect at present as follows:

We see the ship is close to the stern on the Starboard side. While the port side is wide open comparably. When the ship moves with considerable speed parallel to the bank, water flow rushing below from the vicinity of the starboard bow towards the stern gets bottled at the constricted space at the stern. But to satisfy the Continuity Equation, its speed increases below the Starboard Quarter.

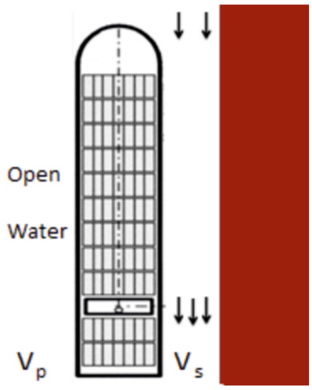

Fig.1. Banking Effect

This increase in speed of passing water decreases the pressure at the V_s zone than the V_p zone on the Port Quarter.

Consequently, water pressure at the port quarter will push the stern more towards the bank making the bow swing towards the center of the channel. This effect of stern moving towards the bank is called the Bank Effect.

Bank Cushion Effect

We know bank cushion effect at present as follows:

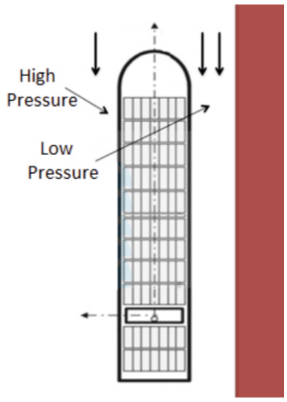

Fig. 2. Bank Cusion Effect

When the ship is approaching a steep bank as in above fig, the water pressure at the starboard bow being less than the port bow (due the asymmetric flow, explained earlier), the bow is pushed towards the port as to dampen the speed of the fall. This is called Bow cushioning effect.

Facts and Explanations

Where there is restriction to the movement of water either in terms of depth or width, its level is bound to rise and opposite is true when restriction is removed or water moves from narrow space to wider and/or deeper waters.

One more fact to remember is that water flows from higher level to the lower level and anything floating on the water will also follow movement of the water.

Now relate these two facts to the above explanation of Banking Effect and Bank Cushion Effect:

- Ship is pushing water ahead from the bow thus water level at the bow is bound to rise as ship is restricting the water movement within the narrow passage.
- Water level will rise more on the side nearer to the bank as compared to the side opposite as there will be lesser restriction to water movement on the side opposite to the bank when compared to the side nearer to the bank.
- Water level on the side along the entire ships length opposite to the bank will be, more or less same with slight dip towards the end, depending upon the restriction on the opposite side.
- Water level at the stern, on the side nearer to the bank will be lesser than the water level anywhere else around the ship because of restriction and delay in replacement of water along the ship's side.

Conclusions

Water level along the ship side from high to low will be as given below for the ship having bank on her starboard side:

- Starboard Bow
- Port Bow
- Port Quarter
- Starboard Quarter

Since water level at the stern nearer to the bank is least. Thus, following the same principle of water movement from higher to lower level; it is bound to move towards the bank with the water replacement happening from opposite side and thus it is known as banking effect.

As explained above in facts, the water level at the bow nearer to the bank will be higher than water level anywhere else around the ship. Thus, following the same principle of water movement from higher to lower level bow of the ship will move away from the bank which is known as Bank Cushion Effect.

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NAVIGATOR/OOW FATIGUE DETECTION AND ALARMING SYSTEM

Kamran Farooq Beigh
Anglo Eastern Maritime Academy, Karjat
kamranbeig72@gmail.com

Tushar Mehta
Anglo Eastern Maritime Academy, Karjat
tusharmehta322@gmail.com

Neeraj Tekwani
Anglo Eastern Maritime Academy, Karjat
tekwanineeraj7@gmail.com

ABSTRACT

This paper is an introduction to our research which aims to develop a navigator/OOW safety assistant system. We proposed an improved strategy and practical system to detect fatigue based on machine vision and OpenCV algorithm. Kinds of face and eye classifiers are well trained by OpenCV algorithm in advance, the proposed strategy firstly detects face efficiently by classifiers of front face and deflected face. Then, candidate region of eye is determined according to geometric distribution of facial organs. Finally, trained classifiers of open eyes and closed eyes are used to detect eyes in the candidate region quickly and accurately. The indexes which consist of PERCLOS and duration of closed-state are extracted in video frames real time. Practical tests demonstrated that the proposed system can detect fatigue with real time and high accuracy. The system assesses the ability of conducting safe navigation and notifies for any dangerous situation.

