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Part of the evanescent modes in the normally incident gravity surface wave's energy layout around a submerged obstacle

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A Introduction

Near coastal areas **bathymetric variations modify the behaviour of the waves.**

In particular, the **evanescent modes** are generated **during the transient mode** near steep bathymetric variations.

The role of evanescent modes is often omitted in models using the linear potential theory.

B Aims

$$\Phi_{Result} = \Phi_{Propagatives} + \sum \Phi_{Evanescents}$$

- **Quantify the energy** trapped by a submerged obstacle then
- **Compare this energy** to the energy flux of the wave incident in order to
- **Determine a characteristic time** ($T_{evanescent}$) of establishment for these modes

C Numerical resolution

We employ the numerical model developped by Takano (1960) then by Rey et al. (1992,1995) for **2 D cases**.

This model is normalized to ensure its convergence to taking account a great number of evanescent modes and huge deep.
The energy related to the evanescent modes is :

- Over the plane plate

$$E_p + E_c = \sum_{n=1}^{P} \frac{\rho g a_n^2}{4k_{s,n}} (1-\exp(-2k_{s,n}L))(1-\frac{2k_{s,n}h_s}{\sin(2k_{s,n}h_s)})$$

- Under the plane plate

$$E_c = \sum_{n=1}^{P} \frac{\rho k_{ss,n}}{8} ({B_{ss,n}^{-}}^2 + {B_{ss,n}^{+}}^2)(1-\exp(-2k_{ss,n}L)) * (h_0 - h_f)$$

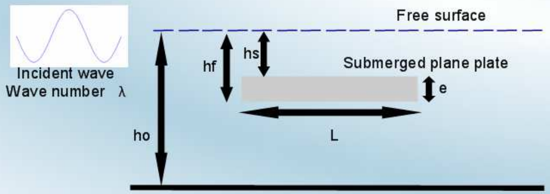
- Upstream and downstream the plane plate

$$E_p + E_c = \sum_{n=1}^{P} \frac{\rho g a_n^2}{8k_n} (1-\frac{2k_n h_0}{\sin(2k_n h_0)})$$

- Incident energy flux over 1 period

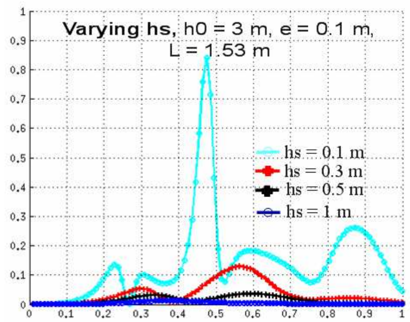
$$E = \frac{\rho g a^2 \omega}{4k}\left(1+\frac{2kh}{\sin(2kh)}\right) * T$$

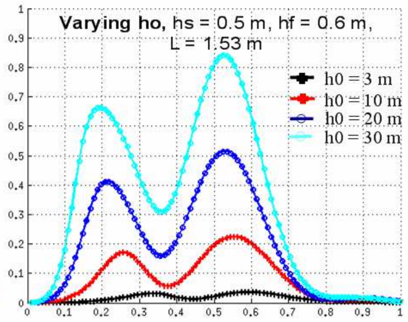
Where the coefficients a_n, B_n are computed

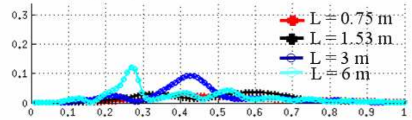


D Results

Ordinate axe : Rate between the energy of the evanescent modes and the incident flux per period
Abscissa axe : Frequency (Hz)







The quantity of energy trapped is impacted by :

- The **geometry** of the plate
- The **immersion** of the plate
- The **frequency** of the incident wave

E Conclusion

The **quantity of trapped energy** during the transient stage of the propagation is related to the **geometry** of the obstacle, its **immersion** and the **wave parameters**.

The characteristic time of establishment is such $\frac{T_{evanescent}}{T} \sim Energy\ Rate$

References

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