OE4080
Term Project

Wave Analysis Toolbox and Validation

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Content

- Dataset and Visualization
- Toolbox
- Validation
- Wave Height Analysis and Validation
- Spectrum Analysis

Dataset

- Bideford Bay, UK

  Resource: [Link]

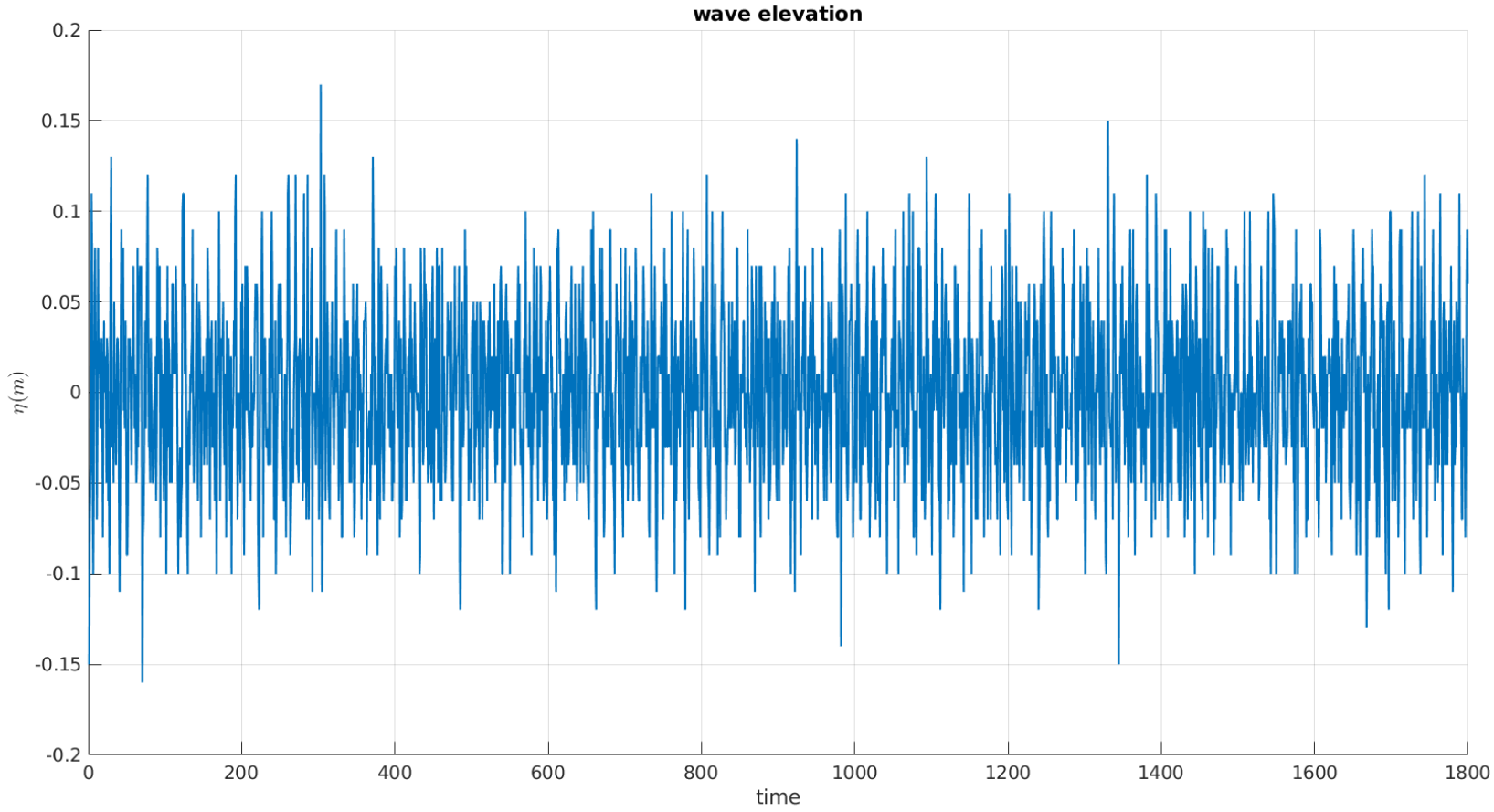
- .RAW-file contains the wave elevation data, sampled at a frequency of 1.28 Hz

- Contains 30 minutes of data
  2304 lines of measurements

Wave elevation (cm)

