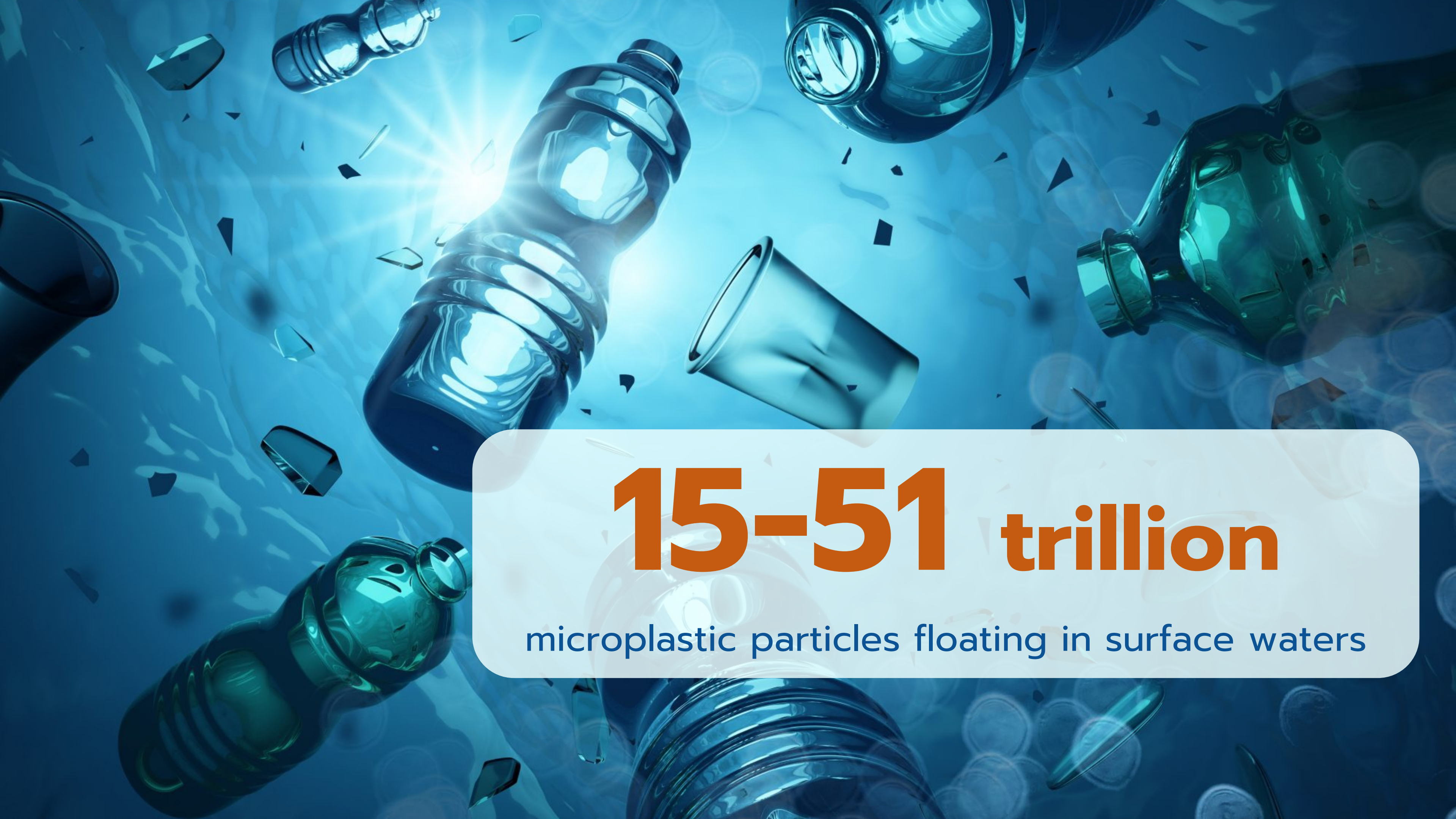

15-51 trillion
microplastic particles floating in surface waters

microplastics
already found its way back to us

physical and chemical damage to organ systems

marine life mistakenly feeding on plastics

