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Prestudy on Sonar Transponder

Avalon INNOVATION

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Introduction

Avalon Innovation has been asked to investigate the potential for making a sonar responder, driven by the energy in the sonar pulse. The main application in mind is a device to attach to fishing equipment, for instance nets and other equipment that might be lost at sea and hard to find. To identify this kind of transponder on a standard, unmodified sonar/fish finder display, the signal needs to be modulated in a way that clearly distinguishes responder return signals from normal return signals from fish, sea floor or debris. If possible, some sort of identification or other code could be superimposed on the displayed return signal.

Generating this kind of synthetic echo return signal without any source of external power will have to accumulate energy received from the sonar transmitter. The accumulated energy will have to be released in over time in a controlled way.

The purpose of this study is to investigate the preconditions for such a system, and furthermore evaluate whether such a system could be feasible.

We will attempt to answer the following questions:

- What is the state of the art of the technology?
- What does the power budget and signal characteristics from sender to responder look like?
- What power and frequencies are present among commercial echo sounders?
- How does the sonar signal spread out? Is it directional?
- How much of the radiated power could the maximum reach of a responder be?
- What does the link budget look from transmitter to responder (and back)?
- What sensitivity and what effects does eco-receiver receive?
- What does it have for dynamic range?
- How does the directional characteristic from responder to receiver look, how much of the redirected effect reaches the recipient?
- Should it function to mainly modulate the reset amplitude from responder to receiver, or do we need to modulate the time characteristic even in the response?
- How much does a responder need to change echo signal strength to be identified as just a responder and nothing else?
- How much does a responder need to modulate the time characteristic of the response?

Is a passive resonator possible or is an active one necessary?

- How much power / energy could a passive resonator absorb?
- How much power / energy would a passive resonator need to store / retransmit or detect?
- How would the time characteristic look like a passive resonator given different Q values?
- If a passive resonator is deemed technically inappropriate, can an active resonator then be an alternative?
- How would an active resonator work?
- What other aspects can be investigated in the project?
- What does sonar respond to from fish?
- Can you use some kind of reflector?
- How would a product handle the demanding environment?
- What can be required in terms of protection / enclosure?

To answer the above questions in a structured way, we will break down the investigation into the following sections:

Background

- Sonars and fish finders - an analysis of existing systems based on sonar technology
- Transmitter power and frequencies - a study to determine the usual operating ranges of sonar
- Beam characteristics - a look into the various antenna designs, and their corresponding amplification patterns
- Propagation in water - we must look at how the sonar is attenuated in water
- Returned signals from underwater targets - how well does sonar “bounce” off of objects such as fish?
- Receiver sensitivity

Link and power budget Calculations

- With the given inputs from the background knowledge, we can determine which factors are critical, and how to optimize them

Conclusions

Recommendations for further work

- A workshop was held in Simrishamn on Sept 6th 2018. In the workshop, this study was presented briefly but also presentations from other actors with knowledge in the field (for example the Swedish Coast Guard, Fenn Enterprises (a Seattle-based company which currently uses sonar to detect ghost nets in Puget Sound). Many ideas were discussed, and ideas for further work were brought up.

Background

Sonar (originally an acronym for Sound Navigation And 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. Two types of technology share the name "sonar": passive sonar is essentially listening for the sound made by vessels; active sonar is emitting pulses of sounds and listening for echoes. Sonar may be used as a means of acoustic location and of measurement of the echo characteristics of "targets" in the water. Acoustic location in air was used before the introduction of radar. Sonar may also be used in air for robot navigation, and SODAR (an upward looking in-air sonar) is used for atmospheric investigations. The term sonar is also used for the equipment used to generate and receive the sound. The acoustic frequencies used in sonar systems vary from very low (infrasonic) to extremely high (ultrasonic). The study of underwater sound is known as underwater acoustics or hydroacoustics.

source ***Wikipedia***

Sonars and fish finders

Fishing vessels, both commercial and recreational vessels of all sizes, are increasingly using active sonars or fish finders to find and identify schools of fish and even single fish. Fish finding equipment technology has evolved quickly since its introduction, both in technical capabilities and in price and availability. Due to this quick evolution, various generations of equipment with different technologies and performance characteristics exists in the field.

A sonar or fish finder system consists of four conceptual functional blocks, a control and display system, a transmitter/amplifier, a transducer and a receiver/amplifier. These functional blocks might all be contained together in one small handheld unit running on batteries, or, for the biggest systems, each block might be more or less refrigerator-sized using kilowatts of power. Each of these blocks affect the system characteristics in different ways.

