Investigation of friction coefficients for the 2D modeling of forest areas along rivers

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In numerical 2D modeling of floodplain forest areas the trees are normally not considered as obstacles e.g. as holes in the model, because of the complexity of the grid, which leads to high computational load. For modelling such areas high roughness factors are utilized to consider the reduction of the flow area. The roughness factors are normally estimated based on known empirical values. There are few studies to investigate the influence of the tree geometry and flow conditions on the roughness estimation for such areas.

To investigate the influence of above-mentioned parameters on the determination of the roughness, different test configurations were investigated in a hybrid approach. A physical model as an experimental flume in the hydraulic engineering laboratory of the Eastern Switzerland University of Applied Sciences (Figure 1) and 2D modeling with BASEMENTv3 were combined as part of a bachelor thesis. Totally 48 tests with four different discharges and slopes and three different tree arrangements were studied (Figure 2). The trees in the physical model were considered as rigid bars made of aluminum. At beginning tests were carried out without installed aluminum bars to determine the roughness of approach and downstream slabs in the flume. These tests were then simulated in the numerical 2D model. As the roughness of the slabs were known, the direct influence of the trees on the roughness could then be determined.

Figure 2: The linear test setup of the trees in the experimental flume. The ground of the experimental flume was covered with exposed aggregate concrete slab and PVC slab and the walls were made of glass.

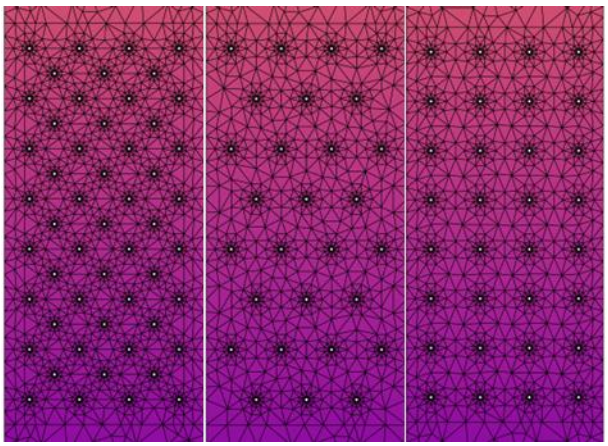

Figure 2: The mesh of the tree arrangements used for the simulation with trees as obstacle: compacted on the left, staggered in the middle, linear on the right.

The hybrid tests showed that the appropriate roughness factor in 2D model for simulation of floodplain forests areas depends on the density of the standing trees but also the arrangement of the trees as well as the approach flow conditions. However, the tests show the influence of the approach flow can be neglected in case of the higher density of the trees.