Tandem segmentation-classification approach for localization of morphological predictors of *C. elegans* lifespan and movement

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*C. elegans* is an established model organism for studying genetic and drug effects on ageing, many of which are conserved in humans. It is also an important model for basic research, and *C. elegans* pathologies is a new emerging field. Here we develop a proof of principal convolutional neural network-based platform to segment *C. elegans* and extract features that might be useful for lifespan prediction. We use a dataset of 734 worms tracked throughout their lifespan and classify worms into long-lived and short-lived. We designed a WormNet convolutional neural network (CNN) to predict the worm lifespan class based on young adult images (day 1 – day 3 old adults) and showed that WormNet as well as InceptionV3 CNN can successfully classify lifespan. Based on U-Net architecture we develop HydraNet CNNs which allows accurately segment worms into anterior, mid-body and posterior parts. We combine HydraNet segmentation, WormNet prediction and use the class activation map approach to determine the segments most important for lifespan classification. Such a tandem segmentation-classification approach shows posterior part of the worm might be more important for classifying long-lived worms. Our approach can be useful for the acceleration of anti-ageing drug discovery and for studying *C. elegans* pathologies.