Damage Identification and Uncertainties in Coupled Non-Linear Thermo-Hydro-Mechanical Problems Applied for Masonry Dams

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Abstract

Many masonry dams were built at the beginning of twentieth century e.g. Fürwigge Dam and Ennepe Dam in Germany, Theodore Roosevelt Dam in Arizona USA. After more than one hundred years in use, material properties of the dam body were changed because of ageing, weathering and chemical effects. Consequently, there could appear some zones or cracks, where the properties of the material (e.g. stiffness, permeability and thermal conductivity) have a big change. It is useful and economic that the damage zone can be identified based on the present measurement data, which are obtained via the devices installed in the dam permanently. Masonry dams have to bear two major loads: water pressure and self-weight. Besides that, the temperature inside the dam structure varies according to the water levels and air temperatures. This causes stresses within the structure and deformation of the dam. These behaviours have been monitored in terms of temporal displacement, water pressure, and temperature. According to the measurement in Bettzieche (2004), the effect of temperature on the deformation of the masonry dam is significant. Therefore, thermal conduction, water transport and force -deformation relations have to be considered when performing numerical simulations of the dam, see Nguyen-Tuan et al. (2015). In this paper, we introduce a method to identify the damage zone by means of back analysis based on the series of measurement data solving an inverse problem iteratively by the Multilevel Coordinate Search method, see Huyer and Neumaier (1999). The uncertainties of the measurements and the uncertainties of the damage zone are considered.

References

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