Research Note

GUI for Spatio-Temporal Mapping of Low Frequency Ambient Noise in the IOR

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Background

The graphical user interface or GUI is a form of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation, instead of text-based user interfaces, typed command labels or text navigation. GUIs were introduced in reaction to the perceived steep learning curve of command-line interfaces (CLIs), which require commands to be typed on a computer keyboard [1].

This interface uses icons, menus and other visual indicator (graphics) representations to display information and related user controls, unlike text-based interfaces, where data and commands are in text. GUI representations are manipulated by a pointing device such as a mouse, trackball, stylus, or a finger on a touch screen. A visual language has evolved as GUI has become common place in both operating systems (OS) and software applications. Even those with few computer skills can now, through the use of GUI, learn how to use computer applications for word processing, finances, inventory, design, artwork or hobbies [2].

The Xerox Alto is the first computer designed from its inception to support an operating system based on a graphical user interface(GUI), later using the desktop metaphor [3, 4]. The first machines were introduced on 01 Mar 1973, a decade before mass market GUI machines became available. A young man named Steve Jobs, looking for new ideas to work into future iterations of the Apple computer, traded US $1 million in stock options to Xerox for a detailed tour of their facilities and current projects. One of the things Xerox showed Jobs was the Alto, which sported a GUI and a three-button mouse. When Jobs saw this prototype, he had an epiphany and set out to bring the GUI to the public.

Apple engineers developed Lisa, the first GUI-based computer available to the public. It was too expensive; no one bought it. But the seed germinated into a flower that would change the world. Released in 1984 and billed as "insanely great," the Macintosh caught the public eye with one of the most famous commercials ever. This immortal television advertisement depicted users of IBM's PC as Orwellian drones trapped in the maw of a monochromatic, brutally mechanical, command-line interface, and dramatized their symbolic liberation by a woman bearing a new tool for home computations [5].

Alan Kay was born on 17th May 1940, and is now known as the man who developed object oriented programming. At the beginning of his career he predicted that one day soon we would have inexpensive personal computers with a phenomenal amount of power and high quality graphics. After Kay finished his PhD in Graphical Object Orientation, he did some work on Programming Language Design at the Stanford Artificial Intelligence Laboratory. He then joined Xerox PARC as a researcher in 1971 and with the help of Dan Ingalls, designed a programming language called Smalltalk where individual entities or ‘cells’ communicate with each other. Kay also came up

with the idea of the ‘Dynabook’, a laptop computer for children. Together with Chuck Thacker they developed a prototype Dynabook which they named the ‘Alto’, the first personal networked computer. It also had the very first Graphical User Interface called the ‘Xerox Star’ instead of the previous command line interface. The main aspect of the GUI was to use graphic metaphors for objects like computer programs and documents [6].

Discussion

A major advantage of GUIs, is that they make computer operation more intuitive, and thus easier to learn and use. GUIs generally provide users with immediate, visual feedback about the effect of each action. GUI allows multiple programs and/or instances to be displayed simultaneously. This feature can used to design a user-friendly GUI for spatio-temporal mapping of low frequency ambient noise in the Indian Oceanic Region (IOR).

The features that can be used for GUIs are:

- GUIs were introduced in reaction to the perceived steep learning curve of command-line interface (CLI), which require commands to be typed on the keyboard [7].
- The major benefit of a GUI is that systems using one are accessible to people of all levels of knowledge, from an absolute beginner to an advanced developer or other tech-savvy individuals. They make it simple for anyone to open menus, move files, launch programs or search the internet without having to tell the computer via the command line to carry out a function [8].
- GUIs also provide instant feedback. Clicking an icon will open it up, for example, and this can be seen in real-time. Using a command line interface, you won’t know whether it’s a valid entry until you hit return; if it’s not valid, nothing will happen [8].

Automatic Identification System (AIS)

The AIS has been developed with the primary aim of collision avoidance for water transport. It uses both land and satellite based sensors to receive and further transmit the unique identification, position, course and speed of the vehicle thus supplementing marine radar for collision avoidance. AIS since its development has gathered many uses including collision avoidance, fishing fleet management and control, maritime security, aids to navigation, search and rescue, accident investigation, ocean current estimates, infrastructure protection and fleet and cargo tracking. With such widespread use, AIS has become the most important tool for Maritime Domain Awareness (UDA) [9].

Although sound emanates in the ocean from a myriad of sources, shipping has become a dominant source of low frequency ambient noise in the ocean and thus mapping the noise created by the ships becomes important both for defence and marine conservation purposes [10]. **Donald Ross**, a civilian submariner and acoustics expert is credited with discovering that low-frequency ocean ambient noise is largely determined by shipping, and that ocean ambient noise has been steadily increasing due to human activities. He also made the first detailed measurements of the noise characteristics of nuclear submarine [11].

Over the years, the shipping noise estimation techniques as well as the applications have evolved quite a bit with advancement in technology and now have relevance to multiple military and non-military applications across multiple stakeholders [12].

Application

Estimation of shipping noise levels has been an important aspect from both marine conservation as well as national security perspective, considering the dominant contribution of ship in the low frequency ambient noise levels of the ocean. Processed AIS data can be taken and using geographical information system such as QGIS can be converted into a heat-map of low frequency ambient noise in the IOR.

A GUI can then import the processed map and can take specific instructions from the user and show the processed results accordingly. A lot of technicality.