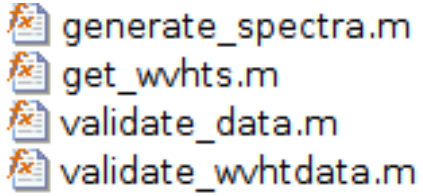
```
0, 13, 3, -13
0, 3, 13, -13
0, 15, 17, -11
0, -10, 2, -1
0, 7, 4, 2
0, 10, 25, 18
0, -26, 27, 10
0, -13, 20, -23
0, 24, 22, -13
0, 14, 16, 21
0, -6, 10, 13
0, -6, 14, -6
0, -11, -1, -8
```

Visualizing Dataset

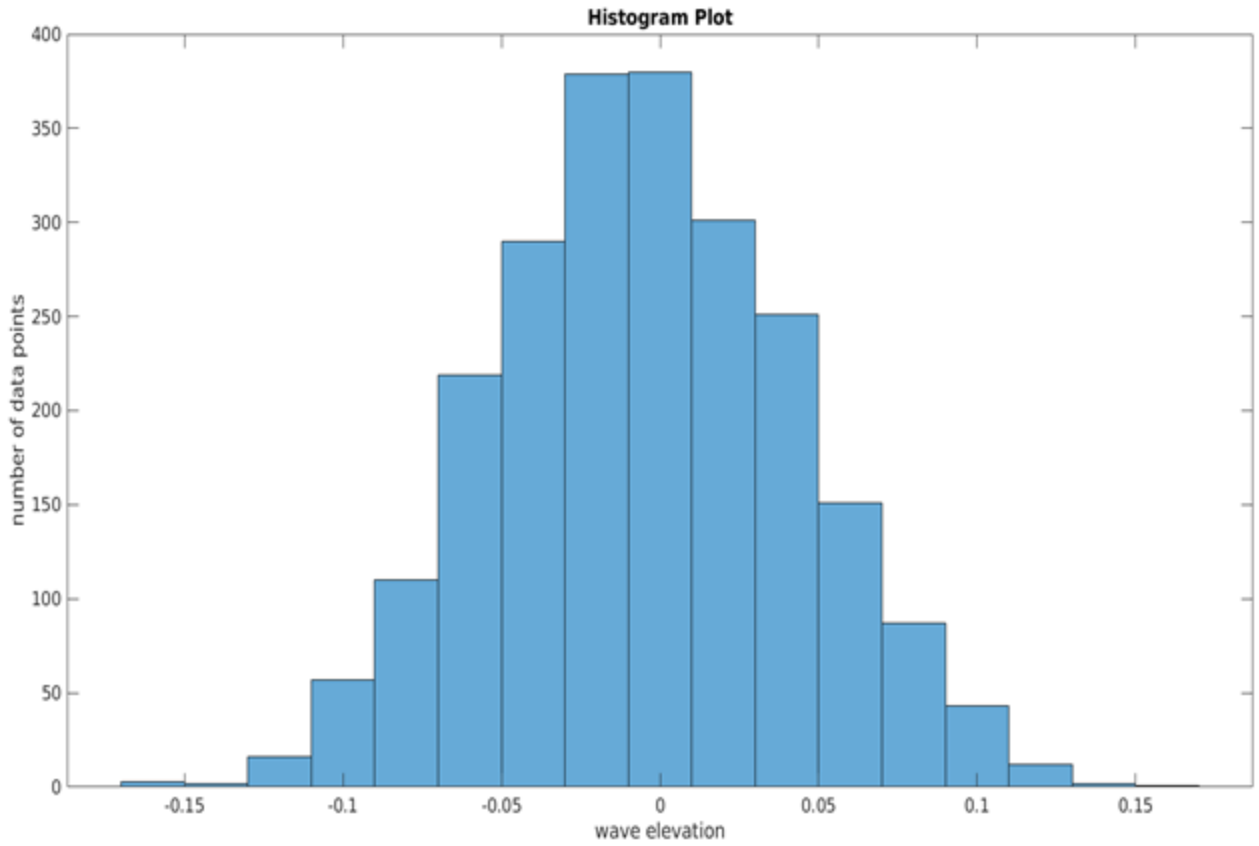


MATLAB Toolbox

