

The Alaska Fisheries Electronic Monitoring Innovation (EMI) Project

Developing Automated Methods to Monitor Fisheries

Validating bycatch reports from processing plants

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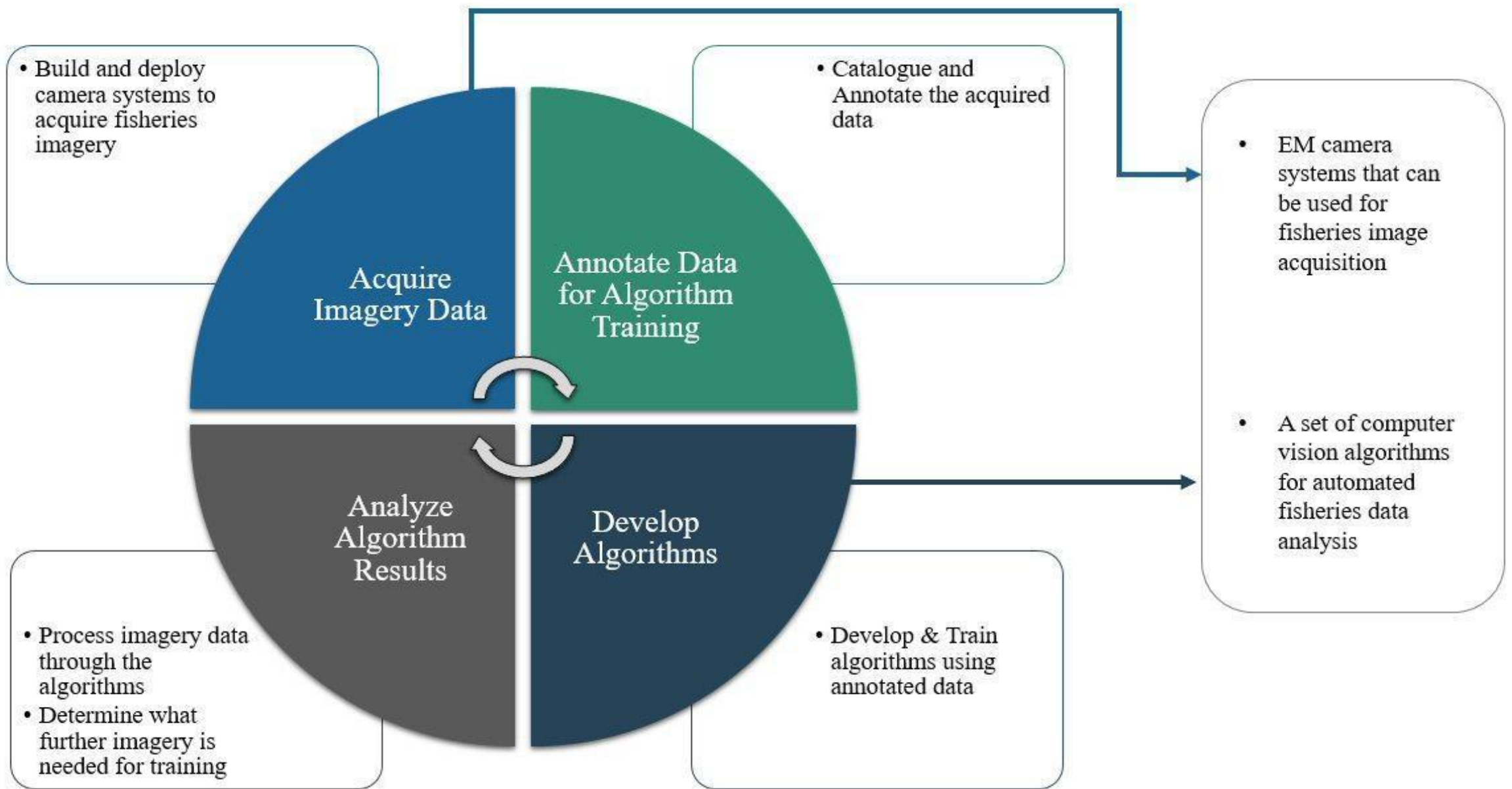
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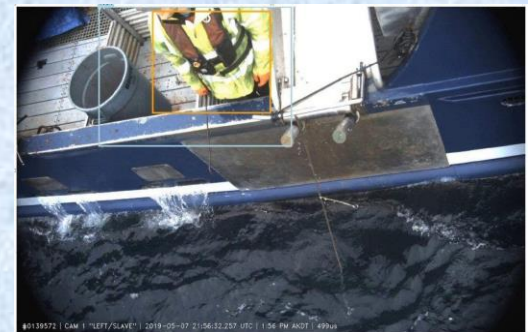
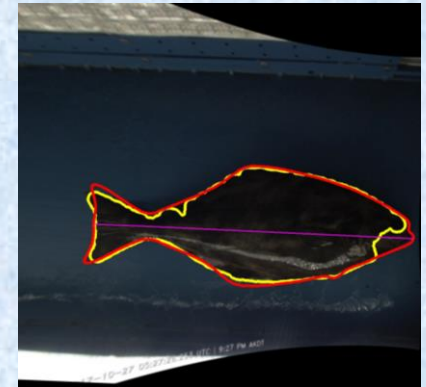
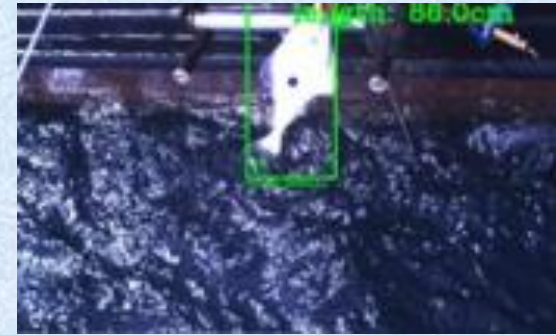
Research Cycle

