All Team Concept Summaries

On the water

The Efficient Charger

Concept Name: *The Efficient Battery Charging System for the proposed electric ferry*

Concept Summary:
Background -

- *For the present study, the ferry route from Halifax to Mill Cove has been considered. The approximate distance is 11.3 Km (6 Nm), the time taken to travel is 18 min (presented in the problem statement). The ferry is expected to travel at about 20 knots to meet the timeline.*
- *Factors considered for the transit – tide, current, wind and other vessels movement in the channel.*
- *Comparative study with similar electric ferry that operates between Denmark and Sweden and takes 20 minutes (Distance covered is approx. 4Km). The ferry is powered by 4.1 MWh battery propelling four 1.5 MW propellers. The charging is done 9 minutes in Sweden and 4 min in Denmark during each transit. This ferry has an endurance of about 14 Km.*

Problem statement -

- *The problem statement considered is about locating the battery charging facility for ensuring efficient operation of the ferry.* **Proposed Solution -**
- *To meet the proposed ferry operations (18 min transit time and turnaround time of about 5 minutes at each location), there would be a need to setup battery charging station both at Halifax terminal and Mill Cove terminal.*
- *A high voltage high current charging facility is to be set up to meet the quick turnaround time.*

- *Considering the existing infrastructure at Halifax ferry point, a High Voltage line from the existing power supply grid line could be provided.*
- *While at Mill Cove terminal, the charging point could be considered from renewable energy sources – solar and wind infrastructures – that could be catered as part of the new development.*
- *As a long-term solution Shannon Park is being considered as another ferry point. This point is approximately at the mid-point between the Halifax and Mill Cove Ferry point and is also close to Tufts Cove Generating Station which could provide easy source for charging of the batteries.*

VALLEY BROS

Concept Name: Emergency Rescue Tool for Ferries

Concept Summary:

15th January 2009 is the date for the Miracle on Hudson where a plane was landed on the Hudson River with no casualties. One of the important factors for this miracle is the NYC ferries. Hence the ferries not only can be used for transportation but also can be used for rescue. Our concept is to deploy the emergency cradle and alert captain or crew when a person is identified in the water and needs to be rescued. This concept requires a Jason Cradle &respective sensor to deploy cradle and cameras equipped on all sides of the ferry. Camera can be used to identify the rescue situation. A deep Learning model is trained using 207 images of 'humans in ocean' that can identify the people in water and can be used to trigger the cradle sensor and alert the crew.

Under the water

Ouroboros

Concept Name: Low shoreline-impact terminal

Concept Summary:

An off-shore ferry dock connected by a footbridge to a land-based terminal located at about 10 meters from the shoreline. This would prevent shoreline hardening by not needing to build a concrete pier (or similar arrangement). It would also keep the ferry away from shallow water, preventing mixing of the sediment which may increase water turbidity and thus decrease photosynthetic ability of shallow-water plants. A stable ship such as a catamaran ferry would likely manage best with a non-land-based dock.

Luigi

Concept Name: Key measurements for an environmentally safe ferry

Concept Summary:

This work was concentrated in two parts. In the first part I conducted a brief research on what are the best conditions, in terms of chemical nutrients and physical conditions, for underwater life to develop. At this point I focused on the basic living conditions for phytoplankton and zooplankton in addition to the important characteristics for the benthic zone.

From the understanding of the fundamental variables for the development mentioned above, in the second part of the work I proceed with an exploratory data analysis of the measurements collected in the Bedford Basin over the last 11 years focused on the factors that, in the research carried out in the first part, showed to be of greater relevance, as shown below:

- *Dissolved Oxygen*
- *Nitrate*
- *Salinity*
- *pH*
- *Particulate Organic Carbon*
- *Particulate Organic Nitrogen*
- *Phosphate*

Given the results obtained, I was able to better understand the behavior of each factor and, mainly, which conditions impact the results obtained, in order to have a correct reading of the results. Based on the premise that the collected values are reasonably within the expected patterns, we can, with the proper guidance of the researchers, establish KPIs to measure the impacts when the Bedford ferry starts operating.

During the presentation, I will detail the analysis and suggest measures to achieve that.