- **Functions**



Wave Elevation Analysis



Histogram Analysis

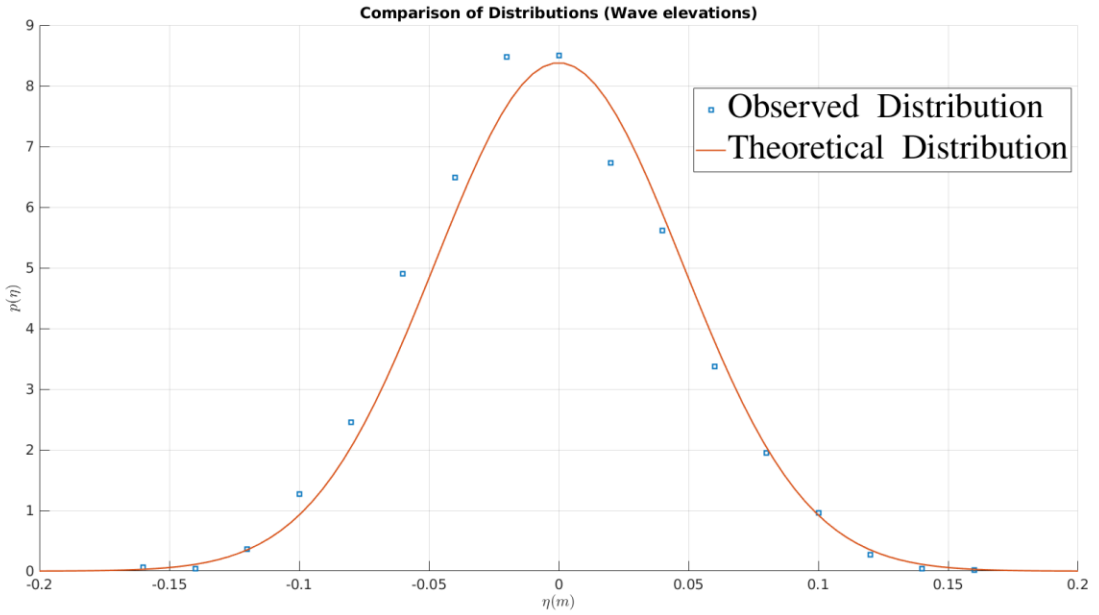
Validation

- **Wave Elevation**

Modelled as a Gaussian

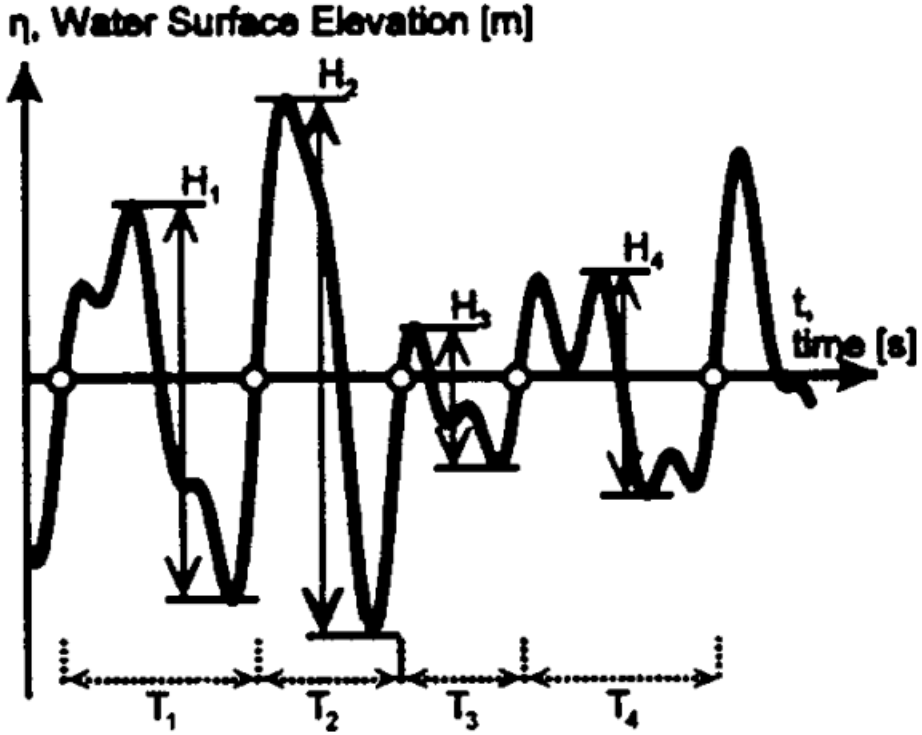
$$p(\eta) = \frac{1}{\sigma_\eta \sqrt{2\pi}} \exp\left(\frac{-\eta^2}{2\sigma_\eta^2}\right)$$

