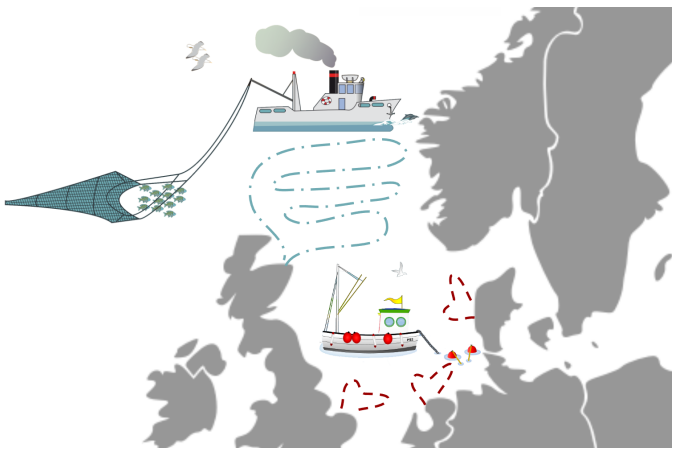
Christian-Albrechts-Universität zu Kiel

Towards a fixed-gear AIS trajectory differentiation

Vision Paper SSTD 2023



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Motivation

Why does the world need this work?

- Computer Science Community has chance to help Marine Conservation by leveraging skills and modern technology
- Automatize surveillance of fishing efforts previously hidden out at sea

Figure: Bycatch caught in fishing net, image source top [1], bottom [2]

Background information

AIS: **A**utomatic **I**dentification **S**ystem

- Satellite Based Communication
- Features include: Unique Vessel ID (MMSI), GPS Position, Speed
- Solved: Tracking and differentiating other fishing activities like trawling, trolling, pure-seine fishing, etc.

Fixed Gear Fishing

- Gear is deployed and left at sea
- Retrieval after varying time period (from 15min to 5+ days)
- Expert knowledge expect three distinctive gears used in North Europe

Fixed Gear Fishing Behavior

Common elements in all fixed-gear trajectories

- Exit harbor, speedy travel to fishing area
  1. Retrieve filled gear
  2. Clear out caught animals, prepare traps for new deployment
  3. Deploy gear
  4. Travel to next set of gear
- Repeat steps 1-4. for all gear sets
- Return to harbor

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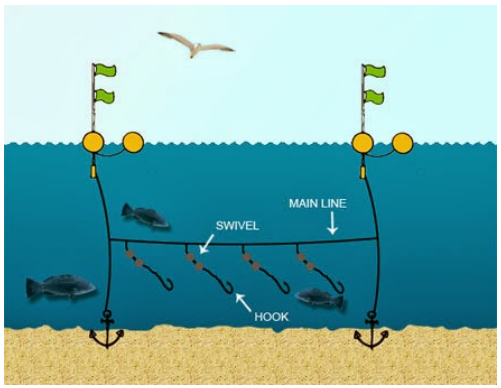
Three different fixed-gear fishing types

Expected differences: Duration of drifting, distance between drift stops, and operating water depths.



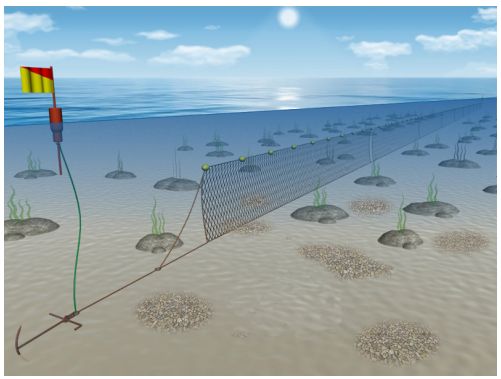


Figure: Fixed gear fishing methods in Baltic Sea. Left to right: Crab Pots, Stationary Longline, Gill net, Image credits [3, 4, 5]

State of the art

Classifying Fishing Gear is common practice and models exist for differentiating Pure Seine, Longline, Trawler, Trolling.

Mine moving patterns Trawlers are detected based on their unique movement pattern. Hidden Markov Model (HMM) successfully trained to detect these.

Using HMM to **detect different states** of fixed gear fishing has been done on VMS data.

