**Are the robots coming for our jobs? Comparing AI image segmentation with geometry-based objective functions for delineating bankfull channels**

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# ABSTRACT

Bankfull channel delineation is a necessary and time-consuming first step for many river analyses. Increasing availability of widespread and repeated lidar data, imagery and GIS data presents an opportunity to undertake studies of river form and functioning at larger scales. Automating channel extent delineation will greatly improve the efficiency of such analyses.

We developed and compared three methods for identifying the bankfull extents of river channels from 1 m resolution lidar DEMs, testing them on a lowland stream in southeastern Melbourne. The first was a cross-sectional slope-threshold detection algorithm. The second was an objective-function method called HydXS which identified the water level in each cross-section at which hydraulic depth is maximised and water starts to spread across the floodplain. The third method used a neural network (a type of artificial intelligence) to segment lidar-based images into river and non-river pixels.

The geometry-based objective method HydXS generally performed best (precision 0.87, recall 0.80), although all methods performed well compared to an expert annotator. The slope-threshold method tended to overpredict and the neural network tended to underpredict, while HydXS had more balanced errors. The results suggest that a method based on a strong conceptual model of channel geometry may be superior to an algorithm which can learn to recognise two-dimensional patterns in an image without any theoretical underpinning. However, the neural network performed better in complex channels with inset floodplains, where the geometry assumptions of the other two methods broke down. This suggests that given enough training data, a neural network can learn to replicate the decisions of a geomorphologist in ambiguous classification problems.

Choosing an appropriate method requires an understanding of channel types and forms being considered and the theoretical underpinnings of different methods as well as availability of training and validation data. Our promising deep learning results are worthy of further investigation in diverse channel types, although the resources and geomorphic expertise required to develop training data should not be underestimated. Finally, the overall outperformance of HydXS shows there is still a role for well-conceptualised geometry-based methods in bankfull extent delineation.