Display unit “Lowrance” Hand-held unit “Fish Finder”

Basic fish finders, either cheap modern equipment used in occasional recreational fishing or old equipment installed in commercial vessels, transmit one fixed beam on one single frequency. More sophisticated fish finders use multiple frequencies and/or beam forming or steering. Some transmit and receive on two or more frequencies simultaneously. Modern mid-range equipment typically transmits in chirped frequency sweeps. Expensive sophisticated sonars use frequency modulated signals and beam steering, either by mechanically rotating the transducer or by utilizing phased array techniques.

Active - Beacons

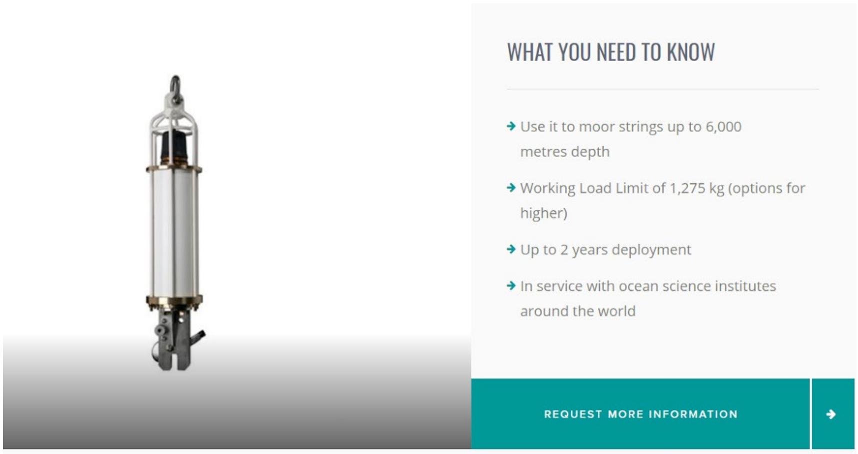
Beacons emit a periodic ping, often with an encoded signal for ID purposes, One such manufacturer is JW, which offers a hand-held unit for divers to home-in on the beacon.

From the JW web page:

JW Fishers acoustic pingers make it quick and easy to relocate an underwater site or piece of equipment. The pinger is attached to an underwater location where it continuously transmits a sonar signal. A diver equipped with a pinger receiver can detect the acoustic signal and follow it directly to the pinger. Pingers are available with different transmit frequencies so several can be deployed in the same general area without interfering with each other. The diver sets the pinger receiver to the desired frequency and is guided directly to the pinger. Operates in the LF (8 -14 kHz) and MF (20 - 50 kHz) frequency bands.

Active - Transponders

Sonardyne manufactures a range of acoustic release transponders, which only respond when interrogated. If the right code is sent to the transponder, it will release a spring-loaded hammer for long-range tracking. The batteries are thus saved since the device does not need to ping continuously.



From the Sonardyne web page

Deep water Acoustic release transponders are. tough, reliable acoustic releasers designed for deployment in up to 6,000 metres of water.

The units are commonly used to moor oceanographic instrument strings on the seabed for periods of up to 36 months. However, their compact size allows them to be easily incorporated into subsea instrument frames or installed on towfish and AUVs to enable ballast to be dropped in an emergency.

Standard features include a Safe Working Load of 1,275 kg (at 4:1) and a spring-assisted release mechanism.

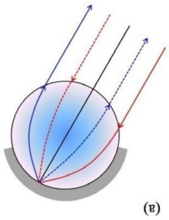
Responds to security-encoded interrogation in the LF (8–14 kHz) frequency band.

Passive - Reflectors

Several products exist on the market which act as sonar reflectors.

Sonar Bell, for example has a product about the size of a grapefruit which has an omnidirectional target strength equivalent to a 2 m diameter steel sphere. The technology is believed to be based on a luneburg lens where the density of the material changes within the sphere to focus the sonar waves in such a way as to always reflect the waved back to the observer (similar to cats eyes).

Unsure of what frequency ranges these work with, or if they must be different sizes/models for different ping frequencies.