Output



EMI program developments

- Monitoring longline catches coming aboard (camera viewing rail):
 - Species and size composition of the catch
- Monitor catches discarded from trawlers (enclosed chutes):
 - Size composition of selected discard species
 - Species and size of all discards
- Monitor crew locations and activities (camera viewing deck):
 - Detect discards, trigger cameras
- **Validate plant sorting processes (cameras viewing conveyors):**



Why Validate Plant Catch Reports?

Prohibited Species Management

- Alaska fisheries limit capture of some high-value species (salmon, crab, halibut) to particular fisheries and prohibit their retention by trawlers
 - Example: Halibut can only be retained by longline vessels with halibut quota – Halibut caught by any trawler must be discarded
- Bycatch of prohibited species by trawl fisheries is monitored and limited
 - Vessel or fishery quotas – Must stop fishing when quota is exceeded

Why Validate Plant Catch Reports?

Monitoring Prohibited Species Bycatch

- Prohibited species are usually a very small portion of the catch, often $< 1\%$
 - Difficult to monitor with precision
 - Onboard sampling low precision
 - rare observations are extrapolated
 - Very time consuming for plant observers
 - requires full time watching conveyor
- Processing plants sort and fully report all catch, but are not independent, disinterested parties



Why Validate Plant Catch Reports?

- Concept: Use electronic monitoring to confirm that all salmon are being sorted from the catch and accurately counted, allowing managers to confidently use salmon bycatch reports from plants
- Challenges:
 - Salmon can be buried in the catch, preventing detection
 - Keeping catch to one layer of fish would greatly slow plant operations
- Solution:
 - Detect most fish entering plant
 - Sorters display salmon to camera when they are found (check-in)
 - Time correspondence between detections and check-in indicate whether detected salmon are sorted from the catch

Detecting salmon entering sorting areas

We collected videos from 4 plants in Kodiak, Alaska and annotated visible salmon



Automated salmon detection from trawl deliveries

- Detect salmon in single frames with Yolov4
- Combine detections into tracks across video with DeepSort
 - Eliminates multiple counts and reduces false positive detections

Results from about 70,000 annotations

Detected 84% of Salmon from rockfish deliveries and 73% from pollock deliveries

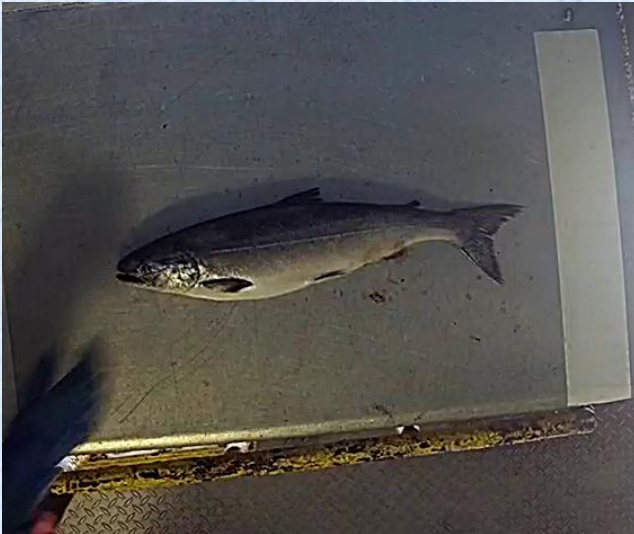


Yolov4: Bochkovskiy, Alexey, Chien-Yao Wang, and Hong-Yuan Mark Liao. "Yolov4: Optimal speed and accuracy of object detection." arXiv preprint arXiv:2004.10934 (2020).

DeepSort: Wojke, Nicolai, Alex Bewley, and Dietrich Paulus. "Simple online and realtime tracking with a deep association metric." 2017 IEEE international conference on image processing (ICIP). IEEE, 2017.

Salmon check-in and species classification

- Detected salmon are slid through a video chute or placed on a dedicated surface under a camera – motion detection greatly reduces video storage
- Identification routine focused on the tail effectively separates salmon species commonly found as trawl bycatch



Checks to validate plant reports of salmon bycatch

- Automated analyses provide times of detection and check-in and salmon species classification
- All salmon detections should be closely followed by a check-in event to validate sorting process
- Plant reports should match the number and species of salmon checked-in

Implementation considerations

- Camera views well lit and properly framed
- Training of sorting personnel on check-in process
- Different dominant species in delivery may require the detection model to be retrained
- Application saves video clips of each detection and check-in to allow human review if needed

Publications

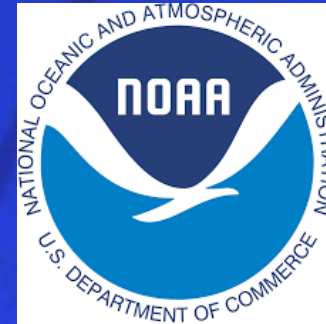
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Aknowledgements

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Volunteer
Commercial
Vessels and
Processing Plants



Alaska
Groundfish
Data Bank

