A Novel Method for Automated Identification and Prediction of Invasive Species Growth Using Deep Learning

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Alien invasive species (AIS) cause habitat destruction, lower crop productivity, climate change, and significant losses in global biodiversity. Global efforts to control rapid expansion of AIS have cost $1.2 trillion. With current AIS response/detection, 42% of threatened/endangered species continue to be at risk. This project aims to automate the detection and prediction of AIS growth using machine-learning-based classification and geospatial prediction models. 2-Dimensional Convolutional Neural Networks (CNNs) were developed, employing transfer learning architectures, Generative Adversarial Networks, and hyper-parameter tuning algorithms. The 2D-CNNs can identify 114 high-impact AIS and native species with 93.52% accuracy. Furthermore, using 152,657,384 3-Dimensional data points from AIS scans, 3D-CNNs were developed. Utilizing the Stanford PointNet segmentation architecture to detect invasive genera in aquatic, heat, and ambient conditions at various growth stages, the 3D-CNNs achieved a 97.78% validation accuracy, encompassing over 75 detectable AIS. Additionally, geospatial LSTMs were created, using climatic and AIS clusters/predatory data to accurately predict suitable locations of spread for AIS in the future. A total of 840 geospatial heat projection maps were created with a negligible training loss of 0.0143. The 2D-CNNs and LSTMs were also deployed to a mobile app. Several blinded field studies were conducted to validate the model results, with an average top-5 accuracy of 91%. The creation of state-of-the-art multidimensional classification/prediction models allows expansion into areas like dynamic LIDAR/aerial detection of AIS growth. Overall, this research offers an inexpensive, scalable, and previously unreported solution to the global AIS crisis.

Awards Won:

Drexel University: Full tuition scholarship

Association for the Advancement of Artificial Intelligence: Honorable Mention

Association for the Advancement of Artificial Intelligence: AAAI Membership for the School Libraries of All 8 Winners (in-kind award / part of 1st-3rd prize and honorable mentions' prize)

U.S. Agency for International Development: Second Award Agriculture and Food Security