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Characterising the roughness properties of alluvial river banks using terrestrial laser scanning.

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Form roughness generated by the irregular topography of alluvial river banks can be a major component of the total flow resistance and bank shear stress with important consequences for modelling stage-discharge relationships and bank erosion. Current models of form roughness assume that the topographic features of a bank can be approximated by a series of Gaussian-shaped roughness elements parameterised in terms of a protrusion height H, a streamwise length scale σ (equivalent to the standard deviation of a Gaussian probability distribution) and a spacing λ between crests. It is further assumed that bank roughness parameters do not vary over time as the bank erodes. Empirical data supporting these assumptions are, however, limited and further work is needed to fully assess the roughness properties of alluvial banks and the sensitivity of bank roughness parameters to changes in bank geometry generated by bank erosion and retreat. In this study, the technique of terrestrial laser scanning is used to conduct high resolution surveys of actively eroding alluvial river banks on two rivers in the English Midlands. The data are used to derive digital elevation models of river bank microtopography which are subjected to a suite of visualisation and analytical techniques to determine the roughness properties of the banks at different scales and how these properties vary over time as bank erosion modifies the local topography. The findings are discussed in relation to modelling strategies for predicting flow resistance and bank shear stresses in alluvial rivers.