University of Natural Resources and Life Sciences, Vienna
Department of Water, Atmosphere and Environment

Computational Methods in Hydrodynamics for Water Resources Management

Daniel Wildt

SWARM Summer School
15 – 26 November 2021

draft: 7th September 2021

Outline I

University of Natural Resources and Life Sciences, Vienna
Department of Water, Atmosphere and Environment

Concept and Intended Learning Outcomes

- Summer School
- Training for teaching staff

Date and venue

Program

- Week 1: Summer School and training of teaching staff
- Week 2: Summer School

Teaching Materials

Concept and Intended Learning Outcomes: Summer School

University of Natural Resources and Life Sciences, Vienna
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The attendees of the summer school will acquire the following knowledge and abilities:

- mathematical formulation of hydrodynamic problems using differential equations
- discretization of differential equations for the numerical solution
- implementation of models for the numerical solution of simple hydrodynamic problems
- use of open-source code for the solution of more complex computational fluid dynamics models

Concept and Intended Learning Outcomes: Training for teaching staff

University of Natural Resources and Life Sciences, Vienna
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Training of teaching staff is held simultaneously within the first week of the summer school. Lecturers will be presented with illustrative ways of presenting highly technical topics such as numerical hydrodynamics to a group of students. In addition they will be provided with relevant teaching materials including Excel Worksheets for the numerical solution of basic hydrodynamic problems.
In addition to innovative teaching methods the training for teaching staff will cover the R-package R/Exams (Zeileis et al., 2014). The package enables an efficient and flexible way of E-learning exams as well as exams on paper.

Date and venue

University of Natural Resources and Life Sciences, Vienna
Department of Water, Atmosphere and Environment

The summer school as well as the training for teaching staff are planned to be held at University of Natural Resources and Life Sciences, Vienna (Austria). Due to travel restrictions depending of the current pandemic situation a change to an online format might be necessary.
The summer school and the training for teaching staff is planned to be held on the following dates:

- Week 1 (summer school and training for teaching staff): 15th November 2021 until 19th November
- Week 2 (summer school): 22nd November 2021 until 26th November 2021

Program: Week 1: Summer School and training of teaching staff

University of Natural Resources and Life Sciences, Vienna
Department of Water, Atmosphere and Environment

Monday, 15th November 2021

- morning: Welcome session, presentation of University, Department and Institute (Michael Tritthart and Daniel Wildt)
- afternoon: Unsteady problems in hydrodynamics (Daniel Wildt)
  - Balancing of the water levels of two tanks connected through a pipe
  - Heat and mass transport in free-surface waterbodies

Tuesday, 16th November 2021

- morning: Ordinary Differential Equations: Water surface estimation in non-uniform flow (Daniel Wildt)
- afternoon summer school: Self-organised learning
- afternoon training for teaching staff: Introduction to the R-package R/Exams

Program: Week 1: Summer School and training of teaching staff

University of Natural Resources and Life Sciences, Vienna
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Wednesday, 17th November 2021

- morning: Theory on computer-based river modelling (Michael Tritthart)
- afternoon: Partial Differential Equations: Development of a flood wave (Daniel Wildt)

Thursday, 18th November 2021

- morning (Daniel Wildt):
  - Set-up of a 1D model of a channel system using the Excel worksheets UNDA
  - Error estimation in physical lab experiments
- afternoon: Hydraulic lab tour

Program: Week 1: Summer School and training of teaching staff

University of Natural Resources and Life Sciences, Vienna
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Friday, 19th November 2021

- morning: Unsteady pipe flow (hydraulic surge; Daniel Wildt)
- afternoon: Excursion and get-together with the IAHR Young Professional Network Vienna (Daniel Wildt)

Program: Week 2: Summer School

University of Natural Resources and Life Sciences, Vienna
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Monday, 22nd November 2021

- morning: Introduction to Linux operating systems and the Unix command line (Michael Tritthart)
- afternoon: Self-organised learning

Tuesday, 23rd November 2021

- morning: Introduction to OpenFOAM (Daniel Wildt)
- afternoon: Self-organised learning

Program: Week 2: Summer School

University of Natural Resources and Life Sciences, Vienna
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Wednesday, 24th November 2021

- morning: *"An Introduction to OpenFOAM: A User View"* presentation by Prof. Hrojve Jasak at the University of Ghent (May 2016) Part I
- afternoon: Group project assignment and work on group projects

Thursday, 25th November 2021

- morning: *"An Introduction to OpenFOAM: A User View"* presentation by Prof. Hrojve Jasak at the University of Ghent (May 2016) Part II
- afternoon: Group project work

Friday, 26th November 2021

- morning: Summary / Project Presentation
- afternoon: Recap of the summer school and feedback meeting

Teaching Materials:

University of Natural Resources and Life Sciences, Vienna
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Participants will be supplied with various teaching materials in digital form:

- handouts
- MS Excel Worksheets
- literature list and weblinks
- OpenFOAM test cases

The materials will be shared with the participants via an E-Learning platform (e. g. Moodle).

Literature I

University of Natural Resources and Life Sciences, Vienna
Department of Water, Atmosphere and Environment

Zeileis, A., N. Umlauf and F. Leisch (2014). 'Flexible Generation of E-Learning Exams in R: Moodle Quizzes, OLAT Assessments, and Beyond'. In: *Journal of Statistical Software* 58 (1). DOI: 10.18637/jss.v058.i01.