Shallow Water Waves GUI

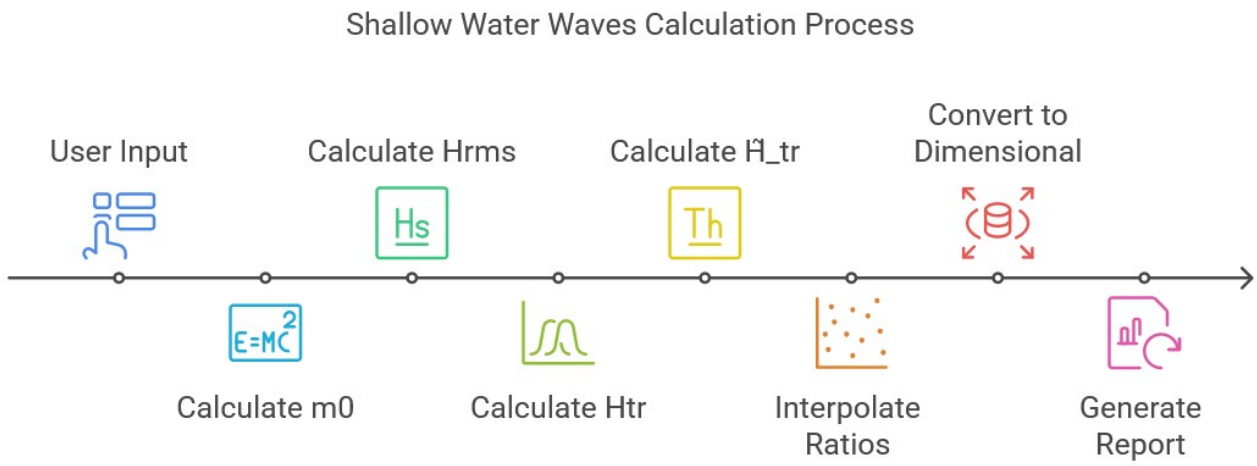
Overview

This program computes local shallow-foreshore wave-height distribution parameters using a model based on the Composed Weibull distribution as described in:

- **"Shallow foreshore wave height statistics"** by H. Groenendijk, Master's Thesis, Delft University of Technology, 1998.

The program is implemented as a Windows GUI application using only the native Win32 API and standard C++ (with OpenMP directives for parallelism). It allows the user to input three key parameters:

1. **Hm0 (in meters)** - The local significant spectral wave height.
2. **d (in meters)** - The local water depth.
3. **Beach slope (1:m)** - The beach slope expressed as “1:m”. (For example, enter 20 for a slope of 1/20 = 0.05.)



Computations

Based on these inputs, the program computes:

- **Free-surface variance**:

$$m_0 = (H_{m0} / 4)^2$$

- **Mean square wave height**:

$$H_{rms} = (3.00 + 3.50 * sqrt(m_0) / d) * sqrt(m_0)$$

(Empirical coefficients have been slightly increased relative to the original deep-water formula to better capture the shallow-water distribution of extreme waves.)

- **Dimensional transitional wave height**:

$$H_{tr} = (0.35 + 5.8 * (1/m)) * d.$$

(For example, if m = 20 then tan(alpha) = 1/20 = 0.05 and

$$H_{tr} = (0.35 + 5.8 * 0.05) * d = 0.64 * d. \text{ ‘ ‘ ‘ })$$

- **Dimensionless transitional parameter**:

$$\tilde{H}_{tr} = H_{tr} / H_{rms}.$$

If $\tilde{H}_{tr}$ is above 3.5, then it is set to 3.5 and `Htr` is recalculated as Htr = 3.5 * Hrms.

Using a 70-row table (with columns for H1/Hrms, H2/Hrms, etc.), a natural cubic spline interpolation is performed at $\tilde{H}_{tr}$ to obtain dimensionless wave-height ratios. These are then converted to dimensional quantities (in meters) by multiplying with Hrms.

A detailed report is then generated (and written to `report.txt`) with the input parameters, intermediate values, interpolated ratios, and computed dimensional wave heights, as well as diagnostic ratios.

Compilation Instructions

To compile the program using `g++` on Windows with OpenMP, you can use the following command:

```
g++ -O3 -Wall -municode shallow-water-waves_gui.cpp -o shallow-water-waves_gui \
    -mwindows -static -static-libgcc -static-libstdc++ -fopenmp
```

References

1. Groenendijk, H.W. (1998). “Shallow foreshore wave height statistics.” M.Sc. thesis, Delft University of Technology (also Delft Hydraulics Rep. H3245). (https://repository.tudelft.nl/record/uuid:fe03dda9-40d9-4046-87fb-459f01fcd3d3)
2. Groenendijk, H.W. & Van Gent, M.R.A. (1998/1999). “Shallow foreshore wave height statistics: predictive model for probability of exceedance of wave heights.” Delft Hydraulics Rep. H3351. (http://dx.doi.org/10.13140/RG.2.2.14180.68486)
3. Battjes, J.A. & Groenendijk, H.W. (2000). “Wave height distributions on shallow foreshores.” Coastal Engineering, 40(3):161–182. (http://dx.doi.org/10.1016/S0378-3839(00)00007-7)
4. Van Gent, M.R.A. (2001). “Wave runup on dikes with shallow foreshores.” J. Waterway, Port, Coastal, Ocean Eng., 127(5):254–262. (http://dx.doi.org/10.1061/(ASCE)0733-950X(2001)127:5(254))
5. Mai, S. et al. (2011). “Wave height distributions in shallow waters.” Coastal Engineering Proceedings 1(32), paper 57. (Field validation of BG model; recommends coefficient recalibration) (http://dx.doi.org/10.9753/icce.v32.waves.63)
6. Verhagen, H.J. et al. (2008). “A practical method for the design of coastal structures in shallow water.” (Conference paper; emphasizes using Tm-1,0 and H2% for shallow-water design). (http://dx.doi.org/10.1142/9789814277426_0241)