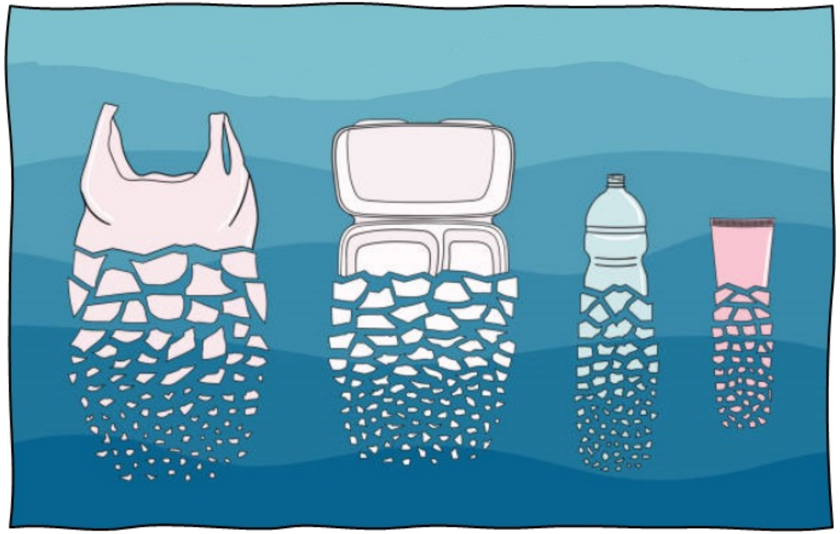

what can we do to detect
microplastics in water?

tiny plastic, big problem!

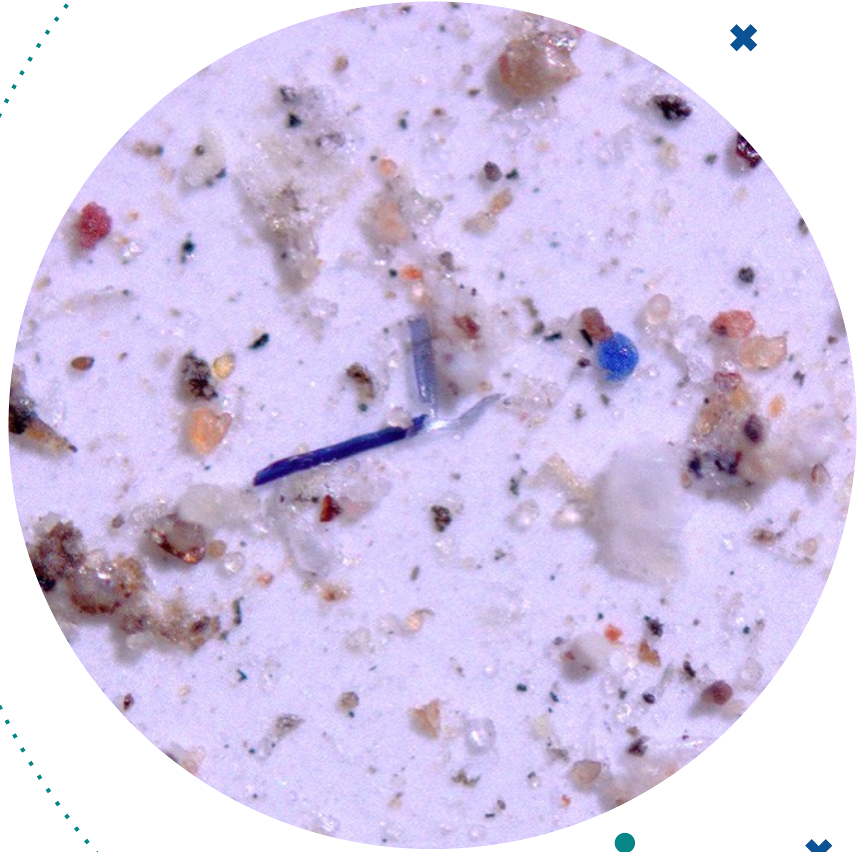
microplastics detection with deep learning