Current Limitations

Classifying fixed gear trajectories from fishing trajectories is solved, as byproduct when detecting other large fishing gear types.

Differentiating different fixed gear methods such as gill-net setting and pot setting has not been done yet.

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Vision

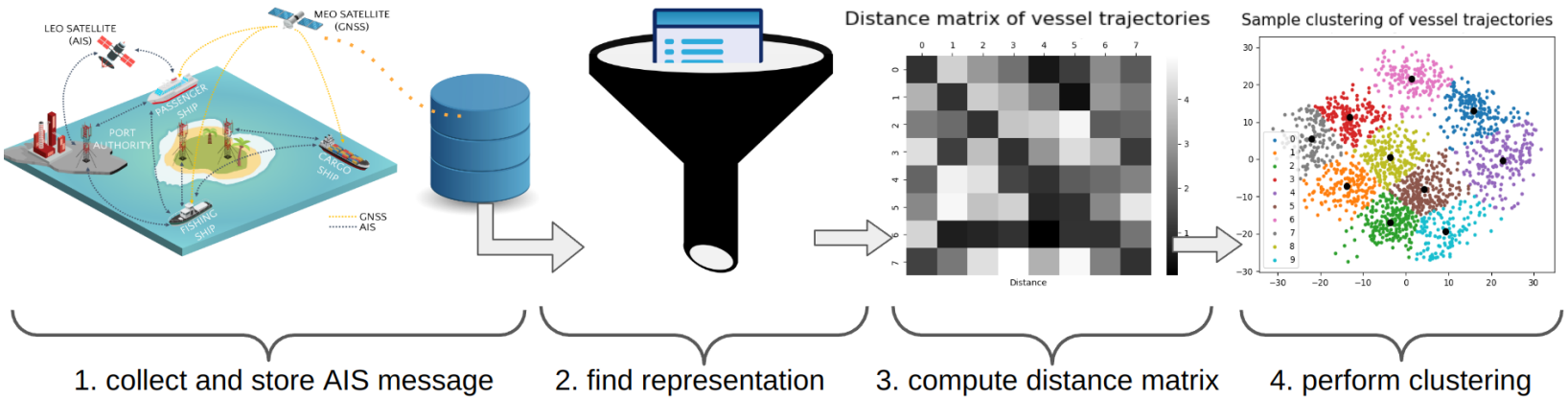

Figure: Aiming for fixed-gear AIS trajectory clustering

Step 1: Collect and preprocess Data
Step 2: Choose suitable data representation
Step 3: Compute Distance Matrices
Step 4: Cluster

Challenges

1. What representation is suited to best incorporate minute differences for comparison?
2. How can the differences be numerically capture? Which metric can be used? Depends heavily on chosen representation

Current Approaches

- Semantic Trajectory analysis (enriched AIS messages)
- Visual Representation as plot with and without seachart, line, polygon, etc.

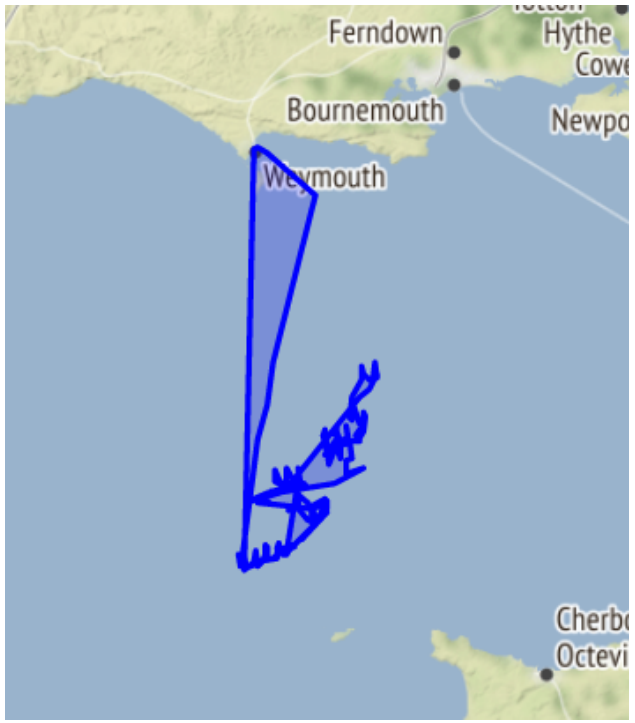

Figure: Single Trip trajectory of fixed gear fishing vessel in English Channel

Future Work

Done

- Pipeline for generating data sets: Process open source data to usable trajectories (eScience and SIGSPATIAL)