Ocean Mapping Group - UNB

Concept Name: *Autonomous Contaminant Tracing Using Towed Magnetic Surveying and Artificial Intelligence*

Concept Summary:

In order to track the impact (or hopefully lack of impact!) that the new hybrid-electric ferry has on its underwater environment, we propose ***autonomous contaminant tracing using towed magnetic surveying and Artificial Intelligence****.*

Magnetic Surveying

Magnetics can be used to trace hydrocarbon contamination because burning fossil fuel produces magnetite & other magnetic oxides as byproducts. These byproducts will induce an anomaly in the magnetic susceptibility of the contaminated sediment layer. That anomaly can be mapped using a towed-fish style magnetometer, towed behind an Autonomous Surface Vehicle (ASV). The mapped magnetic anomaly will show the spatial extent of hydrocarbon contamination in the Basin.

Advantages

- *Significantly easier than trying to perform contaminant tracing through sediment sampling on a pointgrid. Also easier to re-survey in the future.*
- *Periodic re-surveying would help to track both the ferry's impact & the success of the city's remediationefforts in the basin.*
- *Can be done alongside echosounder surveys*
- *Halifax Harbour could also be surveyed in order to demonstrate to the public that the environmentalimpact of the new ferry is visibly less than that of the old diesel ones.*

Machine Learning / AI

The cleaning and correcting of the magnetic survey files requires time and manual effort. We propose to automate the analysis of the magnetic mapping survey using AI to identify the exact contribution of the pollutants from the ferry to the other sources of pollutants. Machine learning can also be used to inversion model the data. This removes the effects of subsurface noise, and provides insight to the 3D extent of contamination.

Cybersecurity

As there is an ever-growing interaction of different sensors and ASV's on the basin, this makes the ferry and the port susceptible to different cybersecurity attacks. We as well propose to use an AI to monitor the communication between the sensors and make the ferry and the port safe from cybersecurity attacks.

Around the water

MPLAN1 Consulting Group

Concept Name: Ferry terminal design and land-use

Concept Summary:

Transit Data

- Growing popularity in walking and rolling over cycling in HRM suburbs (2016)
- 50 two-way trips to Bedford from Halifax City hall = year of humans average CO2 emissions limit targets for 2050.

Building close to shore

- Erosion of shoreline due to the ferry waves coming into/leaving port each time ● Waves pushes air into cracks in the rock or foundation

Location

- Proposed location DeWolf Park
- The need for connecting active transit trails/sidewalks from the DeWolf park to the Mill Cove Plaza (shopping Centre)
- Adding Scooter drop zones to the Bedford area

Terminal Design

- Fully accessible – Stepp free entrance design, tap and pay using transit app
- Commuter friendly - connects to the active transit network and bus routes easily
- Green-energy fueled - Green house open space design/natural lighting and solar panels
- Community area + café
- Pharmacy, convenience store, daycare etc.

Internship seeker

Concept Name: Ferry Schedule builder

Concept Summary:

A good schedule should have a balance between serving the maximum number of people, maintaining low costs and remaining ecologically sustainable. Creating such a schedule could therefore prove difficult, especially for ferries in which the destination is simultaneously the departure.

My project is a 3-step process which allows administrators to easily find out what schedule works best for this ferry.

First, a simple survey I created is run on the concerned population.

Then, the result of the survey in entered in my program alongside other variables (such as max occupancy of the ferry)

My program will then allow you to create the best possible schedule according to your preferences. For instance, it could display a schedule where over 70% of people will be able to take the ferry on their preferred timeframe AND, the average occupancy of every ferry trip on that day is at least 60%. Any element such as average occupancy, maximum/minimum number of ferries per day, number of people not able to board due to unavailable timeframe, minimum ferry occupancy, ratio of people boarding on preferred schedule (and much more) can be combined to create the ideal schedule.

Finally, resulting schedules matching specifications are displayed in excel for easy viewing and sorting.