gaspar | jayme | nepomuceno | paderes
cpt 5

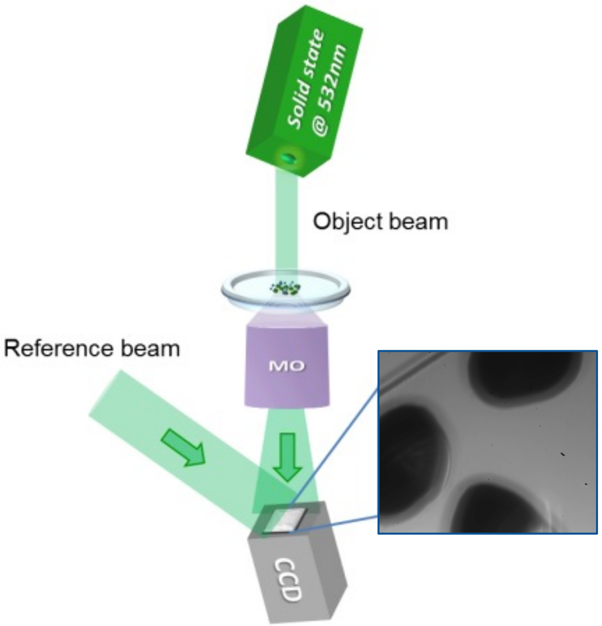
ml3 public presentation, 18 mar 2022



microplastic count indicate pollution levels



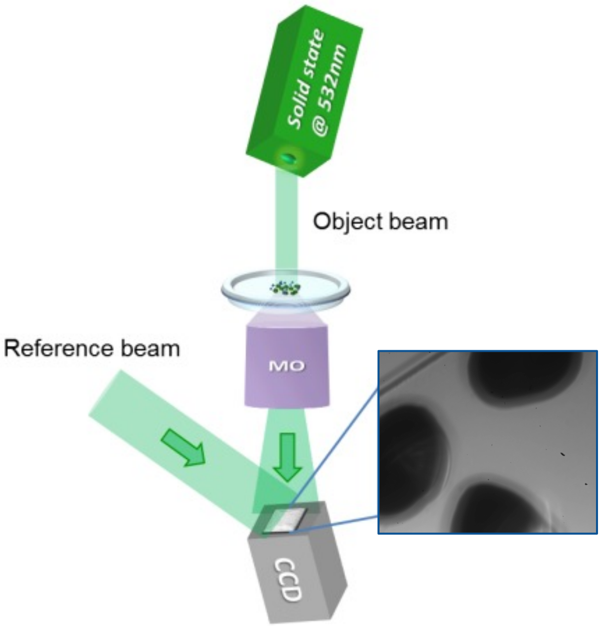
digital holographic microscopy



- ✓ non-invasive and non-contact
- ✓ suitable for underwater imaging where species are fragile
- ✓ offers more information on 3d shapes than 2d images
- ✓ compact and low-cost

Image source: Merola, F., Memmolo, P., Bianco, V. *et al.* Searching and identifying microplastics in marine environment by digital holography*. *Eur. Phys. J. Plus* **133,** 350 (2018). https://doi.org/10.1140/epjp/i2018-12190-y