Keywords

Fatigue detection, Image processing algorithm, Alraming systems, PERCLOS

Introduction

Fatigue "concerns the inability or disinclination to continue an activity, generally because the activity has been going on for too long" example (4 hours watch on bridge). The causes of fatigue can be physical, physiological, or psychological (Lal & Craig, 2001). There is no standard fatigue measurement, because the direct measures are few (Williamson & Chamberlain, 2005). Most measures are of the outcomes of fatigue rather than of fatigue itself. To overcome fatigue, human beings need to sleep. Sleep is essential and inescapable solution for fatigue. In case of fatigue, sleep will overpower any effort to remain awake (NCSDR/NHTSA, 1998). Therefore, the best fatigue measurement is drowsiness which is the clearest outcome of fatigue. Detecting drowsiness and taking action to prevent it while navigating is not an easy task. Moreover, detecting fatigue/drowsiness depending on visual information only, adds more restricts on the reliability of the fatigue measurement. This is because it depends mainly on pattern recognition of facial gestures. One of the bottlenecks challenges of object recognition, in general, is finding efficient and discriminative descriptors that are invariant even in difficult illumination

.

Why do we need this?

Collisions involving sleepy OOW tend to be particularly serious since the sleepy OOW doesn't have a quick enough reaction time, and is too slow to attempt to avoid an accident. Giving OOW early warning that they need to take a break is vital for safe voyage. Following are two case studies reflecting the need of this project;

Case study 1

Helmsman's Fatigue Held Factor In Louisiana Tug Crash Killing 6, OCT. 6, 1964

WASHINGTON, Oct. 5 (AP) —The Coast Guard said today that the tugboat-bridge- bus accident on Lake Pontchartrain last June that resulted in six deaths was caused by the tugboat helmsman's fainting or falling asleep.

The helmsman was Clifford Miley, mate on the tugboat

Rebel Jr. Although the Coast Guard officer who conducted the investigation said no Federal laws had been violated, the Coast Guard commandant, Admiral E. J. Roland, said the manning of the tugboat had been inadequate and the working hours of the crew unreasonable.

The Rebel Jr. was pushing two steel barges early on the morning of June 16 when it collided with the 24-mile-long structure that spans the lake in Louisiana. It swept away a small section of the bridge, and within seconds a bus carrying eight persons plunged from the bridge into the lake. Two survived. The Coast Guard said Mr. Miley and the tugboat master, Ned Palmer, had been aboard the vessel almost continuously

Mr. Miley slept on June 15 but was awakened late in the afternoon and worked with Mr. Palmer and a deck hand until after midnight. The others were asleep, with Mr. Miley at the helm, when the collision occurred about 1:20 A.M. Admiral Roland ordered the report turned over to a United States Attorney “for such action as he deems appropriate.”

The Rebel Jr. was owned by the Ace Towing Company, Inc., of Gretna, La., and was operated by the Louisiana Materials Company, New Orleans.

Case study 2

Human error due to fatigue is the prime reason for the collision of two cargo ships near Ennore Port in Chennai in January last, a report of the investigating team of the Directorate General of Shipping said. The mishap occurred at 4 a.m. on January 28, when MT BW Maple with a flag of Isle of Man was leaving the port after emptying Liquefied Petroleum Gas and MT Dawn Kanchipuram, loaded with petroleum oil lubricant was on its way to berth at the port. Human factor due to fatigue appeared to be the prime reason for the collision, for the mishap, it said. “Fatigue is apparent on the team of BW Maple, since the vessel had an inspection the previous day [of the incident] and the ship's master and his team rest hours were near violation,” the report submitted recently said. The Master of BW Maple was also “psychologically stressed” and that adversely affected his decision-making ability, it said. “On verification it was revealed that he had received a discouraging mail from the managers on the vessel's performance in an audit, that was held in the same port and was not in good frame of mind,” it added. Suggesting regulation of the rest hours of the pilots and other port officials following the mishap, the findings said the draft Indian Maritime Pilots Regulations, which have been drawn by the National Shipping Board's committee may be “ratified and implemented.” The master of BW Maple did not alert the master or duty officer about the presence of another vessel which was just right ahead in close range, leading to human error and the mishap, it said. The report also recommended that one of the lapses in the probe of the incident was the “incorrect assessment of the quantity of oil spill” and said more methods and equipment may be identified and deployed for assessment of extent of spillage. According to the report, that the final quantity of oil spill following the collision of the two ships was estimated to be 251.46 tonnes.