ODS (ocean data science)

Concept Name: A Data-intensive approach: Necessity of a new ferry route from Bedford to Halifax & Technology prototype for ferry ridership prediction

Concept Summary:

1. We proved the necessity of the new Bedford - Halifax ferry route by comparing the Highway111 dailytransportation trend with Highway102. Highway102 connecting Bedford and Halifax has shown an increasing transportation volume over the last 8 years. Highway 111 connects Dartmouth and Halifax, which shows a decreasing transportation trend after the Ferry DH/HD was established in 2017. Besides, the FerryDH also had a seasonal pattern before the pandemic. If we had the Bedford - Halifax route, it will reduce the traffic volume of Highway102, and the ferry will most likely have a unique seasonal pattern for analysis.
2. We further investigated the seasonality of Ferry between Dartmouth and Halifax and plotted theAutocorrelation function to justify the seasonal patterns. We applied the ARIMA model to forecast ferry ridership and used grid search for the best hyperparameters. And we proposed a prototype to automatically read, preprocess, plot and predict traffic volume for ANY given time window for ANY ferry route by inputting a raw data file. This prototype could serve as a forecasting software to better plan the ferry capacity for the upcoming period, especially in peak times. When the Bedford ferry was established, it could also have a similar approach for ridership prediction. (.ipynb file is attached).
3. By making a few reasonable assumptions, we predicted that the Bedford-Halifax Ferry will:
    - ease off the daily traffic volume of HW102 (Bedford to Halifax section) by ~14.5%.
    - have daily ferry rides ~2848.
    - have annual revenue ~$4.1 million.

More than one stream

BlueWhale

Concept Name: EDA for Bedford Basin Bathymetry, Motion Model and AIS system

Concept Summary:
For the underwater domain: exploratory data analysis (EDA) has been carried out to identify the actual bathymetry and topology of the bedford basin. Bathymetric (or hydrographic) charts are typically produced to support safety of surface or sub-surface navigation, and usually show seafloor relief or terrain as contour lines (called depth contours or isobaths) and selected depths (soundings), and typically also provide surface navigational information. Bathymetric maps (a more general term where navigational safety is not a concern) may also use a Digital Terrain Model and artificial illumination techniques to illustrate the depths being portrayed. A traditional Matplotlib and plotly python packages are used to make the seafloor topography more interactive. A motion model and underwater communication system has been designed and developed which provides live visualization of the ferry

network. Developed system can take the inputs of the environmental data such as salinity, depth, temperature, spreading loss and noise level. This is extremely helpful as this provides the speed of the ferry and time analysis of ferry network. Due to time constrain and use of the Realtime clock, The simulation has been adopted appropriate scaling. All the Ferry nodes are accessible using the web dashboard and/or python API. All nodes are running various agents in the containers which runs specific task, below are the example of the same:

- • statemanager: StateManager Agent
- • remote: RemoteControl Agent
- • rdp: RouteDiscoveryProtocol Agent
- • ranging: localizationRanging Agent
- • uwlink: UnderwaterReliableLink Agent
- • node: NodeInfo Agent
- • websh: WebShell Agent
- • simulator: Simulation Agent
- • phy: HalfDuplexModem Agent
- • bbmon: BasebandSignalMonitor Agent
- • arp: AddressResolution Agent
- • transport: Transport Agent
- • router: Router Agent
- • mac: macCSMA Agent

An object avoidance algorithm has been designed and simulated for the AIS system with the ultra-sonic sensor resolution with the intension of making low cost AIS system.

Sea-nic Route

Concept Name: Sea-nic Route

Concept Summary:

We propose a data acquisition & visualization framework to enhance the experience of the Bedford Basin for both ferry commuters and scientists. There exists a handful of turnkey data collection toolkits for mounting on ships of opportunity. Here, we present an in-board ferry sampling scheme (e.g. similar to the European FerryBox system (Petersen 2014)) for our application on the Bedford ferry. This package of sensors and sampling mechanisms provide an array of environmental and biological data collected along the spatiotemporal scale defined by the ship.

The quantity and quality of oceanographic measurements collected by such a system will be of outmost interest for scientific organizations interested in the Bedford Basin and more broadly, the western North Atlantic.

A focal point of our proposal is to provide a data visualization tool to the ferry passengers that will put them in touch with their commute and environment through the seasons. We imagine standing screens

on the boat deck where users can interact with a dashboard to explore some of the data about and around their transit.

Our data visualization dashboard will provide information to the commuters about their public transit's impact on the environment, the environment on which they are riding (data collected from the monitoring toolkit). We hope that such a platform will attract research projects to the Bedford Basin, enhance existing sampling efforts which are stationary and thereby limited in scope, and ultimately foster the culture of data sharing with the public.