Environmental Studies Program: Studies Development Plan | FY 2021–2022

Title	Imagery Acquisition to Support and Enhance BOEM's Deep Learning Projects
Administered by	Headquarters
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Conducting Organization(s)	TBD
Total BOEM Cost	TBD
Performance Period	FY 2021–2022
Final Report Due	TBD
Date Revised	April 10, 2020
PICOC Summary	
Problem	Acquiring annotated digital aerial imagery remains the primary technical barricade for BOEM study Automated Detection and Classification of Wildlife Targets in Digital Aerial Imagery (NT-19-04). Key imagery datasets (e.g. NYSERDA's offshore digital aerial surveys) stay unavailable to the public and Federal agencies and require post processing for re-use by advanced deep learning modeling. This project will acquire "private" annotated digital imagery datasets to support BOEM's digital imagery program.
Intervention	1) This study will obtain imagery and associated annotated datasets developed by The New York State Energy Research and Development Authority (NYSERDA) containing thousands of manually processed images collected over multiple years. NYSERDA Digital Aerial Surveys page Portal to NYSERDA data 2) This effort may also identify and acquire datasets in various regions across the nation.
Comparison	Train, improve, and expand existing deep learning algorithms to classify and detect objects in digital aerial imagery. Create new species-specific deep learning detectors based on newly acquired imagery.
Outcome	Updated taxa specific (seabirds, marine mammals, turtles) deep learning algorithms (each with associated error) for automating digital aerial survey operations.
Context	National

BOEM Information Need(s): BOEM's digital imagery library for deep learning modeling (c.f. BOEM study NT-19-04) is insufficient, containing a limited number of species photographed in a small geographic area. BOEM can augment this library by acquiring annotated digital imagery collected by studies conducted outside of BOEM. For example, NYSERDA conducted multi-year digital aerial surveys in the New York Bight and manually processed each image with species-specific annotation. These NYSERDA datasets contain imagery and associated annotation of seabirds, marine mammals, sea turtles, fish shoals, boat traffic, and various additional objects of interest to BOEM. Acquiring this critical dataset and potentially others across the nation to develop and train deep learning algorithms (NT-19-04) will advance BOEM's digital aerial survey program designed to improve accuracy in detecting and classifying objects in imagery collected by aircraft surveys.

Background: A recent partnership developed between BOEM, USGS, UC Berkeley formed around building species-specific deep learning algorithms to automate detection and classification of objects in imagery collected on digital aerial surveys. To date, the collaboration designed and created neural network seabird detectors, which are deep learning programs designed detect seabirds in imagery (Ke et al., 2020, in prep), and a new high-resolution camera system to collect targeted imagery. Expanded algorithm development requires large volumes of imagery for training. BOEM's library contains a limited species profile from Cape Cod, Massachusetts and the south-Atlantic Bight.

Convolutional neural networks (CNN) revolutionized object detection in digital imagery by providing systematic and quantitative means to measure and improve accuracy in detecting and classifying objects while reducing or eliminating tedious and time-consuming manual processing steps. CNNs are the successor of multilayer perceptrons a form of computer vision that nests within the domains of artificial intelligence and deep learning.

This project proposes to dovetail with three existing BOEM studies that are collecting and processing imagery: 1) Atlantic Marine Assessment Program for Protected Species digital aerial surveys (AMAPPS III B and C). This U.S. Fish and Wildlife Service component of AMAPPS aerial surveys will target species-specific and community hotspots identified by aerial and ship-based observations; 2) PC-17-01 Seabird and Marine Mammal Surveys Near Potential Renewable Energy Sites Offshore Central and Southern California; and 3) All of these newly acquired collections will train CNNs in development by BOEM study NT-19-04 - Automated Detection and Classification of Wildlife Targets in Digital Aerial Imagery.

Objectives: Our primary goals are to: 1) acquire manually processed and annotated imagery collected on marine wildlife surveys to expand and train deep learning algorithms in development by study NT-19-04; and 2) address objectives A-E set forth in the Executive Order on Maintaining American Leadership in Artificial Intelligence (Executive Order 13859; 2019-02-11).

Methods: The acquired imagery and associated annotated datasets will support development of CNNs to detect and classify seabird, cetaceans and sea turtles in development by ongoing

BOEM study NT-19-04 - Automated Detection and Classification of Wildlife Targets in Digital Aerial Imagery (Ke et al., 2020, in prep). Please refer to methods in NT-19-04.

Specific Research Question(s): Please refer to research questions in study NT-19-04.

Current Status: N/A

Publications Completed: N/A

Affiliated WWW Sites: N/A

References:

Ke T-W, Yu SX, Koneff MD, Fronczak DL, Fara LJ, Harrison TJ, Landolt KL, Lubinski BR, White TP, Yates SF, et al. In prep. A deep-learning approach to detection of marine birds from digital aerial imagery. PLOS One.