standard deviation



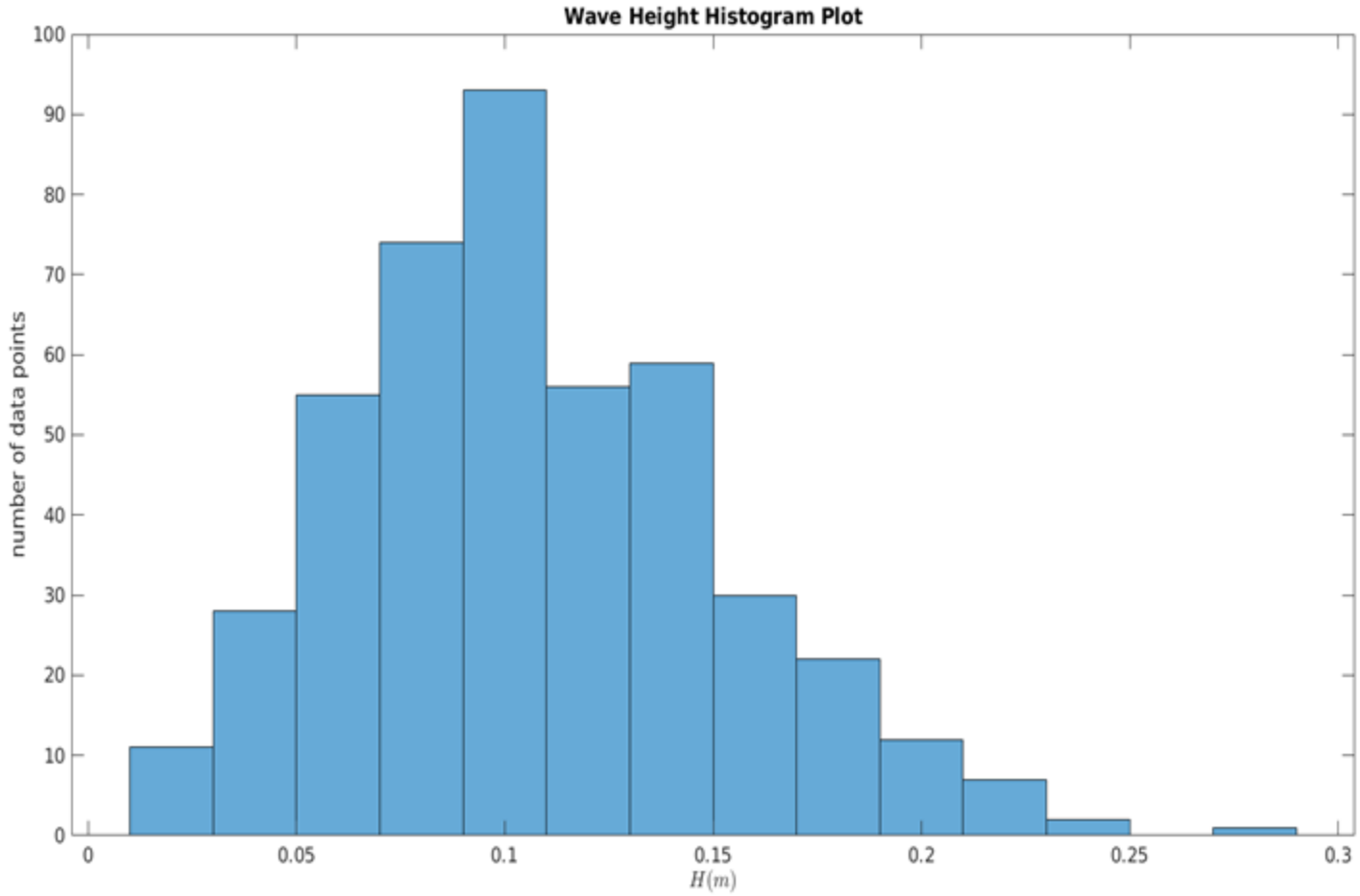
Wave Height Analysis

- **Zero Up-crossing**
- **Zero Down-Crossing**



Source: Paper

Wave Height Analysis



Histogram Analysis

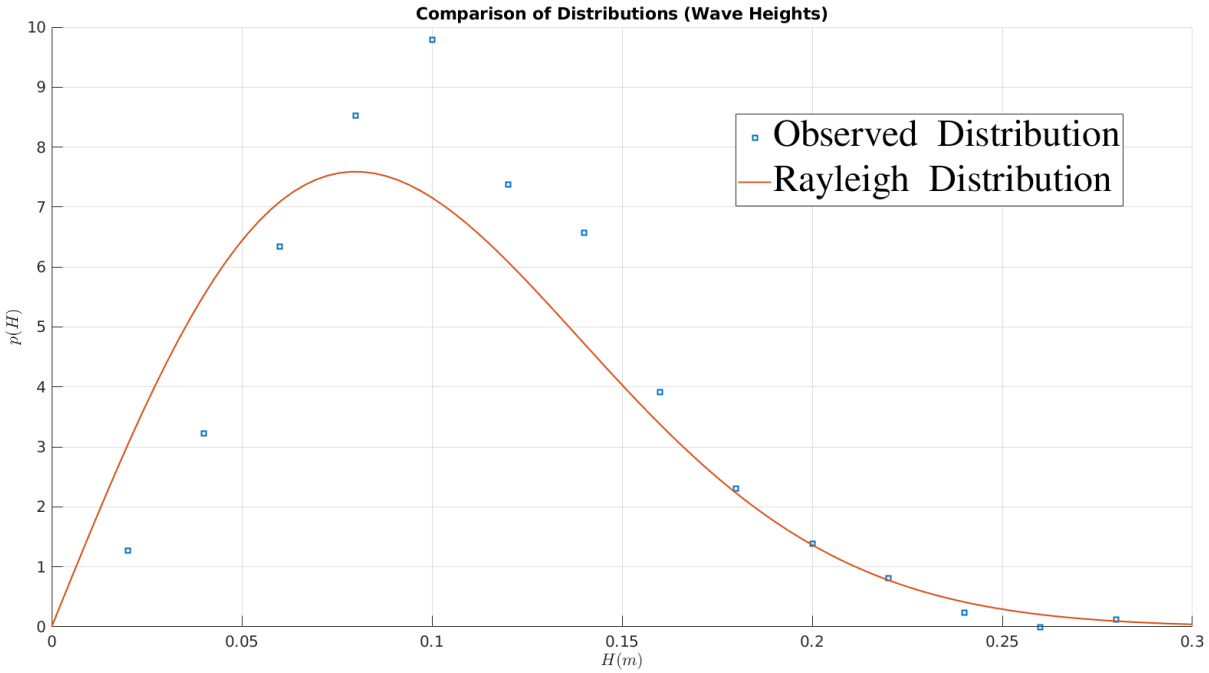
Validation

- **Wave Height**

Modelled as a Rayleigh Distribution

$$p(H) = 2\,\frac{H}{H_{\text{rms}}^2}\,\exp\left[-\left(\frac{H^2}{H_{\text{rms}}^2}\right)\right]$$