Transmitter power and frequencies

Most sonars and fish finders normally transmits in frequencies from low tens to low hundreds of kHz. Older units transmit at a single fixed frequency, more sophisticated units allow selection of various fixed frequencies or arbitrary frequencies. Common frequencies are 50 and 200 kHz. Peak amplifier power going to the transducer varies from 100 to 200 W for less sophisticated units for recreational use to a few kW for bigger units. These numbers are the power from the transmitter amplifier, not the power that actually ends up in the water. Various references give the coupling efficiency from transmitter amplifier power to power in water from the transducer as between 5 and 50%. The active transmitter duty cycle is very low, especially for a fixed-frequency unit, around 1% or less. This is due to the desire to have high depth resolution and long range at the same time, and the duty cycle is often adjustable by the operator for the current operating conditions, although most often indirectly through range and update rate or resolution settings. Thus the average transmitted power is much lower than the advertised power, which can also be seen from power consumption specifications. Average transmitter output power over multiple transmit-receive cycles is single watts for recreational units, up to tens or a few hundreds of watts for big commercial units for industrial-scale commercial fishing.

Transmitted power can be in hundreds of watts up to thousands of watts for submarine hunting applications. It is often quoted in dB and can be as high as 185 dB. This may however, be harmful to marine life.

The literature suggests that around 200 dB is the theoretical limit, as any higher would imply that the amplitude causes a vacuum in its low-pressure phase.

Chirp vs. Ping

Sonars traditionally “ping” at a specific frequency. It is also possible to “chirp” through a range of frequencies. Instead of sending one frequency at a time, the CHIRP sends a continuous sweep of frequencies, from low to high. With the CHIRP echo sounder technology, the frequencies are then interpreted individually when they return. Because this continuous range of frequencies gives CHIRP a significantly wider range of information, CHIRP can create a clearer image with higher resolution.

Chirping allows more energy to be used per second since the received signals do not interfere with each other much, and therefore the signal burst can be much longer. This reduces “clutter” or noise and makes objects more visible on the display.

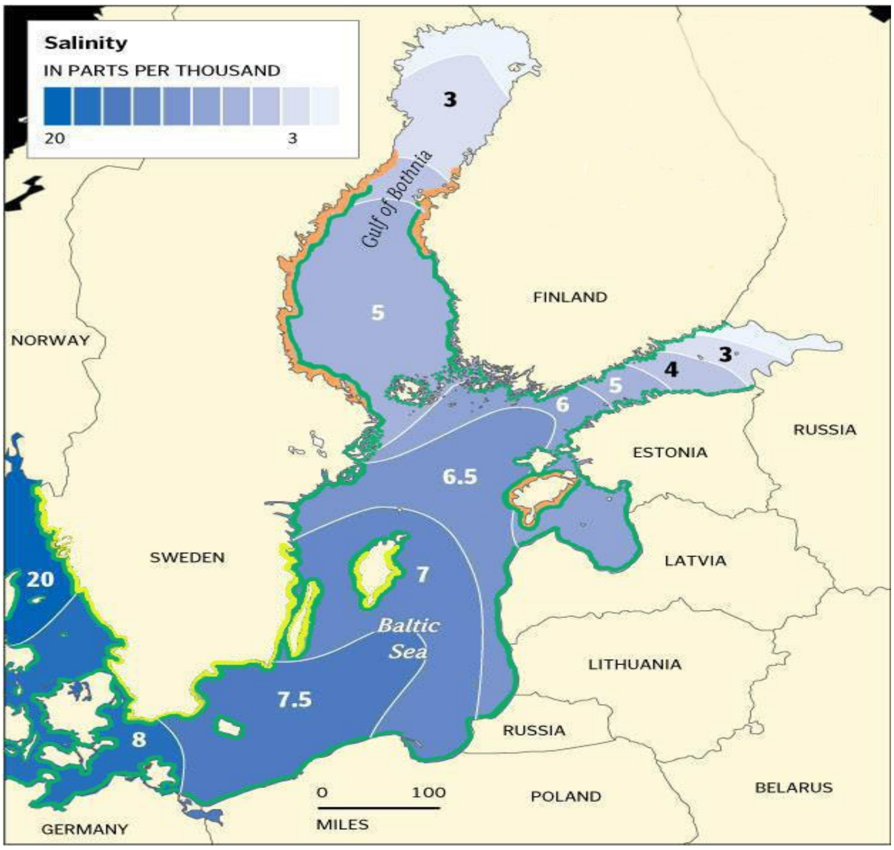
Beam characteristics

The beam/lobe characteristics is a result of the geometry and design of the transducer. In general, higher frequencies results in tighter, more narrow, beams. This is expected from geometry and physics. Commercially available transducers specify beam width in the -3 dB width, the angle off axis where the power density has fallen to half of the peak value. Some manufacturers specify the -6 dB width, which makes their beams look wider on the specification sheet. Some manufacturers do not specify the criteria for the beam width, but manufacturers of more expensive and professional systems do. Beam characteristics from different manufacturers are similar, for comparable frequencies and transducer sizes, which is expected. Typical beam widths are -3 dB at 20-40° (10-20° off boresight) at 50 kHz, and -3 dB at 5-10° (2.5-5° off boresight) at 200 kHz.