Technical and design challenges

The complex interaction of the major physiological factors responsible for sleepiness – circadian rhythms and the homeostatic drive for sleep – pose formidable technical challenges to the design and development of fatigue detection systems. The technology must be robust and capable of high accuracies in diverse operational environments with constantly changing conditions and varying customer needs.

To meet the requirements of efficiency and functionality the technology should comply with the following guidelines:

It should measure what it is operationally and conceptually intended to measure and be consistent in these measurements over time. Thus, a device designed to measure eye blinks (operationally) and alertness (conceptually) should measure these all the time for all OOWs.

The software technology used in the device should be optimized for sensitivity and specificity. False negatives should be minimized through accurate and reliable detection of reduced alertness levels. False positives should be minimized through accurate and reliable identification of safe navigation and operator vigilance.

The device should be robust, reliable and capable of continuous operation over extended periods, such as a shift. Maintenance and replacement cost should not be excessive.

Be capable of real time monitoring of navigator or operator behavior.

The device should be capable of accurately operating under various operational conditions during the day, at night and under illuminated conditions. Accuracy should not be compromised by conditions in different climatic conditions, such as humidity, temperature, vibration, noise, etc.

Audible warning signals should not startle the operator and should be adjustable over a reasonable range. The signals should be distinct and audible under operating conditions to not be confused with other alarms and signals.

How does the system work?

It monitors navigator's behaviour closely, noting any erratic eye movements, so that it can judge the moment when OOW start to feel sleepy and need to stop and take a break. It continuously evaluates OOW eye movement, and works out when it may be time to take a break.

There will be a Kinect camera that constantly takes image of OOW, a beagle board that implements image processing algorithm, and a feedback circuit that could generate alarm and a power supply system.

Features:

1. Daytime eye detection using RGB mode of Kinect.
2. Night time detection using IR mode of Kinect.
3. Eyelid distance tracking to detect the sleepiness.
4. Real time image processing more than 1 frame/second
5. Start of general alarm on ship.
6. Sleepiness detection is efficient and alarms will be generated.
7. Enhanced algorithm to ensure the darkness detection ability

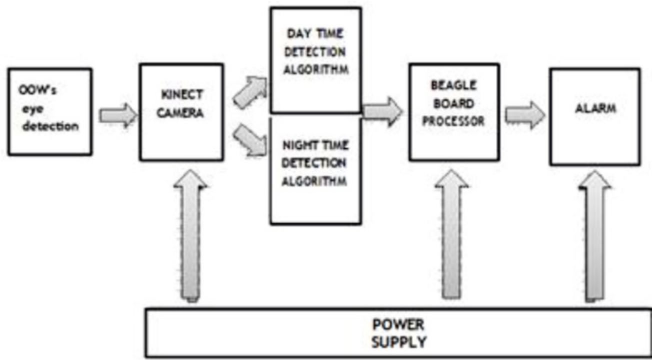

Fig.1. Block Diagram

Block Description

Kinect Camera:

The Kinect Camera (Microsoft Kinect Xbox360) is used in monitoring/helmsmen capturing there pictures, facial expressions The images are then sent to the Beagle board for processing. The camera will be placed near the helm and on different positions on bridge which will be ship specific. Three modes are available for the Kinect: the RGB mode, IR mode, and Depth mode. Only the RGB and IR mode is required in this project. For navigator the camera will be rotating and the Kinect will keep the track of the OOW Motion- sensing technology as implemented in Kinect currently requires a sizable area for use (0.8m minimum to 3.5m maximum user distance).