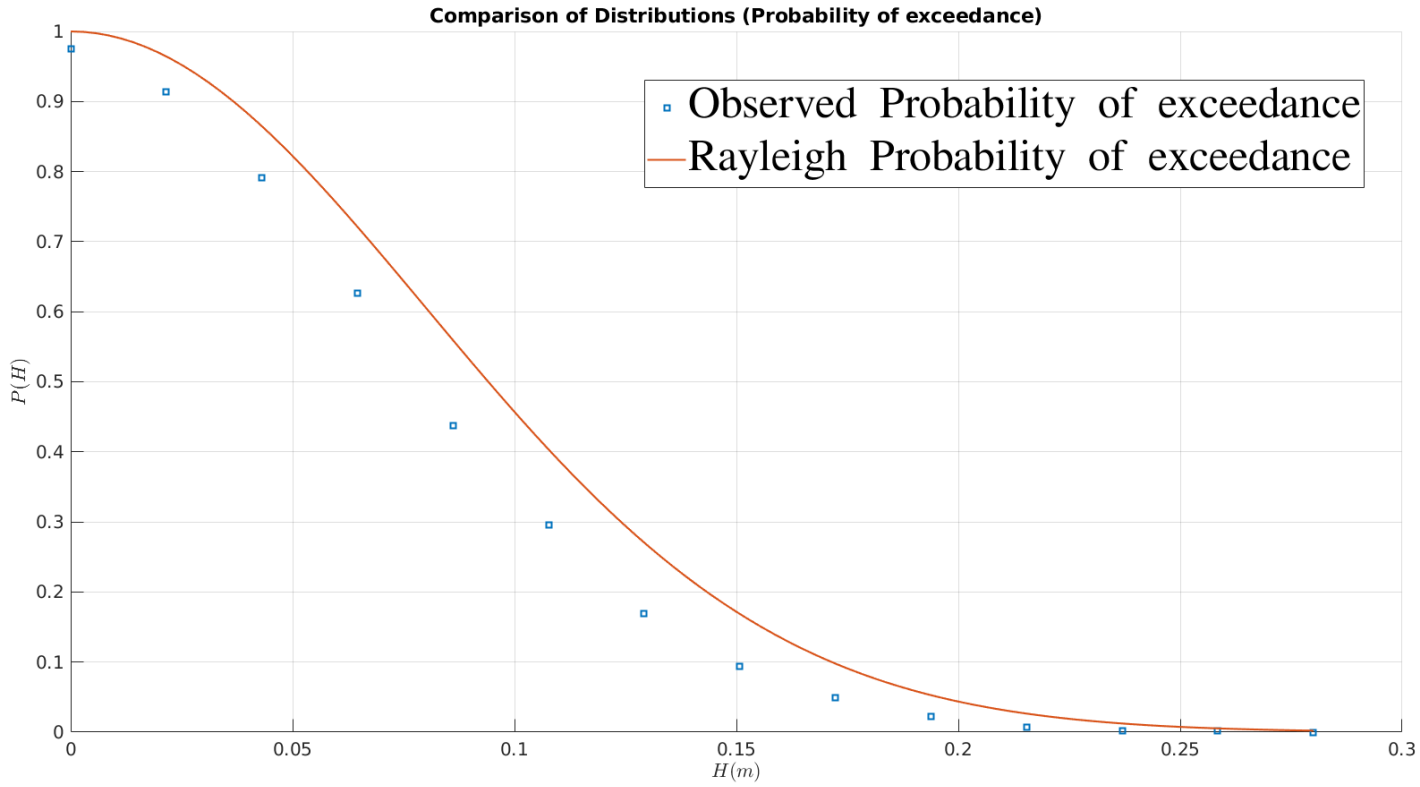
Root Mean Square value of Wave Height



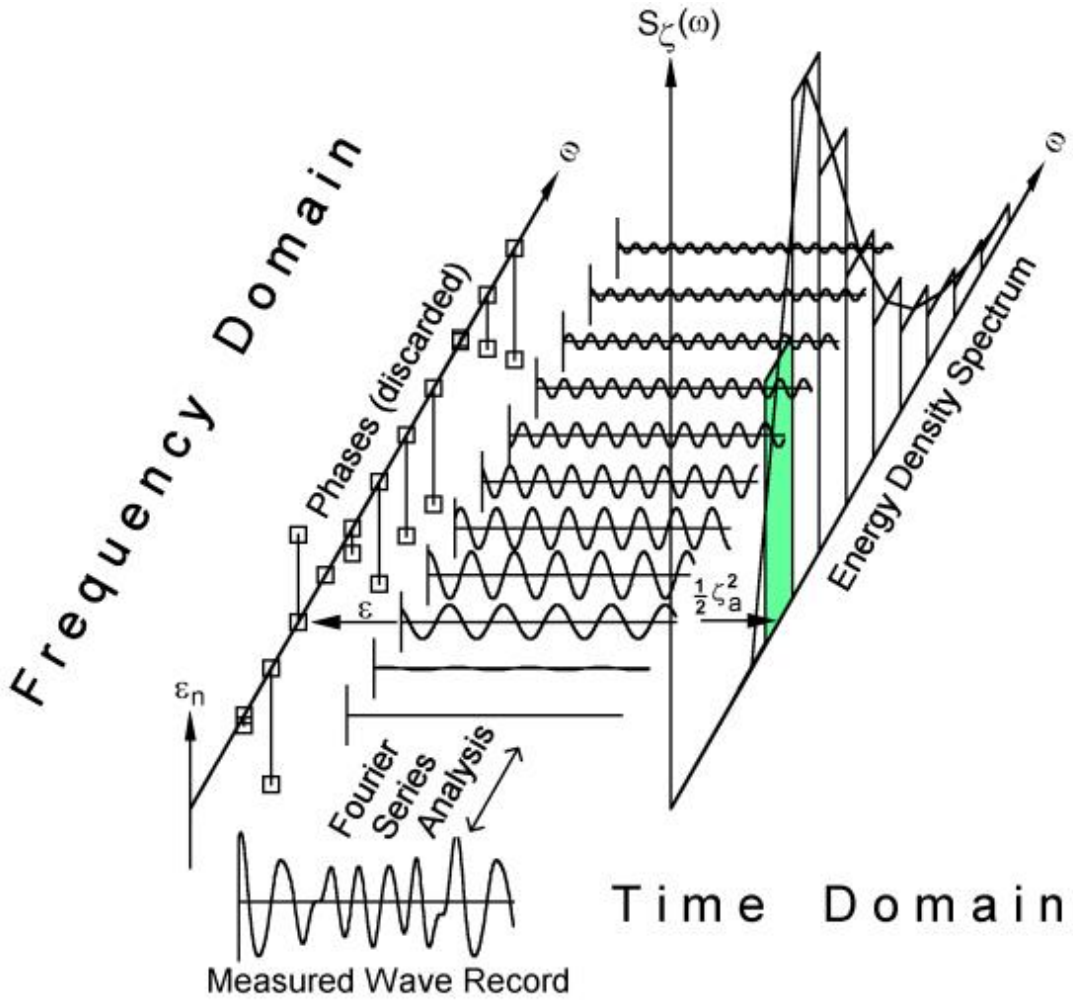
- **Probability of Exceedance**

Wave Heights modelled as a Rayleigh Distribution