More sophisticated units scan their beam actively, either by aiming the transducer mechanically or by using phased-array techniques. These units are not considered in this document.

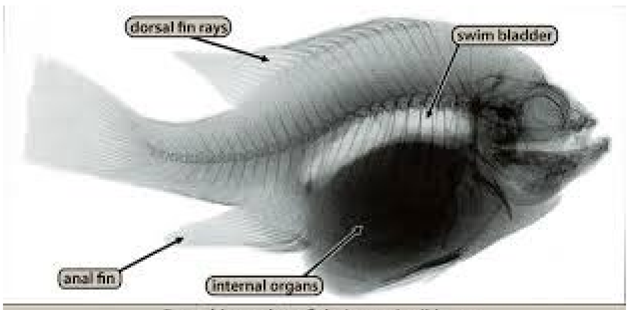
Propagation in water

Propagation of ultrasound in water is fairly well known. Speed of sound in water can for our purposes be assumed to be constant at around 1500 m/s. Attenuation comes mainly from viscosity, and thus attenuation rises with increasing salinity. For 0.75% - 0.8% salinity typical of the southern Baltic sea attenuation is around 10 dB/km, and for ocean salinity of 3.5% attenuation is around 30 dB/km.



Returned signal from underwater targets

Returned signals from underwater targets, typically fish, is of great interest both to the commercial fishing industry and to academia. There is a lot of research done regarding this. A relation is given in the references as target strength ≈ 20 log(length in cm) - C dB. Where C can be between 65 and 75 dB, depending on the species of fish.



Pumpkinseed sunfish, *Lepomis gibbosus*

The return signal of fish-like targets is mostly due to index mismatch in the swim bladder boundary.

In the references we find an approximate model for the reflected level of fish-type targets for sonar applications as

$$TS = 20\,log(Ltarget\ \ ) - 70\,dB$$

where L_{target} is an approximate target size in centimeters. As a general indication, the target strength of a fish-like target on the order of 10 cm is around -50 dB.

In one of the appendices various plausible scenarios with this model is calculated. Results is in the same order of magnitudes as we expect. Peak power reaching decimeter-size targets under reasonable conditions are in tens or low hundreds of milliwatts reflected signals leaving a decimeter-to-meter-scale fish-type target are 30-50 dB down, or a factor of 1000-100000 times lower. Average power over multiple transmit-receive cycles are on the order of tens of microwatts to single milliwatts. This is acoustic power in the water, before any losses due to collection or harvesting.

Receiver sensitivity

Unit manufacturers seldom specify receiver sensitivity directly, but some measures can be inferred. One manufacturer of large commercial fishing industry sonars indicate that their receivers have an input range from -20 to -150 dBW. This can be taken as an upper limit of receiver sensitivity, no receivers are likely to be better than this modern high-end system. Others indicate dynamic range around 100 dB or time-varying gain of 100 dB, which indirectly indicates that target return signals at the receiver can be expected to vary in this order of magnitude. From pure geometry, one would expect a range of 10-1000 m to correspond to a dynamic range of 80 dB, so these numbers seem reasonable.

Link- and power budget calculations

The signal chain from the transmitter amplifier to the receiver amplifier passes through these steps, as an initial model:

- Transmitter output power
- Transmitter efficiency from electrical input power to acoustic power in water
- Transmitter lobe directivity function and geometric loss
- Propagation loss through water to target
- Target signal absorption and re-radiation efficiency
- Target re-radiation lobe directivity and geometric loss
- Propagation loss through water to transducer
- Transducer efficiency from water to electrical output power to receiver
- Noise

Transmitter output power

- See discussion above, Maximum 185 dB.

Transmitter output efficiency

- Unknown, but perhaps -3 to -6 dB.

Transmitter lobe directivity and spreading losses.