Detection Algorithm:

The coding and algorithm part will be built using OpenCV. The algorithm includes two parts: daytime detection and night detection. For daytime detection, the RGB mode is used; while for night detection, the IR mode is used instead. If IR mode fails to work, however, histogram equalization method will be used for night detection. The histogram equalization is a method to greatly expand the colour range of the image. In this case, we need a light that will slightly illuminate the helmsman. The sleepiness is determined based on the change of helmsman's eyelid distance or the black of eyes or by the change sequence. For both daytime and night, the helmsman's initial eyelid distance will be recorded as long as they get on the helm. The record will be removed after person leaves. During the watch, the camera will take 2 or 3 frames per second. Then the eyelid distance will be analyzed: if the distance remains small for several frame, the navigator will be treated as fell sleepy. Same will be done with the officer on watch, for him the action detecting kinect camera will be used so that OOW's mobility is not restricted.

Main Processing Unit: BeagleBoard

The Beagle Board would operate as the controller for all other components. First, it will send and collect information from the Kinect. Then it would perform algorithms to determine the status of the helmsman by comparing the incoming data with the normal graph.

Power Supply/Control Unit

System runs on a simple 12-24v power supply which will be connected to our ship power supply.

Alarming system

If the system detects that OOW might be starting to lose concentration, for first line of alert, in accordance with IMO Res. MSC.128(75), sufficient number of visual (flashing lights) and audio indications will get executed.

The visual indications will be visible from all operational positions within the bridge where the OOW (Officer of the Watch) may be stationed to perform his duties.

These positions are made up by, but not limited to, Conning work station, Navigation support work station, steering work station and 2 x docking work stations

The buzzer stops when the officer presses the [RESET] button. The Main Alarm Panel will reset the timer and return to the dormant period, when the alarm is acknowledged by the watch officer if there was repetition of the same situation there will be an alarm in captain's cabin for recommendation to assess the situation and change OOW if required.

Schematics and Simulation

The coding and algorithm part will be built using Open CV on the Ubuntu System. The algorithm should work all the time to detect the sleepiness of the navigator. While daytime detection is accomplished by taking RGB images, night time detection is done by taking IR images. If IR mode fails to work, however, histogram equalization method will be used for night detection, which could effectively expand the colour contrast of a local area in the image. In this case, we need a LED to slightly bright the OOW.

Histogram Equalization

Histogram Equalization will be used at night detection if IR mode fails. Basically, this method increases the global contrast of images, by effectively spreading out the most frequent intensity values. The basic idea of it is to spread the low contrast image pixel values to the entire 0 to 255 color range, according to the frequency of each pixel value in the image.

BeagleBoard

Our BeagleBoard will power and communicate with Kinect camera board and open CV to run our algorithms. Then the output will be sent to our alarm system if danger is discovered by the algorithm.

Experiment and Data Analysis

Our system (experimental system) runs on a PC with Intel Core (TM)2 Duo 2.10 GHz CPU and 2 GB RAM, using the third-party library OpenCV to perform system tests in Visual Studio 2008. Racing game was used as driving conditions. Nine subjects took part in the experiment with simulate driving environment. The resolution of these videos is 352 × 288 pixels and the frame rate is 25 fps. Each frame contains human face.

We recorded ten groups of video streams in this experiment. The videos are divided into two categories. The first category (i.e., 1st–4th groups) shows various facial expressions which occurred in three subjects simulate driving experiments. There are 1630 frames in each group of videos. These videos are used to test the performance of face detection and eyes detection.

The second category consists of the remaining 6 groups (i.e., 5th–10th). Six subjects were asked to implement driving tasks for long enough time to become fatigued finally. These videos are used to extract fatigue index. In order to collect valid videos for assessment of driver fatigue, subjects are involved in training and experimental sessions. The whole experiment duration for one subject may last two or more days, it depends on his training performance. Before experiment, subjects are asked not to eat chocolate and drink coffee or alcohol. The length of each video is about 70 minutes. There are 105,000 frames in each group of videos. In the first 55 minutes of experiment, subjects are asked to take intensive simulate driving. Many curves and steep slopes are presented in driving conditions. And extra tasks of alert and vigilance (TAV) were exerted in order to ensure subjects concentrating on driving highly during the experiment. In the last 15 minutes, we relieved subjects' stress by declining missions and using a flat road with fewer curves. The monotony of driving induced driver to be fatigued. Obvious features of fatigue for subjects in this simulate driving can be summarized as increased blink times, blinks frequency, and duration of closed-eyes state.

