AUTOMATIC OPTIMIZATION OF A FLOOD DEFENCE MEASURE WITH ELEMENTAL PARAMETERIZATION

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The Rhine is one of the major rivers in central Europe. 50 million people in seven nations inhabit its catchment area. These nations cooperate for a plan to reduce the impact of the water quality and quantity of the river to the adjacent areas. One part of this plan intends to reduce the height of the flood waves. To achieve this it is planned to move dikes to give some of the former natural floodplains back to the river or at least leave natural floodplains uninhabited. A Rhine dike with a sheet pile wall therefore protects the settlement from inundation. But the floodplain impacts the groundwater level on both sides of a dike, which creates a threat to houses, especially their basements. To insure that groundwater levels do not rise higher because of the dike-construction the depth and its alignment have to be optimized. The use of automatic optimization in water resources or flood management is at a starting point. HOMANN (2004) uses a system for the optimization of groundwater pumping with good results. VAN LINN (2004) describes a project to find the optimum solution for groundwater infiltration in the vicinity of open pit mining areas. It seems to be obvious to benchmark this kind of automatic optimization for other applications, too.

An automatic optimization strategy is invented to find the optimum solution for a dike with a sheet pile wall as a flood defence measure. A groundwater model of such a region yields the groundwater levels for a dike configuration. To figure out a good way to optimize the dike in general a good approach for the parameterization of the wall's depth and the location of the dike are made in an arbitrary test case. A new parameterization strategy named *Elemental Parameterization* (EP) is invented, which needs less parameters than the strategy used by VAN LINN & KÖNGETER (2005) to describe the necessary geometry. A 2.5-dimensional two-layer model accounts for the hydraulic impact of the varying sheet pile wall according to the parameter sets. In the framework of this investigation steady state boundary conditions are chosen and the evaluation of inundation or groundwater levels is restricted to a fictive settlement area. To automate the optimization process the Derandomized Evolutionary Strategy (DES) is chosen as algorithm. The DES is an algorithm that belongs to the group of evolutionary strategies. HANSEN & OSTERMEIER (2001) invented this technique that tries to constrain random mutation and thus accelerates the search for the global optimum.

The optimization system consists of several modules building a circle of input, processing and output (Fig. 1). Starting object-parameters are (pre-) processed to obtain accordant input data sets, which describe and run the changing numerical model. Model results are then (post-) processed to give an evaluation of the input parameters. If termination conditions are not reached this evaluation leads to a new appointment of parameters by the algorithm, which provide the input for the next optimization circle.

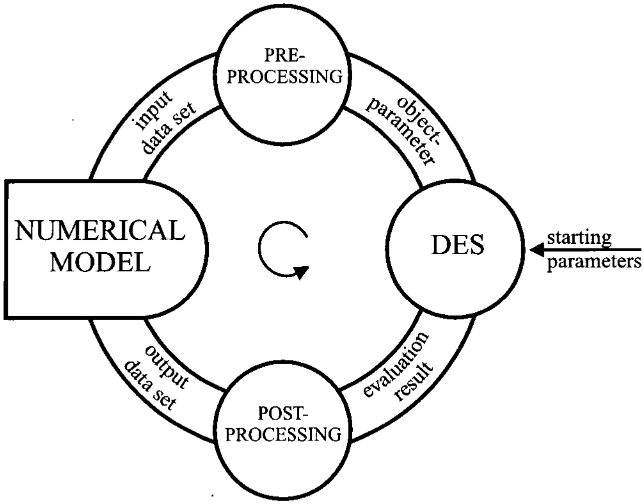

Fig. 1 Module scheme of the optimization system

Before being applied to a real site unsteady state investigations and a more comprehensive evaluation scheme will be considered in future work. The evaluation scheme should include real economy considerations as the monetary evaluation of construction cost of the flood defence measure and of loss or damages. Taking into account the probability of a design high water a complete risk assessment could be included. To improve performance detailed investigations of the different parameterization strategies will be accomplished.

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