Values and factors in this chain have been estimated and calculated by reading manufacturer specification sheets and assuming plausible models. A reasonable initial estimation of lobe shape is that the intensity, power density, falls off in proportion to $cos^2(\phi_{eff})$, where ϕ_{eff} is the effective off-boresight angle when scaled to the appropriate beam width. Then the maximum power density radiated into a full semi-sphere will be given by

$$I_{max} = P_{tot} \frac{\int_0^{\frac{\pi}{2}} 2\pi \ sin(\phi) \ d\phi}{\int_0^{\frac{\pi}{2}} 2\pi \ sin(\phi) \ cos^2(\phi) \ d\phi} \ sr^{-1} = \frac{P_{tot}}{3} \ sr^{-1}$$

where P_{tot} denotes the total radiated power from the transducer, and the focussed power density for a more narrow lobe with the same shape will be found as

$$I_{max}(\phi_{lobewidth}) = \left(\frac{2\pi}{\phi_{lobewidth}}\right)^2 \frac{P_{tot}}{3} \ sr^{-1}$$

The solid angle occupied by a circular target of radius r meter at a distance of D meter will be

$$\Omega_{target}(r, \ D) = 2 \ \pi \ \left(1 - cos\left(arctan\left(\frac{r}{D}\right)\right)\right) \ sr$$

Propagation loss through water to target (and back)

As per discussions above, between -10 dB/km in one direction. Must be multiplied by two for return direction.

Target signal absorption and re-radiation efficiency and Target re-radiation lobe directivity and geometric loss. As per discussions, the approximate power reflected from a fish

$$TS \ = \ 20 \ log(Ltarget \ \ ) \ - \ 70 \ dB$$

For example a 10 cm fish may have -50 dB. However, if the target is specifically designed to reflect sonar, this may between -3 and -6 dB.

Noise

Oceanic noise is prolific.. There are five bands of noise:

I. f < 1 Hz: hydrostatic, seismic

II. $1 < f < 20$ Hz: oceanic turbulence

III. $20 < f < 500$ Hz: shipping

IV. 500 Hz $< f <$ 50 KHz: surface waves

> Note that noise from surface waves can be inhibited by using a submerged torpedo transponder using “blinders” such that the surface noise is cancelled.

V. 50 kHz $< f$: thermal noise

Ideas

Resonators as energy storage elements or harvesters

Storing energy in mechanical resonators at the high frequencies used by sonars seems unlikely. Some quick calculations show that a steel tuning fork would need to be very thick to reach ~100 kHz, say 9 by 9 mm, or in millimeter scale, 0.1 mm thick and 1 mm long. These tuning forks will not store much energy. All the energy in one sonar pulse will deflect such a beam on the order of tens of nanometers. These small deflections will be impossible to tap energy from.

Choosing a better suited material than steel will not help much either. Even making the resonator from the best known material, diamond, will only make the situation a few times less bad.

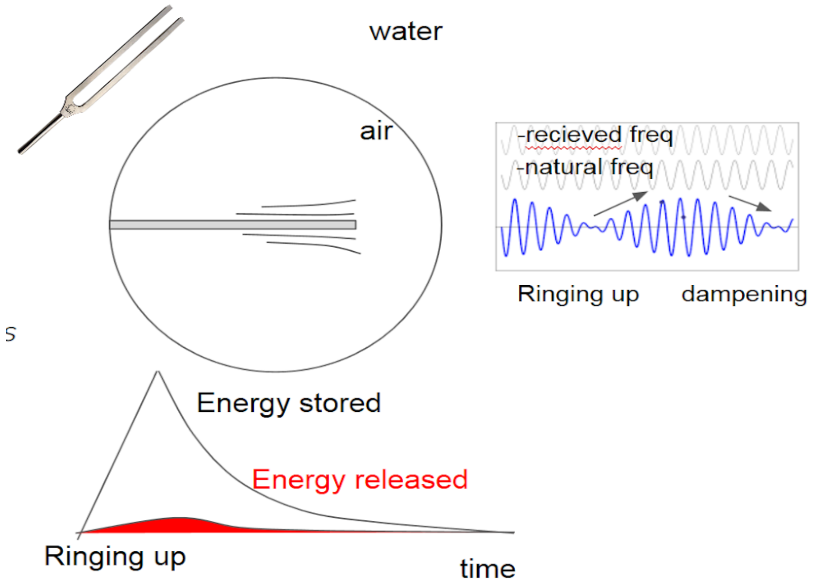
An air cavity resonator will resonate at half wavelength. Speed of sound in air is 340 m/S, so cavity length for resonance at 100 kHz is 1.7 mm. Not much energy to store in that air column either, and even harder to extract.

