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ISOGEOMETRIC BOUNDARY ELEMENT ANALYSIS OF UNDERGROUND EXCAVATIONS

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In isogeometric analysis the same basis functions as in Computer Aided Design (CAD) are used for the analysis. These are Non-Uniform Rational B-Splines or NURBS. The advantage of using these functions is that geometry information can be taken directly from CAD data with the possibility of avoiding mesh generation. In addition, the use of these functions for the approximation of the unknowns offers greater flexibility in the refinement procedures and also result in a reduction of problem size. The authors have published previously on the subject of isogeometric BEM (IGABEM) and have shown that isogeometric procedures can also be used for the evaluation of volume integrals that arise when non-linear inclusions are considered [1, 2].

The aim of the paper is to show, on a practical example in geomechanics, the advantages of the IGABEM. The example includes 2-D and 3-D simulations of a cavern of a hydropower station. It will be shown how geometries are discretized and how smooth they can be defined in 2-D and 3-D with only a few parameters. The resulting equation system with the IGABEM has much fewer unknowns than the conventional BEM approach and an excellent solution quality is obtained.

The excavation of the cavern is performed in stratified geological formations. In the rock mass weak material layers are embedded which show pronounced non-linear material behaviour. In the numerical model geological layers are considered as inclusions. The volume of the inclusion is defined by bounding curves in 2-D and bounding surfaces in 3-D with a linear interpolation between them. The inclusions can have material properties different to the infinite domain and also can exhibit non-linear material behaviour. A comparison of the isogeometric analysis is made to results of conventional BEM/FEM approaches.

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