Some of the special features that the GUI can contain are:

- The software will be able to map both manually entered data as well as data taken directly from the internet.
- It will also be able to show 3D profile of noise in a selected area
- This software will also have option for showing temperature gradient, ocean floor contour plot and type of ocean bottom.
- User will also get an option of comparing two strategically important areas either by selecting the area manually or entering coordinates.

Some work already achieved in this field are

Mapping Ambient Noise for BIAS- The Baltic Sea is a semi-enclosed sea with nine bordering states. It consists of 8 sub catchment areas (sub-basins) and a numerous of harbours. The shipping density is one of the highest in the world. The international project “Baltic Sea Information on the Acoustic Soundscape” (BIAS) started in September 2012. The aim of this report is to describe the production of extended monthly and annual soundscape maps of the BIAS project area through modelling. These maps correspond to the initial assessment of the environmental status of underwater noise and human activities in accordance with the latest methodological recommendations of the Technical Subgroup Noise of the Marine Strategy Framework Directive. Original methodologies have been developed to ground truth the maps that enable the representation of both natural and anthropogenic noise. The noise maps produced serve as raw material in the GIS planning tool elaborated in the framework of BIAS [13].

Spatial Variation of Ambient Noise in Indian Ocean Region- The work attempts to study and map variations in the ambient noise levels corresponding to the fluctuations in the surface parameters and shipping traffic. The site specific behaviour of the tropical IOR is demonstrated using surface data available from moored buoy at three distinct locations of IOR. Shipping traffic density based on AIS data is used to map highest shipping noise levels in IOR. The analysis methodology can be used for characterization and improvement of sonar performance along with marine spatial planning in environmental conditions of the tropical IOR [14].

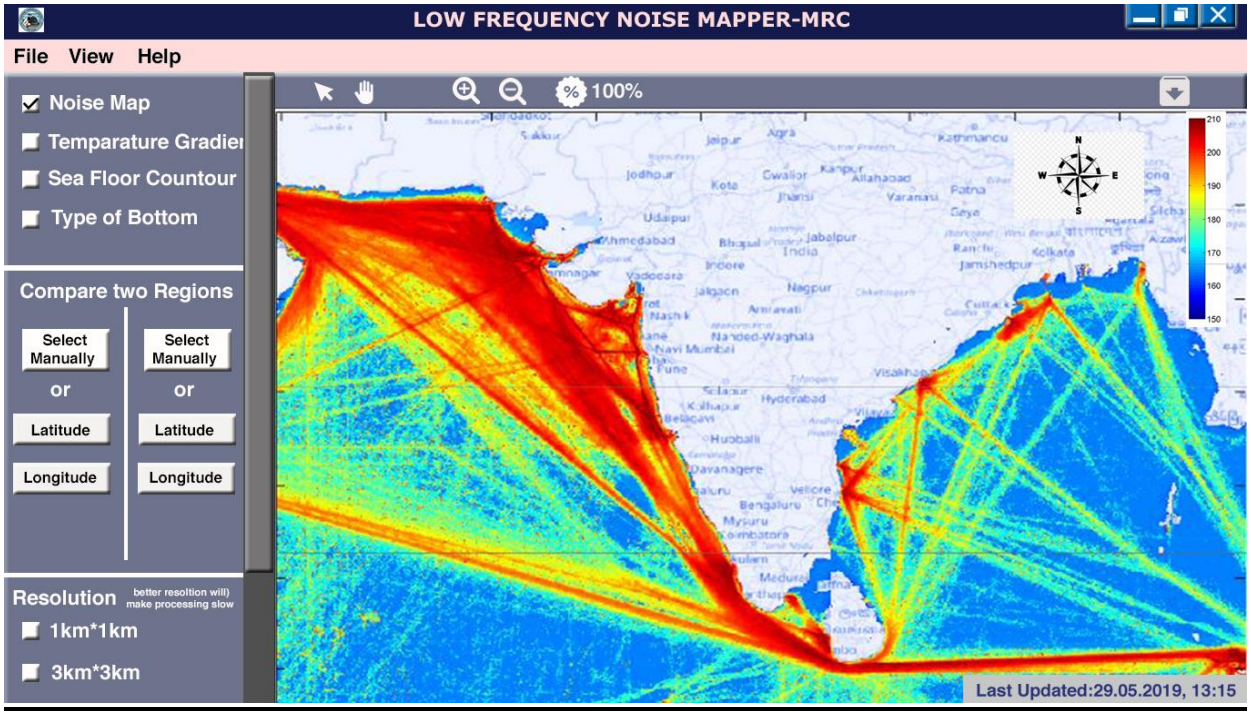

Fig1. A sample GUI to show low frequency ambient noise in real time

Future Scope

Navy-Submarine Deployment: Sonar (originally an acronym for sound navigation ranging) is a technique that uses sound propagation (usually underwater, as in submarine navigation) to navigate, communicate with or detect objects on or under the surface of the water, such as other vessels. Submarine should be deployed as such that there is low anthropogenic noise in the surrounding so as the use of SONARs should be judicious [15].

Maritime Conservation: Anthropogenic noise is considered an acoustic pollutant, with an anticipated increase through the expansion of shipping, resource extraction and offshore development. Impacts of acoustic pollution on marine biota range from death due to physical injury and auditory damage, to behavioural and habitat-use changes. Marine animals rely on sound for navigation, feeding and communication and are known to be particularly sensitive to anthropogenic noise, with effects being detected over tens of kilometres from sources. Effects depend on various factors, including overlap in space and time with the organism and sound source, duration. Thus study of such mapping will help to decide marine animals' conservation sites [16].

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