Another factor that will hinder using a mechanical resonator as energy storage element is the necessary Q factor. Since the intermittence of the sonar signal is so low, a very short burst of energy and then a long period of silence, a resonator would need an extremely high Q factor to not lose all energy before the next transmission. The necessary Q will be many thousands or tens of thousands, at least. The downsides to this high Q is that the resonator will have extremely high frequency selectivity, and also need a long time to ring up. These properties of oscillators/resonators are well known.

One possible mechanism would be that a mechanical resonator could delay the response for a short while, the resonator ringing up during the pulse and then releasing the energy after the received pulse is over. This would have very low efficiency, and only shift the response a very short time, on the order of the pulse length. So the response will only be smeared out and parts of it shifted a few meters deeper, at the cost of a much lower returned signal strength.

Another way of seeing this is that the sonar receiver needs to use many watts to detect the extremely small signals reaching the receiver, thus using many watts to extract only parts of the available energy in the low level sonic signal.

In addition to the efficiency problems mentioned, further challenges associated with the resonator concept have been realized. Resonators typically work at a specific frequency. In order to ring up a significant level, the incoming ping (or continuous tone, if a transmitter could be constructed to emit continuously) would need to match this frequency quite closely. If it does not match, and the transmitted tone is too long, there will be a dampening effect, and the transponder will not ring up.



Besides this difficulty in guaranteeing a good match between responder and transmitter there are other factors, which are more severe. as the doppler effect from the transmitter's ship (presumed to be moving) will create a significant doppler shift which will worsen the situation. Finally, as the transmitted signal passes through ever-deepening layers of water there will be significant index changes (proportional to density, which is in turn dependant on temperature and salinity)

Conclusions

After conducting this short study, it seems unlikely that there is a feasible way forward with the single-element resonator concept. The principles and physics involved are well understood, and real power and energy levels will not be multiple orders higher than found in this study, which seems needed for passive/active harvesting concepts to work. The absolute levels of power and energy are too small, and the difficulties in matching the harmonic frequency of the responder are too great.

However, passive reflectors in well thought out geometries and designs will make the return signal seem stronger, but we see no possible way to modulate the returned signal without external power available. Thus a passive reflector will not be able to distinguish from a normal return from a fish or school of fish, apart from possibly being somewhat stronger.

Thus far, we cannot recommend going forward with this concept.

Recommendations for further work

Leading up to, and during the Sept 6th workshop in Simrishamn, additional ideas were conceived and proposed, across of number of fields. Considering primarily only the technical aspects, the additional ideas can be summarized as follows:

Ghost Net Hotline

An (automated) telephone and/or internet service to report locations of lost (or found) nets.

Transponders - to help retrieve nets lost in the future

Transponders could be used to aid in retrieving lost equipment in several different use cases. Additional work would be needed to identify these use cases, but these may include:

- Preemptively attaching transponders to all nets,
    - Could be used to give the owner's identity, and the owner could be contacted to pick up their own net
    - Could be used to give the date that the net was deployed. Nets deployed longer than a certain duration could be considered abandoned, and removed
    - Could merely be used to strengthen the signal of the net itself in some way, without encoding or battery power (see passive transponder below)
- If a net needs to be cut and left at sea (because it has snagged on the bottom) a transponder can be specifically attached to the remaining net at this moment, to help in clean up efforts.
- If a diver encounters a net while exploring a wreck, for example, they could attach a transponder to warn other divers with an audible warning, and perhaps help sonar scanning vessels to locate it as well'
- Fishermen may not want others to know where they fish, so the transponder codes could be kept secret to others, while authorities could have "skeleton key" code which triggers all transponders to respond.
- Determine if it is necessary that a transponder be readable from "any" commercially available sonar, or if only the specialized net-hunting vessels need be able to access the transponders
- Determine if it is possible that the most common sonars on the market today are configurable to detect transponders as well, of if they simply find fish and have no ability to talk to 3rd party transponders.
- Is there a case to be made for the government handing out transponders free of charge to help reduce future losses
- Is there any environmental impact from the choice of transponder (battery leaks, sonar disturbing marine life such as dolphins)

Once all the use cases have been identified, a decision should be made if we need active or passive transponders (or a combination, or even a hybrid)

Passive Transponder ideas

- A wide band resonator similar to a xylophone may be used return more energy over a longer time after being stimulated by a chirp or ping.
- A set of “harmonic” strings could also be used, The strings would be adjusted to have natural frequencies which combine to give large bursts of energy at lowest-common-denominator periods. For example if the natural periods were 1,2,3 and 4 time periods, then the LCD is 12. Therefore superposition would give a more noticeable peak every 12 periods, which may be detected by algorithms in the sonar, or which can be found more easily using post-processing with a computer.
- A video was presented showing the harmonic interaction between a transmitter, a receiver and a small ping pong ball. The interaction generates a large rhythmic pulse, which may or may not be regular. Ocean surface waves may add to the energy and make the object behave similarly to a bell buoy.

