SMART BUOY TRAJECTORY PREDICTION AND ANOMALY DETECTION

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A major environmental problem of fishing is that of ghost fishing. Ghost fishing occurs when fishing gear that is abandoned or lost at sea drifts into open water, entangling and killing fish with it. The dead fish, along with the fishing gear sinks to the ground, where scavengers feed on the corpses of the fish. As the weight frees up, the fishing gear rises back up to the surface where it can entangle more fish, continuing this horrible cycle. Blue Ocean Gear, a California-based company, helps commercial fleets track fishing gear by embedding GPS sensors to buoys, which are floating objects that are used to identify the fishing gear they are attached to. The GPS transmissions from buoys provide real-time coordinates of the fishing gear, which can help reduce ghost fishing.

However, due to lifespan limitations of the sensors' batteries, smart buoys cannot transmit hourly GPS coordinates, which can pose a problem, as commercial fleets need more regular updates. For Blue Ocean Gear to provide these regular updates, the Clinic team at the UChicago Data Science Institute (DSI) developed predictive models to estimate locations of the fishing gear even at intervals when no transmissions are available.

The DSI team built four prediction models—-two deep learning models, one statistics based model, and one physics based models—to provide two impactful insights: predictions of buoy trajectory and detection of anomalous movements of the buoys. The DSI team implemented predictive physics based models by observing features such as speed and the direction of buoys and by simulating how ocean currents move floating particles in the water. The physics-based models had an excellent predicted trajectory with an average error of around 1 nautical mile from actual buoy locations (Fig 1). The deep learning neural networks did not work well because buoy movements are highly irregular, and so the model required an immense amount of data that Blue Ocean Gear did not have (Fig 2). Additionally, the DSI team was able to detect anomalous buoy movement based on statistics like the mean distance traveled in an hour by each buoy. Then, if a buoy moved more than the 75th percentile distance, it can be deemed as anomalous and potentially 'drifting'. With these two impactful insights, the DSI team helped Blue Ocean Gear track fishing gear in a timely manner, thereby incentivizing fishermen to buy the buoys and help reduce ghost fishing.

Fig 1: Physics Based Model Prediction

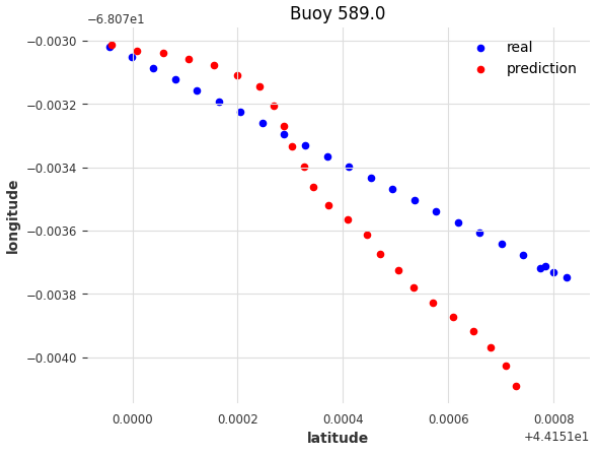

Fig 2: Deep Learning Model Prediction