



Numerical methods for water flow and contaminant transport

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Motivation and objective

Numerical models of water flow and contaminant transport are essential tools for modern environmental and civil engineers. While many commercial and public domain computer codes are available for this purpose, their successful application requires a thorough knowledge of the underlying numerical techniques, with their strengths and weaknesses. This course focuses on numerical solution of partial differential equations, which describe various types of flow and transport processes in both surface and subsurface water bodies.

Scope

The course is divided into 3 parts (3 x 5 hours). Each part prepared and presented by one of the lecturers:

1. Introduction and solution of the transport equation (lecturer: prof. R. Szymkiewicz)
 - classification of partial differential equations
 - basic spatial discretization schemes: finite differences, finite elements
 - overview of time discretization schemes: explicit and implicit methods
 - consistency, stability and convergence of numerical solution
 - accuracy of the solution: numerical diffusion and dispersion errors
 - all topics will be discussed on the example of one-dimensional advection-diffusion equation
2. Surface water flow (lecturer: dr hab. M. Szydłowski)
 - one-dimensional open channel flow (Saint-Venant equations): solution using finite difference method
 - two-dimensional shallow water equations: solution using finite volume method ???
3. Subsurface flow (lecturer: dr hab. A. Szymkiewicz)



- three dimensional saturated groundwater flow: solution using block-centered finite difference / finite volume method, types of boundary conditions, modeling wells and drains
- one-dimensional unsaturated flow (Richards equation): solution using finite difference and finite element schemes, treatment of nonlinearity, implementation of boundary conditions

Terminy wykładów					
Data	Dzień tygodnia	Godzina	Sala	Prowadzący	Tytuł zajęć
2015-06-15	Pn	9.15-12.00	Hydro 106	prof. dr hab. inż. Romuald Szymkiewicz (WILiŚ)	Numerical methods for water flow and contaminant transport - module 1: introduction and solution of the transport equation
2015-06-16	Wt	9.15-11.00	Hydro 106	prof. dr hab. inż. Romuald Szymkiewicz (WILiŚ)	Numerical methods for water flow and contaminant transport - module 1: introduction and solution of the transport equation
2015-06-17	Śr	9.15-12.00	Hydro 106	dr hab. inż. Michał Szydłowski (WILiŚ)	Numerical methods for water flow and contaminant transport - module 2: surface water flow
2015-06-18	Cz	8.30-10.00	Hydro 106	dr hab. inż. Michał Szydłowski (WILiŚ)	Numerical methods for water flow and contaminant transport - module 2: surface water flow
2015-06-19	Pt	9.15-14.00	Hydro 106	dr hab. inż. Adam Szymkiewicz (WILiŚ)	Numerical methods for water flow and contaminant transport - module 3: subsurface flow