Active Transponder ideas

- Determine the use cases and requirements for an active transponder and scan the market to see if an off the shelf product already exists. If not, developing a simple, inexpensive transponder which meets the specific requirements of finding lost equipment at the ranges and use cases determined.

Improving the Sonar Data at the source

- Stabilization of the sonar transceiver “torpedo”
  - A control system could be devised to keep the sonar torpedo level in the water and minimize the effects of surface waves acting on the towing vessel.
- Coherent integration of signals to reduce signal to noise ratio (using multiple torpedos for example)
- Improved handling of data to keep fidelity of sonar signals (which are originally analog but get digitized once by the sonar equipment, and digitized again when being displayed on the screen at sub-optimal resolutions)

Computerized Post Processing

- Computerized post-processing of the sonar signals may be a promising area. As it was demonstrated in the workshops, sonars are capable of detecting fishing nets today, assuming there are people skilled enough to understand the subtle patterns which emerge on the sonar plots. As an estimation, 45 days worth of collected sonar data takes about 10-20 hours to process by humans. Post processing by a computer may help to identify objects which may be used to lessen the workloads on humans by
  - Simple adjustments/enhancements to the sonar images for example using greater contrast for later human interpretation
  - Applying filters to reduce saturation in the near field, and increase expose in the far field
  - Doppler processing, applying fourier transforms, etc.
  - Other standard sharpening and noise suppression techniques may be useful

        - Simulated coherent integration using the average of adjacent scans
    - Pattern recognition/enhancing software to detect lines, or blurry areas (which are how nets often appear when they are stretched out or bundled together respectively), highlighting these areas as an aid to human post processing
    - Using image recognition to slowly remove the human dependance in the future.
        - using artificial intelligence based on “ground truth” data and/or
        - Particle filter methods (randomly generate test points on the image and perform simple algorithms to determine if the particle meets the criteria for “net” or not, if not “die” if so “stay alive”. Look for concentrations of particles.)
        - Other advanced algorithms including algorithms to minimize false-positives.
    - “Stitching” or overlaying multiple images of the same area, possibly from various sonar manufacturers, using a computer
    - Converting 2D images into 3D images
    - Automating the reporting of nets from the sonar data (whether human or computer) to a sort of “map” database.

Map/Database

As the location of nets and other equipment becomes known, either through sonar scanning of the sea bottom, or by reports coming in through the hotline, this data will need to be stored. In addition to the physical location of then nets, other data may be included in the database (if it is known) such as:

- Is the object a net, or other type of equipment (lobster traps, etc)
- Length of the net
- The nets orientation
- The date the net was lost (recently lost nets are prioritized)
- The owner of the net
- The depth of the water at the nets location
- The condition of the net (if it is bundled or spread across a long distance)

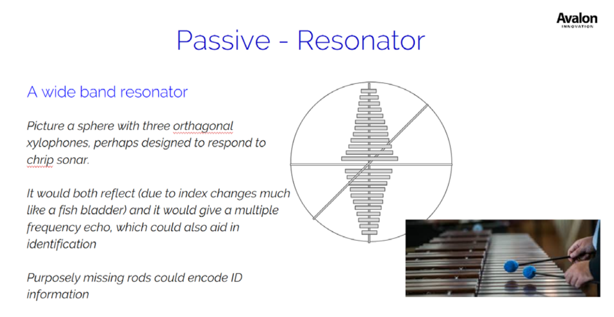
Dispatching algorithm

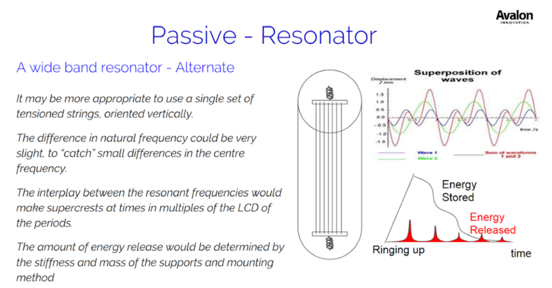
When net and other equipment locations are known, it is a type of “travelling salesman” algorithm to determine the best nets to collect first. For example it may be unwise to collect nets systematically by cleaning up a certain area until it is free of nets before moving to the next area. It may be more effective to focus on:

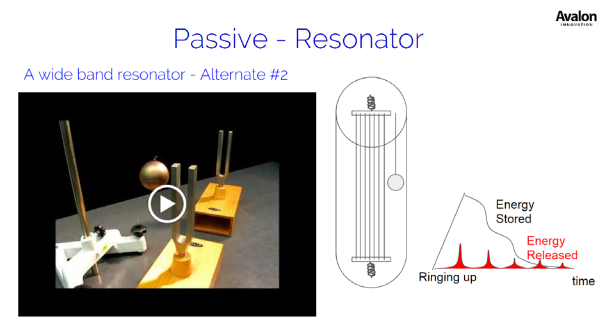
- Recently lost nets (which are still quite effective at catching fish)
- Longer nets
- Nets oriented to the flow of sea currents
- Nets which are stretched over a longer distance
- Nets which are grouped close to one another may be more efficient to gather by sailing crews.

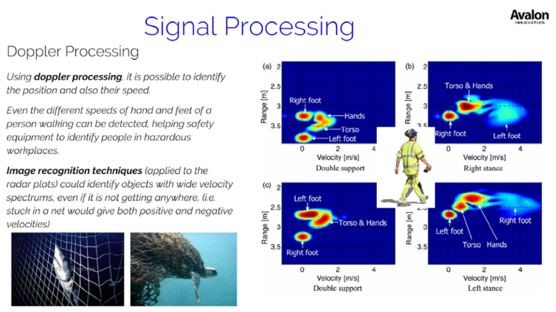
Remotely Operated Vehicles

- We learned in the workshop that ROVs are under development by Crayton's team in Seattle to handle the job of bundling up found nets to ensure that they do not disintegrate while being winched to the surface. This work could be enhanced or leveraged in many ways
  - to make the ROVs autonomous in the future,
  - ROVs could be involved not only in the bundling process but also in the surveying stages.
    - Their immunity to surface waves would give a cleaner sonar signal.
  - Recharging with solar energy, and beaming their info to shore via radio would mean that the ROVs would not need to return to port often.









References

Background

https://en.wikipedia.org/wiki/Sonar

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The MARELITT Baltic project

Derelict fishing gear (DFG) is addressed worldwide as a source of marine litter with extensive hazardous effects on the marine ecosystem. From 5.500 to 10.000 gillnets and trawl nets are lost every year and despite intense media focus – the problem is poorly known in the fisheries industry and among politicians.

The MARELITT Baltic project is one of the first transnational initiatives in the world to provide an operation oriented all-in-one solution for how to approach DFG. It will turn a diffuse problem into a clear and apprehensible topic that can contribute to an enhanced international readiness to act.

The project is divided into five work packages (WP), where package 2, 3 and 4 are the major parts concerning the cleaning, prevention and recycling of lost fishing gear.

Cleaning the sea and planning future action at sea
The aim of WP 2 is to plan and execute DFG retrievals in Sweden, Estonia, Poland and Germany both on the seafloor and wrecks. The activities will be based on methodologies and techniques tested in earlier national projects. These experiences will contribute to a common methodology which is crucial given the extreme hydrographic and morphological variation in the Baltic Sea. The new operation platform will make cleaning operations both transparent and demonstrate if the task is physically possible.

Responsible fisheries prevention scheme
The aim of WP 3 is to develop an overall approach to mitigate the problem of lost fishing gear in the future. It can roughly be divided into three types of actions. Firstly, the project will increase knowledge on fishing technological and strategic changes over time and how these changes have influenced the evolution of gear loss. In the second step, the project will focus on the potential causes to why fishing gears are lost. The third category of action includes development of preventive methods such as gear marking technologies helping to track irresponsible fishermen or assisting responsible fishermen to locate lost gears.

Marine litter reception facilities and recycling
The aim of WP 4 is to identify the options for a safe and fully sustainable handling and recycling of the lost fishing gear in a circular approach. Within this work package the phase from reaching the harbour through cleaning, sorting, transport until processing of recycling of the nets will be dealt with. The work encloses a variety of approaches such as creating a knowledge baseline about the transnational status and capacities of harbours, waste handling systems and industries in the Baltic Sea countries.

Projectpartners

Sweden
Municipality of Simrishamn, Lead partner
Keep Sweden Tidy

Germany
WWF Germany

Poland
WWF Poland Foundation
Maritime University of Szczecin
Kolobrzeg Fish Producers Group
Institute of Logistics and Warehousing

Estonia
Keep the Estonian Sea Tidy
Estonian Divers Association

More information

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