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PNNL-SA-166231

Deep Learning for Fish Identification from Sonar Data

CRADA 481

September 2021

Daniel Deng

Electric Power Research Institute, Inc.

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Abstract

To help solve the challenges of hydropower energy production related to the potential for eel injury and mortality from passage through hydropower turbines, we will develop a deep learning method for identifying migrating eels from imaging sonar. This project continues with a prior project conducted by the Pacific Northwest National Laboratory (PNNL) and the Electric Power Research Institute (EPRI) in FY2018-2019. The proposed method employs Convolution Neural Network (CNN), a powerful deep learning method for image classification, to distinguish between images of eels and non-eel moving objects. We propose to collect more laboratory data and add more existing field data to train a powerful deep learning model. In addition to eels and sticks as classified in previous studies, we will add images containing several non-eel fish species and macrophyte mats to the training data. A multi-class classification model will be developed to distinguish these objects. Object detection algorithm will be explored and developed to locate and identify multiple objects in each sonar frame. Motion analysis will be performed to track the movement of objects in sonar video clips. We will also improve the data conversion algorithm so that it can read in both DIDSON and ARIS (both are imaging sonars developed by Sound Metrics Corp) data files and convert them to images with comparably high resolution, regardless of the varying detection ranges in different environments. The developed algorithms will be packaged as a software with a graphic user interface. The software will be evaluated by external collaborators in the field. The developed framework can be generalized for automatic monitoring of fish passage and migration using other imaging sonars like ARIS and will benefit the design and operation of ecologically friendly hydroelectric projects. The developed wavelet and CNN model configuration parameters can potentially be transferred to lamprey detection in similar riverine environments.

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