$$1 - P(H) = \exp\left[-\left(\frac{H}{H_{\text{rms}}} \right)^2 \right]$$

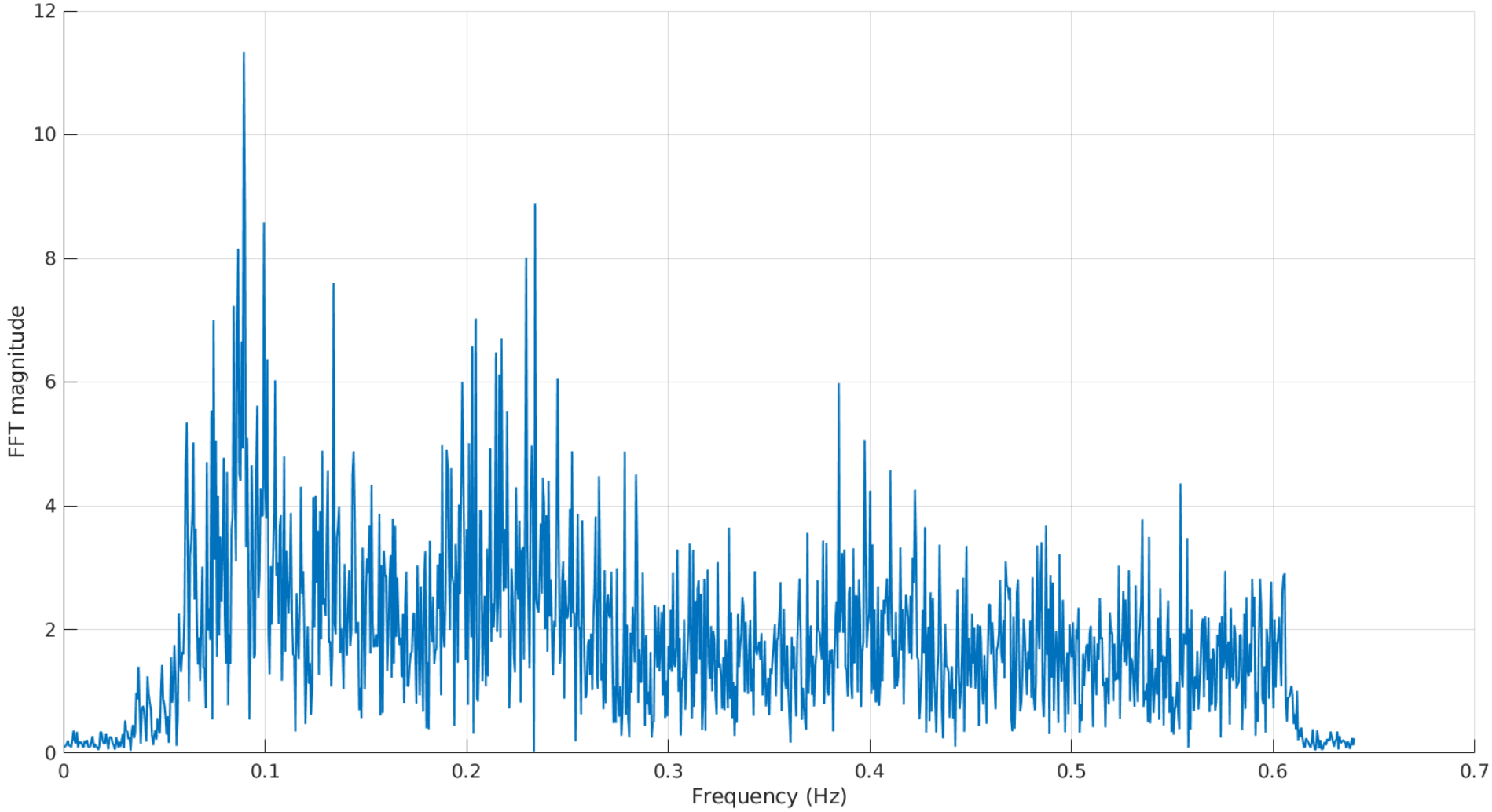


Spectrum Analysis



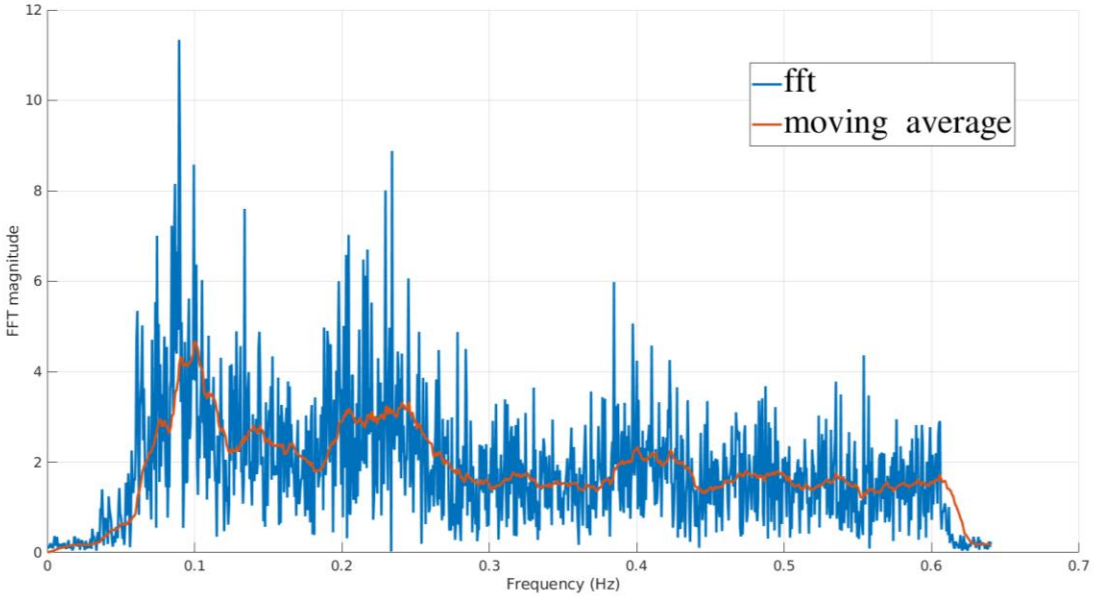
Source: Journee Hydrodynamics

Spectrum Analysis