In order to distinguish detection results, the result of front face classifier was marked as a white rectangle and the result of deflected face classifier was marked as a green rectangle. The first row shows the results which were detected by the front face classifier marked with white rectangles. Face was lost because the right deflection angle of face is too large in 3rd frame. The second row shows the results which were detected by deflected face classifiers marked with green rectangles. And in the second row, face was lost by the deflected classifier in the first and fourth frame because the faces were in the state of looking straight ahead. The third row shows the results detected by the two classifiers. Hence, all faces including front and deflected conditions were detected successfully. This method can carry out real-time detection with a high accuracy.

Conclusions

This paper provides a practical driving fatigue detection system based on OpenCV algorithm. We proposed a new strategy to detect eye state instead of detecting eye directly. In our detection strategy, we first detect face efficiently using classifiers of both front face and deflected face. Then, candidate region of eye is determined according to geometric distribution of facial organs. Finally, trained classifiers of open eyes and closed eyes are used to detect eyes in the candidate region quickly and accurately. As a result, PERCLOS escalating rate could be calculated and used as the index of fatigue. When the PERCLOS escalating rate increased more than 200%, the OOW could be considered in fatigue state. Moreover, this paper implemented a Fatigue Detection Warning System. The system makes decision of fatigued or not according to PERCLOS and duration of closed-eyes state. Experiments demonstrated that the proposed system has a high accuracy. Meanwhile, the processing speed can reach 30 fps on PC and on tablet, which meets the requirement of real time.

Of course, this system could make further improvement on accuracy and speed of detection by using discrete cosine coefficients and covariance feature, respectively. In addition, this paper has dodged the conditions under poor illumination. It should be perfected in the future research.

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HAZARDS SIMULATION & SAFETY AWARENESS TRAINING: AN EXPERIENTIAL LEARNING

Deepchand Dhankar
Tolani Maritime Institute,
deepchandd@tmi.tolani.edu

Nitin Junnarkar
Tolani Maritime Institute,
nitinj@tmi.tolani.edu

Avadhut Shaligram
Tolani Maritime Institute,
avadhuts@tmi.tolani.edu

ABSTRACT

In maritime Training and education, computer based simulators training methods have been in use and found to be effective, however personal safety training through hazards simulation methods have been recently used. With physically controlled hazards simulation safety training enables students and providers to learn, practice, and repeat procedures as often as necessary in order to feel the hazards close to realistic, correct mistakes, fine-tune their skills. Tolani Maritime Institute initiated the modernization of its safety training pedagogy by developing a hazard simulation training lab. Hazard Simulation training method is an important solution to ship board work place safety. Integrating simulation of hazards into traditional safety awareness education programs have attracted all major stake holders the trainer, trainees , shipping companies and the institute itself. Hazard communication is an essential part of occupational safety and health programs, but must be understood by intended audience. Simulation of hazards as training methods for safety training, works well to create an impact on the minds of trainee. This paper explores the importance of simulation of hazards as a training pedagogy for increasing safety awareness.

Keywords

Hazards Simulation Training (HST), Safety Awareness, Training Methods, Safety Health and Environment

Introduction

Poor hazard anticipation skills are a risk factor associated with high reported cases of physical injuries arises due to slip trips falls and injuries while working on or near rotating equipment on board ships. A number of training programs and risk control measures are in place like conducting risk assessment, holding tool box meeting, obtaining work permit etc. But despite that so many accidents, personal injuries and loss of life are being reported. Shore based training is the place for grooming & transformation of right knowledge, right skill and right attitude, towards safety health and environment. A Hazard simulation is a form of experiential training and learning. Hazards Simulations are instructional scenarios where the learner is placed in a "work situation" defined by the instructor. They represent a real work place scenario and possible hazard, which students can feel/experience. Hazard Simulation training in way, is a lab experiment where the students themselves are the test subjects. They experience the reality of the scenario and gather experience from hazard simulation training .

Hazards

A hazard is an agent which has the potential to cause harm to a vulnerable target. **Hazards can be dormant or potential, with** only a theoretical probability of harm. Hazards can be classified in several ways. One of these ways is by specifying the origin of the hazard. One key concept in identifying a hazard is the presence of stored energy that, when released, can cause damage. Stored energy can occur in many forms: chemical, mechanical, thermal, radioactive, electrical, etc. Another class of hazard does not involve release of stored energy, rather it involves the presence of hazardous situations. They may also be classified as health or safety hazards, by the populations that may be affected, and the severity of the associated risk. In most cases a hazard may affect a range of targets, and have little or no effect on others.

