Integrating drone imaging with artificial intelligence to detect marine plastics

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Waste plastic makes up 80% of all marine debris from surface waters to deep-sea sediments. Plastic has been detected on shorelines of all the continents, with more plastic materials found near popular tourist destinations and densely populated areas (Lebreton *et al.*, 2017). The majority of plastic waste comes from China, Indonesia, the Philippines, Thailand and Vietnam. Hence, tackling the problem in these countries will have the largest impact on reducing the amount of marine plastic litter (Ryan *et al.*, 2019). Remote sensing has already shown to be very valuable for the capturing of information of marine plastic debris over vast areas along shorelines (Martin *et al.* 2018; Nakashima *et al.* 2011; Kataoka *et al.* 2018, Knaeps *et al.* 2020). For calibration and validation of satellite datasets, small drones are essential. Besides, machine learning has been shown to be useful in automated detection of beach litter (Martin *et al.*, 2018).

With the scope of the AIDMAP project, we address this issue in Vietnam through use of small drones and in-situ observations combined with Artificial intelligence (AI). In order to tune drone flight parameters like altitude, camera setting, resolution of the image and performance of designed AI model, we did a first drone campaign over a lake in Mol, Belgium and here we present results of macro-plastic detection in this campaign.

Region Based Convolutional Neural Network (RCNN) showed good performance for macro plastic detection comparing to other deep-learning algorithms (Fulton *et al.* 2019). We applied Detectron2 (Wu *et al.*, 2019), which is a faster RCNN, for 3 flight scenarios with RGB and multispectral cameras and various flight altitudes from 5 to 90 meter. Over 10000 images were obtained, where 80 percent was used for calibration and 20 percent for validation. As a result, considering Intersection of Unit (IOU) between trained model and predictions at 50, average precision obtained over 78 percent which is a promising step toward real time plastic detection.

References

- Martin, C., Parkes, S., Zhang, Q., Zhang, X., McCabe, M. F., & Duarte, C. M. (2018). Use of unmanned aerial vehicles for efficient beach litter monitoring. *Marine pollution bulletin*, *131*, 662-673.
- Lebreton, L. C., Van Der Zwet, J., Damsteeg, J. W., Slat, B., Andrady, A., & Reisser, J. (2017). River plastic emissions to the world's oceans. *Nature communications*, *8*, 15611.
- Ryan, P. G., Dilley, B. J., Ronconi, R. A., & Connan, M. (2019). Rapid increase in Asian bottles in the South Atlantic Ocean indicates major debris inputs from ships. *Proceedings of the National Academy of Sciences*, *116*(42), 20892-20897.
- Nakashima, E., Isobe, A., Magome, S., Kako, S. I., & Deki, N. (2011). Using aerial photography and in situ measurements to estimate the quantity of macro-litter on beaches. *Marine pollution bulletin*, *62*(4), 762-769.
- Kataoka, T., Murray, C. C., & Isobe, A. (2018). Quantification of marine macro-debris abundance around Vancouver Island, Canada, based on archived aerial photographs processed by projective transformation. *Marine pollution bulletin*, *132*, 44-51.
- Knaeps, E., Sterckx, S., Strackx, G., Mijnendonckx, J., Moshtaghi, M., Garaba, S. P., & Meire, D. (2020). Hyperspectral reflectance dataset of dry, wet and submerged marine litter. *Earth System Science Data Discussions*, 1-24.
- Fulton, M., Hong, J., Islam, M. J., & Sattar, J. (2019, May). Robotic detection of marine litter using deep visual detection models. In *2019 International Conference on Robotics and Automation (ICRA)* (pp. 5752-5758). IEEE.
- Wu, Y., Kirillov, A., Massa, F., Lo, W. Y., & Girshick, R. (2019). Detectron2.

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