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Gabcikovo dam and Liptovska Mara dam – statistical analysis of measurement data

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Introduction: Water level in the observation wells is measured regularly and one of the reasons is evaluation of the safety of the water constructions. In this paper we are exploring the reliability of the measuring devices that are responsible for evaluation of the safety of the two largest and the most important dams in Slovakia. We test ability of selected statistical methods to detect early inaccuracies of measuring devices and thus improve the evaluation of the safety of the water constructions. As a follow-up study, we used the time series model (Neural network) to predict water levels in the observation wells that were considered to be without defects. Neural Network is also able to show dynamics of the filtration stability of the observational well.
Methods: On the Liptovska Mara dam weekly data was used as a monitoring tool. On the Gabcikovo dam five minute time series of the measurements of the water level in observation wells around the right lock chamber were used. Data from the measuring devices of the dams were explored with boxplots, correlations, neural network, etc. The mentioned statistical tools analyze time series and detect the errors that measuring devices make when generating data and can be used to predict errors even in real time. In the second step, agreement between predicted data from neural network and measured data in the real time was evaluated. We used grid search for finding the optimal number of neurons and then predicted errors by using this model. The ability of the neural network in evaluation of the sealing of the dilatation joints on the filtration stability in the years 2009 – 2011 is presented.
Results: From the 18 selected measuring devices on the Liptovska Mara dam there are only 3 devices which can be considered as reliable. On the Gabcikovo dam, 8 of 9 measuring devices (observation wells around right lock chamber) were considered as a reliable. There was very good agreement between the predicted and measured data at the Liptovska Mara dam using the neural network model. At the Gabcikovo dam the dynamics of the filtration stability around the right lock chamber is presented.
Conclusions: The significance of the neural network is the ability to predict the water level in the observation wells at a dam site and total filtration stability of the dams by using the real measures in the time series. This is a desirable step to ensure adequate safety with the possibility to solve potential defects earlier.