Simulation: A simulation is an approximate imitation of the operation of a process or system, that represents its operation over time. Simulation is used in many contexts, such as simulation of technology for performance optimization, safety engineering, testing, training education, and video games. Simulation is also used with scientific modelling of natural systems or human systems to gain insight into their functioning,[2] as in economics. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage.

Safety

Safety is the state of being "safe" .The condition of being protected from harm or other non-desirable outcomes. Safety can also refer to the control of recognized hazards in order to achieve an acceptable level of risk.

Safety Awareness

Safety awareness is the starting point to accident prevention. Safety awareness can be understood by anything which provides knowledge about safety and provides solutions against safety hazards. Safety can be of anything and anywhere. It might be at home, at school or colleges or at the workplace. 'Safety awareness 'appears to be a caution.; to be aware of an impending danger or an unwanted or undesirable thing that's likely to happen. Personal safety is about being aware of your surroundings, avoiding potentially dangerous situations, using common sense and trusting your instincts.

Training

Training is teaching, or developing in oneself or others, any skills and knowledge that relate to specific useful competencies. Training has specific goals of improving one's capability, capacity, productivity and performance. It forms the core of apprenticeship and provides the backbone of content atinstitute of technology (also known as technical colleges or polytechnics). In addition to the basic training required for a trade, occupation or profession, observers of the labor-market recognize as of 2008 the need to continue training beyond initial qualifications: to maintain, upgrade and update skills throughout working life.

Photo 1 : EPS Crew Attending the HST Course

Experiential Learning

Experiential learning is the process of learning through experience, and is more specifically defined as "learning through reflection on doing". Use of Simulations & Simulators in Maritime Education & training is the way for experiential learning. Recent trends in the marine industry toward smaller crew size, heightened public concern about marine safety and expectations for improvements, and changes in navigation and ship control technology, the integration of marine simulation into mariner training programs offers advantages and opportunities to improve human performance in a safe environment. The *simulator* refers to the hardware or apparatus that generates the simulation. *Simulation* refers to the representation of conditions approximating actual or operational conditions. Simulations can be formalized into scenarios that are used for teaching and performance evaluation. The theoretical rationale for the use of simulators for training is based on the concept of skill transfer—that is, the ability to adapt skills learned in one context to performance or task execution in another. Indeed, a faith in the "fact" of transfer constitutes the basic justification for all formal training programs. It is assumed that skills and knowledge learned in a classroom can be applied effectively to relevant situations outside the classroom. With the addition of simulation to the course curriculum, the instructor can fill the gap between theory and application.

Establishing of Hazards Simulation lab at TMI

Tolani Maritime Institute initiated the modernization of its safety training pedagogy by developing a hazard simulation training lab. Hazard Simulation training method is an essential steps for increase safety awareness through simulating the hazards and making every participant to feel observe the hazards and understand the control measure to stop recurrences work place. The corner stone of the hazard simulation and safety awareness training program is experiential learning. Integrating simulation of hazards into traditional safety awareness education programs which have attracted both the trainer, trainees, and shipping companies. For Setting up Hazard Simulation safety training facilities, the credit goes to NYK shipping management company as they wanted to initiate the hazard simulation training program In India for their officers and crew members.

Objective of the Hazard Simulation & safety awareness Training course

This course familiarizes the trainees to many aspects of Health and safety at work and is planned to raise safety standards and awareness to reduce the physical work related injuries if not totally eliminate personal injury (and death) onboard.

Raise students' awareness of workplace hazards that could cause physical injuries, illness or fire hazards

Equip students with prevention strategies that will protect them from injuries or illnesses on board.

Encourage students to be active participants in creating safe and healthy work environments

Course Content of hazards simulation training at TMI

1. Dangers associated with falling
2. Dangers associated with not wearing a hard hat Helmet) at work place helmet
3. Dangers associated with not wearing safety shoes at work place
4. Dangers associated with falling object (impact force / energy of falling Object
5. Dangers of impact force (shock load)
6. Dangers associated with the use of ladders, portable ladders, and scaffoldings
7. Dangers associated with hoisting heavy object using chain hoist (manual chain hoist / electric chain hoist)
8. Dangers while adjusting wire sling
9. Dangers associated with manual lifting
10. Dangers associated with working on rotating machines / equipment
11. Dangers associated with electricity
12. Dangers associated with welding (electric welding)
13. Dangers associated with handling steel plates
14. Danger associated with mooring

Important Features of Hazards Simulation training

Experiential learning is the most important component of hazards simulation training at TMI and is effectively controlled by the instructor. The hazards simulation modules have been designed keeping the safety of the participant in mind. Hazards simulation training takes place under instructors control and guided training environment. Experiential learning theory (ELT) was developed by David A. Kolb, in year 1984. Kolb's experiential learning theory is a four-stage cycle of learning. Kolb's theory has a holistic perspective which includes experience, perception, cognition and behavior.