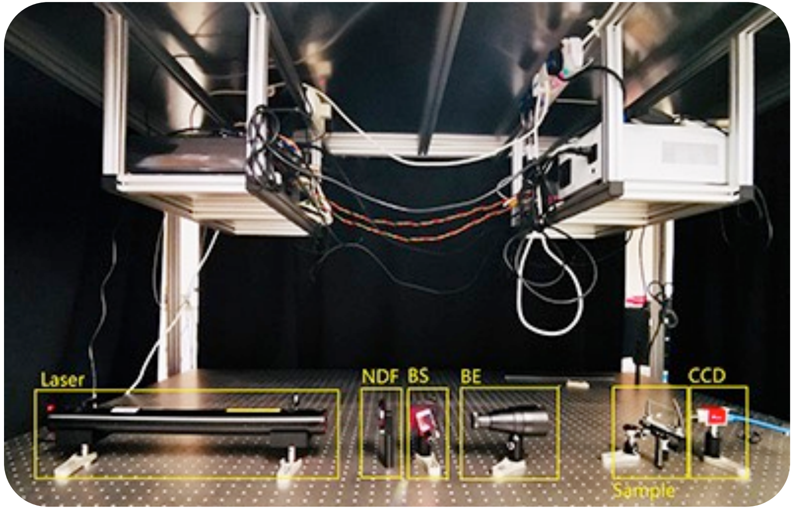
digital holographic microscopy



- × requires image pre-processing for feature extraction
- × classification and analysis dependent on SMEs

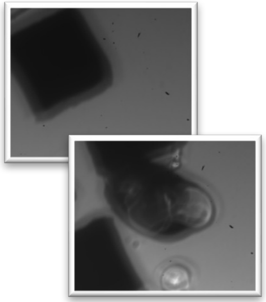
Image source: Merola, F., Memmolo, P., Bianco, V. *et al.* Searching and identifying microplastics in marine environment by digital holography*. *Eur. Phys. J. Plus* **133,** 350 (2018). https://doi.org/10.1140/epjp/i2018-12190-y

how can we use **deep learning** to enhance the **microplastics detection process?**



Source of image: Automatic Detection of Microplastics by Deep Learning Enabled Digital Holography (Zhu et. al., 2020)

methodology



data gathering

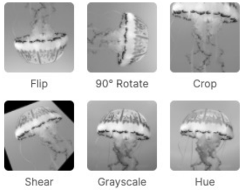
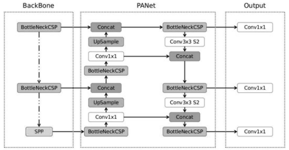
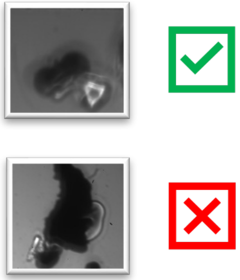


image annotation & augmentation

YOLOv5



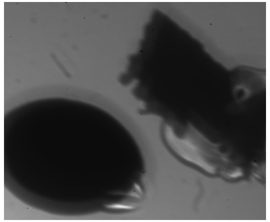
model building



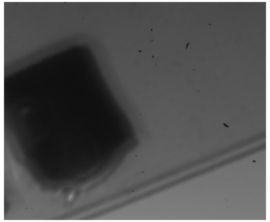
evaluation of results

data

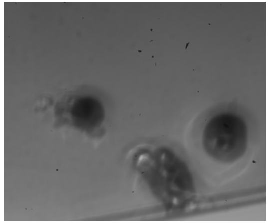
sample images



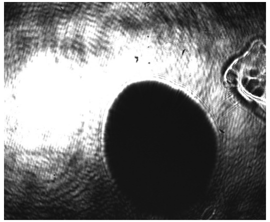
1 PE w/ dust



1 PHA



3 PS



1 LDPE

- 472 open-source hologram images
- includes various plastic types
- microplastic count varies from 0 to 5
- 40% of images include dust