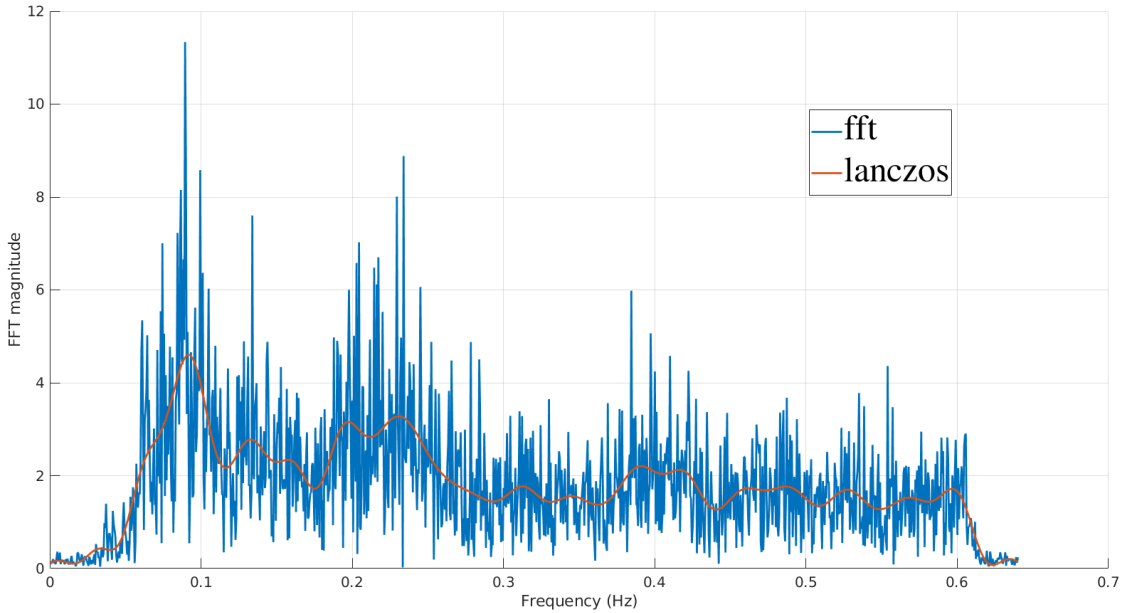


Spectrum Analysis

- **Filtering**



Smoothing using moving average



Smoothing using Lanczos filter

References

- Whitford, D.J., Waters, J.K. and Vieira, M.E., 2001. Teaching time-series analysis. II. Wave height and water surface elevation probability distributions. *American Journal of Physics*, *69*(4), pp.497-504.
- Journée, J.M.J. and Massie, W.W., 2001. Offshore hydromechanics.