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Random walk approach for dispersive transport in pipe networks

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After heavy pluvial events in urban areas the available drainage system may be undersized at peak flows (Fuchs, 2013). Consequently, rainwater in the pipe network is likely to spill out through manholes. The presence of hazardous contaminants in the pipe drainage system represents a potential risk to humans especially when the contaminated drainage water reaches the land surface. Real-time forecasting of contaminants in the drainage system needs a quick calculation. Numerical models to predict the fate of contaminants are usually based on finite volume methods. Those are not applicable here because of their volume averaging elements. Thus, a more efficient method is preferable, which is independent from spatial discretization.

In the present study, a particle-based method is chosen to calculate transport paths and spatial distribution of contaminants within a pipe network. A random walk method for particles in turbulent flow in partially filled pipes has been developed. Different approaches for in-pipe-mixing and node-mixing with respect to the geometry in a drainage network are shown. A comparison of dispersive behavior and calculation time is given to find the fastest model. The HYSTEM-EXTRAN (itwh, 2002) model is used to provide hydrodynamic conditions in the pipe network according to surface runoff scenarios in order to real-time predict contaminant transport in an urban pipe network system. The newly developed particle-based model will later be coupled to the subsurface flow model OpenGeoSys (Kolditz et al., 2012).

References:

Fuchs, L. (2013). Gefährdungsanalyse zur Überflutungsvorsorge kommunaler Entwässerungssysteme. Sanierung und Anpassung von Entwässerungssystemen–Alternde Infrastruktur und Klimawandel, Österreichischer Wasser- und Abfallwirtschaftsverband, Wien, ISBN, 978-3.

itwh (2002). Modellbeschreibung, Institut für technisch-wissenschaftliche Hydrologie GmbH, Hannover.

Kolditz, O., Bauer, S. et al. (2012). OpenGeoSys: an open source initiative for numerical simulation of thermo-hydro-mechanical/chemical (THM/C) processes in porous media. Env. Earth Sci. 67(2):589-599.