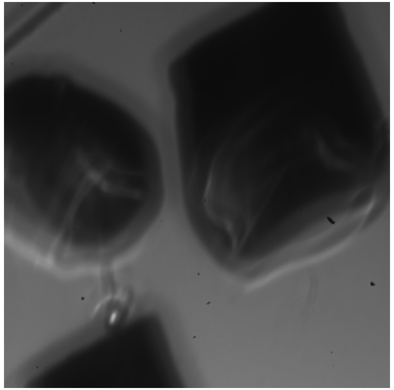
image annotation & augmentation

roboflow

unannotated

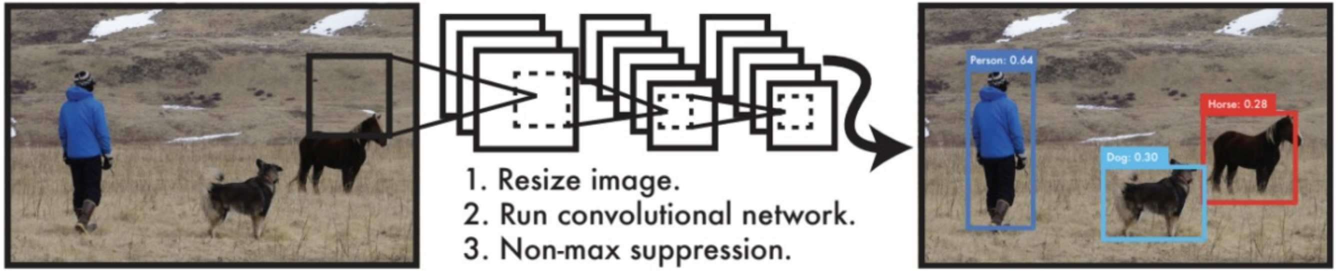
annotated

original image



augmented image

microplastics detection with YOLOv5



you only look once

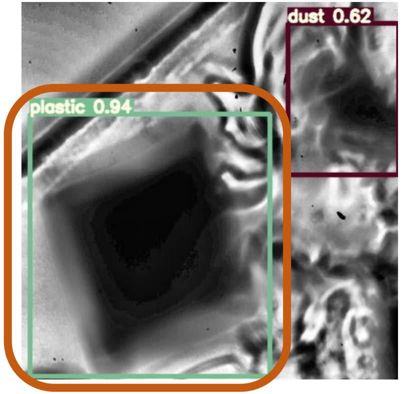
divides the image into regions and predicts bounding bo

1. resize image.
2. run convolutional network.
3. non-max suppression.

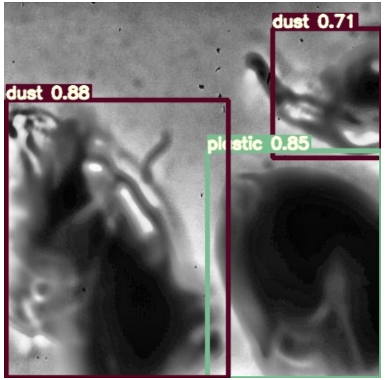
results

visual inspection

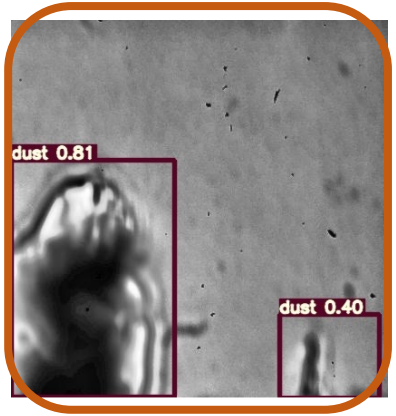
model	YOLOv5s
epochs	500
training time	1h 25m
mean average precision (mAP)	90.2%
inference time	0.008s



✓ 1 plastic, 1 dust



✓ 1 plastic, 2 dusts

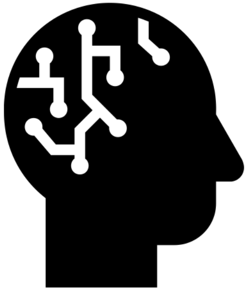


✓ 0 plastic, 2 dusts

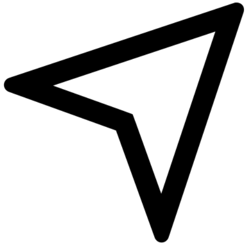
✓ 5 plastics

key takeaways

low-cost digital holographic microscopy is sufficient for microplastic classification tasks.



YOLOv5 performed well in automating feature extraction and classification of microplastics.



our implementation also **distinguished and located microplastics unlike previous studies.**

measuring microplastic levels will lead to appropriate actions and policies.

let's continue the conversation.

manu
gaspar

jazel
jayme

colleen
nepomuceno

mavel
paderes

join our meeting room after all the presentations at

https://bit.ly/microplastics-cpt5