Rip Current Detection: An Orientation-aware Machine Learning Approach

Ecsedi, Boglarka (School: Istvan Bocskai Secondary Grammar School in Hajduboszormeny)

An ever-changing hazardous natural phenomenon – called a rip current – causes numerous fatal accidents all over the world. To address this problem, I use an image processing algorithm to detect and localize rip currents with a powerful near real-time deep neural network called Faster R-CNN (Ren, He, Girshick, & Sun, 2016). I specially assembled training and validation datasets of more than 1000 images of rip currents and used transfer learning to improve the baseline model with my custom data. The results showed an accuracy of 85.19% for an IoU threshold of 0.5 and an average precision (AP) of 0.371. To further improve the performance of the detection model, I developed an orientation-aware region proposal layer and incorporated it to the framework of Faster R-CNN. This layer predicts rotated bounding boxes in contrast to the traditional axis-aligned bounding boxes. I used the IoU parameter to evaluate the effectiveness of the orientation-aware region proposal layer. The findings revealed that the orientation-aware region proposal layer always outperforms the axis-aligned region proposal layer of the original Faster R-CNN. In one of the settings, I found a maximum efficiency improvement of 88. 33%, and an average efficiency improvement of 11.07%. The development resulted in detecting rip currents with a higher efficiency, allowing the algorithm to adapt to many angles, positions of the object and different perspectives. An automated rip current detection system using the improved detection algorithm is currently under development. This approach contributes to the deeper understanding of hazardous natural phenomena, to the early identification of the hazard, thus preventing accidents and to protecting the value of human life.

Awards Won:

IEEE Foundation: Third Place Award of $400

NC State College of Engineering: Alternates

Innopolis University : Full tuition scholarships for the Bachelor program in Computer Science