INTERNSHIP

Subject	Programming a (graphical) user interface for WIHA, a state-of-the-art mild-slope wave model for wave penetration into harbours
Date	15 August 2017
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Start of the project	Autumn 2017
Duration	8-12 weeks
Location	Witteveen+Bos Consulting Engineers, Deventer
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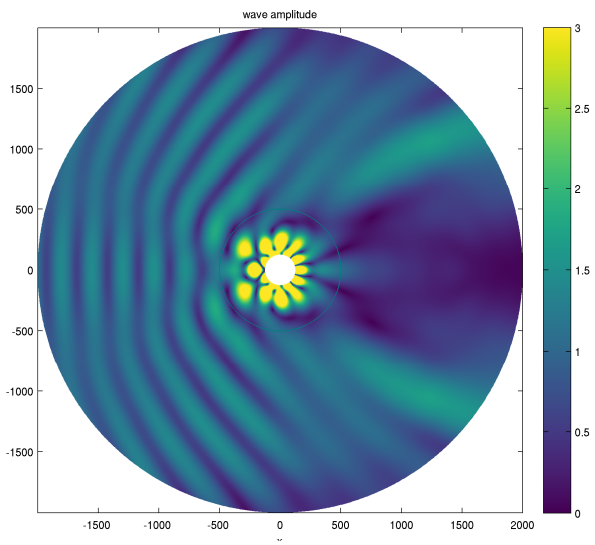
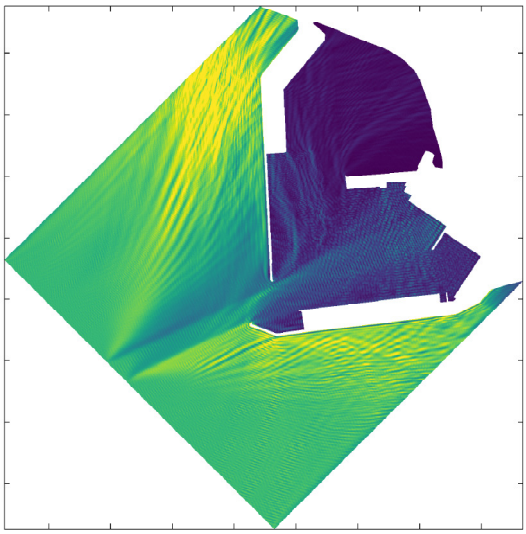
Motivation and objectives

Witteveen+Bos is a leading consultancy company, with many projects involving harbour and coastal developments. Within these projects, wave data is essential for design. Typically, measured wave data is only available at deeper water, and transformation is needed to the site location and to inside the harbour. Witteveen+Bos uses numerical models for this transformation, such as the spectral wave model SWAN, the non-hydrostatical wave model SWASH or the mild-slope model PHAROS. These models have either long simulation times or do not include the important process of diffraction around the harbour structures or around the entrance channel.

Therefore, Witteveen+Bos has recently developed the numerical model WIHA (Waves In Harbours), a mild-slope model capable of simulating refraction, reflection and diffraction of waves in and near harbours. The model's distinguishing features are its inclusion of modern versions of the mild-slope equation, reduced numerical dispersion and weakly-reflective boundary conditions of high order.





For the use in projects the model needs to be further validated with lab experiments and field data. Furthermore, the user interaction needs to be improved for the ease of use in projects. The model has to be extended with important processes like wave breaking and bottom friction.

Therefore we are looking for a student who could develop scripts and processes to improve the user interaction in an internship project. And subsequently, preferably the same, student can start validating the model with different test cases based on field data, lab experiments and analytical solutions in a MSc graduation project. As we are still developing the model it would be beneficial to to incorporate these standardized validation tests into a test bench – which automatically generates performance results for the model.

Model description

The mild-slope equation – in the versions of Berkhoff (1972,1976) and Porter (2003) – has been implemented in a finite element program. The model is linear and two-dimensional, including the processes of diffraction, refraction, (partial) reflection and shoaling. By combining results for different wave directions and frequencies, directional spreading and frequency spectra can be taken into account.

The mild-slope model computes the transformation of an incoming single-frequency and unidirectional wave by bathymetry and geometry (of harbours and coastlines). The land boundaries are specified through their reflection coefficient, and incoming-wave boundaries are weakly reflective.

It is a phase-resolving model, implying that it provides the full wave pattern (surface elevation), e.g. inside a harbour. At each node of the finite element grid a complex-valued number contains the local wave amplitude and phase. Typically, a grid consists of triangular shaped elements, ranging from several thousands to several millions. For each combination of incoming-wave frequency and direction, a linear system of equations is constructed and solved. Solutions for one frequency and a range of wave directions are obtained within one minute (for about one million nodes).

Approach

The project can be sub-divided as follows:

1 Programming the (graphical) user interface of the model (this project);
2 Programming Matlab routines to use Google Earth as input (separate internship project);
3 Validation of WIHA (MSc graduation project):
   - Model test cases, both field data, lab experiments and analytical solutions will be provided.
   - Setting up a test bench, a batch of standardized test cases which can be run again when the model is updated. The test bench should give automatic results on model performances.

Required skills:

- Matlab programming
- General knowledge on short wave propagation (wave theory, wave spectrum)

Graduation at Witteveen+Bos

Witteveen+Bos is keen to offer talented students an opportunity to gain first-hand experience of working at an engineering firm. Ways in which this can be done include an internship or a final project. Each year dozens of students opt for a final project or internship at Witteveen+Bos. This gives them an insight into our organisation, into how we work and, last but not least, into their own career opportunities. We provide an exciting setting for an internship or final project, one that will challenge you as a student to apply your knowledge and skills. We also provide solid supervision.

Working at Witteveen+Bos means working for a best-in-class engineering firm. Our 1100-plus professionals deliver contributions to challenging and innovative projects in the Netherlands and other countries.
Our enthusiastic and enterprising employees work alongside each other in multidisciplinary teams. Our culture is best described as open, informal and committed. Besides working on complex projects our employees work on their personal development. This gives them an opportunity to shape their own careers.