In Progress

- **Semantic description** of trajectories and **visual representation** for computing similarities

Future Points

- Clustering and Validation of current approaches
- State-wise Sequence representation
- Including other vessel data

References

- K. E. Skora. (2023) Toter schweinswal im stellnetz von krzysztof e skora hel marine station. [Online]. Available: https://www.delphinschutz.org/presse/geisternetzen-neues-leben-einhauchen/
- U. of Barcelona. (2019) How to avoid seabird bycatch in the mediterranean. [Online]. Available: https://www.oceansentry.org/how-to-avoid-seabird-bycatch-in-the-mediterranean/
- L. Prochaska. (2019) Recovered crab pots available to rightful owners. [Online]. Available: https://www.nccoast.org/2019/01/recovered-crab-pots-available-to-rightful-owners/
- unknown. (2019) Longline fishing. [Online]. Available: http://www.hookline-fishing.com/fishing-techniques/longline-fishing.html
- Seafish-Report. (2014) Ecological risk assessment of the effects of fishing for south west fisheries; ices divisions vii e,f,g h, sr670.

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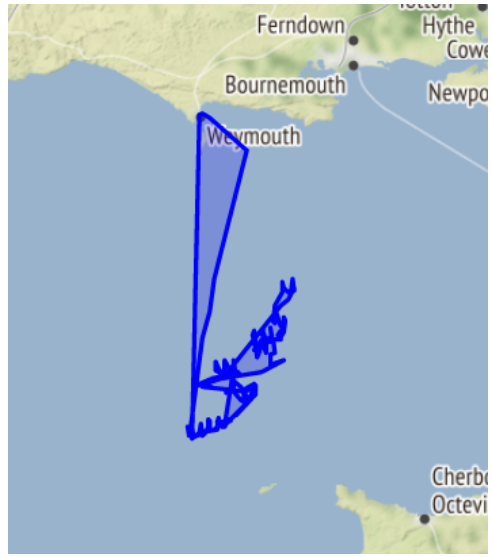
Get in touch via e-mail:



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Vision: Towards a fixed-gear AIS trajectory differentiation

Motivation

Short version. We want to help reduce the amount of this:

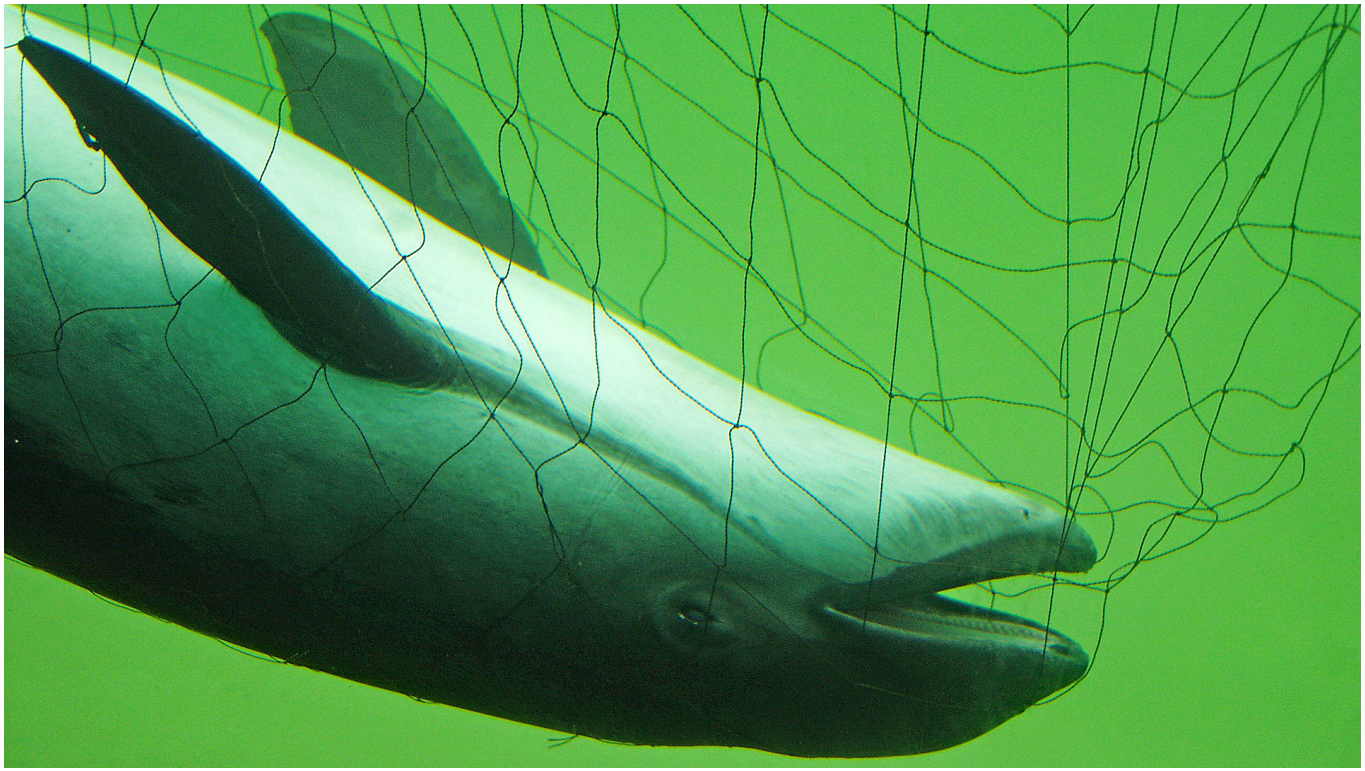

Figure: porpoise caught in fishing net, image source [1]

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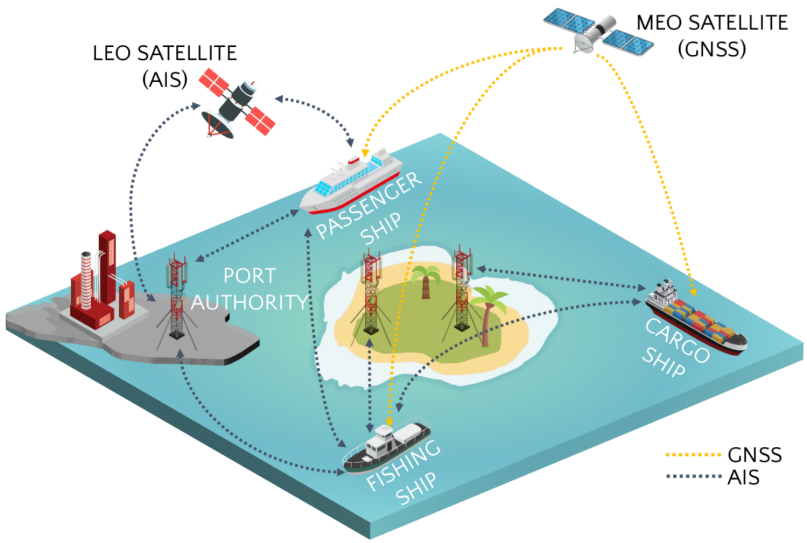
AIS

- 26 Message Features, incl. Unique Vessel ID, GPS Location, Speed, Course
- Open Source DMA, raw data stream, preprocessed by GFW
- Faulty data because of sensors or manipulation
- Theory every 30 seconds, reality differs



Soaking duration

The soaking duration can be used as indicator for targeted fish, and therefore for gear used.

Animal	Common Times
Crabs	15 min to 1 Hour
Lobster	2-8 Hours

Tabelle: Soaking times based on expert knowledge and fishing reports

Regulation on Fixed Gear

Existing regulations on fixed gear:

- Gill net prohibited between November and January close to shore
- Only in Germany, not Denmark
- Marine Conservation Organizations demand extension until April