The experiential learning cycle

The learning cycle involves four stages, namely: concrete learning, reflective observation, abstract conceptualization and active experimentation. Effective learning can be seen when the learner progresses through the cycle. The learner can also enter the cycle at any stage of the cycle with logical sequence.

The first stage is concrete learning, where the learner encounters a new experience followed by the second stage is a reflective observation, where the learner reflects on the experience on a personal basis. The third stage of learning theory is abstract conceptualization, where the learner forms new ideas, or modifies existing abstract ideas, based on the reflections arising from the reflective observation stage. The fourth and last stage of learning theory is the active experimentation in which the learner applies the new ideas to his surroundings

Photo 2: Impact of Dynamic (Shock) Load

Relationship Between Experiential learning theory and Hazard simulation safety Training

The hazard simulation safety training is truly based and designed on the experiential learning theory. As The first stage in the hazard simulation aims to create concrete learning as the trainee encounters a different learning methodology. The ship board based work activity and associated hazards are simulated ,wherein the trainee is made to feel and experience the hazard , when one trainee is doing the task other trainee are watching and observing safe and unsafe practice which serves reflective observation, where the learner reflects on the experience on a personal basis. The instruct lead discussion and cross questions by the participants boost abstract conceptualization, thus the learner forms new ideas. For active participation and experimentation, the course intake is kept minimum,10 students per course per day which provides ample opportunity to rotate students to actively involve students in every training module.

Photo 3: Demonstration of Full Body Harness

Photo 4: Demonstration of Use of Grounding Devices

Identifying Risk, Identifying Unsafe acts / practices / conditions, and Applying Controls

During the Hazard Simulation Safety training at TMI, within a carefully-staged interactive training environment, the participants are encouraged to identify risks / unsafe acts /unsafe conditions and use stop card/ freeze card if they do observe so. The participants jointly, follow rules as per Safety Management System & Code of Safe Working practice to exercise safety by learning to apply control measures. Accompanied by an instructor, the participants learn to observe unsafe act/ unsafe conditions and learn to apply control measure through use of STOP Card **(Suspend, Think, Observe & Proceed)**, Check list, Lock Out Tag out etc.

Conclusions

Not having heard something is not as good as having heard it; having heard it is not as good as having seen it; having seen it does not as good as know it; knowing it is not as good as putting it into practice (Xun Kuang). In the Hazards simulation training at TMI the participants are shown the Right and wrong work practice and as part of experiential learning the hazards are simulated and each trainee experience the hazard, see the hazards occurring,, feels the hazards happening and self-experiencing it, hear the impact of the hazards (sound)when it is simulated for other participant. Hazards simulation training is expected to bring a change in trainee safety behavior Practicing of safe working practice is an essential element in ensuring safety on board. Wearing right PPE for the job at hand, doing the task as per ship safety management system, holding tool box meeting applying control measures will help in minimizing. Controlling accidents on board Which is the prime objective of Hazards Simulation Training at Tolani Maritime Institute. Although there are a variety of different hazards in the work environment and off the job, physical injuries to hand foot and eyes injuries can be prevented by following some common sense rules. First, recognize and respect all of the hazards present in the work. Next, wear the appropriate protective PPE at all times. This may include safety shoes, apron, boiler suits, hand gloves spectacles, goggles, face shields and welding helmets. Make sure protective equipment are in good working condition, fits properly and is clean and in good condition before and after use. By understanding the causes and consequences of injuries, and by following best practices for work at hand can prevent life changing injuries thereby minimizing accidents injuries on board ships. Safety comes first. On seeing the popularity of hazard simulation Training methodology, It is suggested that more such safety modules in the areas of work place injuries occurring due to physical, electrical mechanical operation be developed to add on the present hazard simulation training modules.

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