Geotextile tubes optimization for beach protection

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The optimization problem: The central issue is to successfully apply mathematical optimization methods in the context of coastal engineering and show that satisfactory simulation tools can be used in an inverse way like a help tool for the design of geotextile tubes. More precisely, the study deals with the problem of the protection of the lido between Sète and Marseilles, a site subject to severe coastal erosion (we estimate a loss of 45ha from 1945 to 2000). The optimization problem is to prove that critical quantities near the coastline in the lido of Sète (water waves energy, currents,...) can be monitored by the geotextiles tubes and their distances to the coastline.
The model: The numerical model used for the computation is a refraction-diffraction model REF/DIF developed at the Center for Applied Coastal Research (University of Delaware, US) by James T. Kirby and Robert A. Dalrymple and is principally based on the mild-slope equation in term of free surface elevation ξ [1],

$$\nabla \cdot (CC_g \nabla \xi) + \omega^2 \left(\frac{C_g}{C} \right) \xi = 0 \tag{1}$$

where $C = \sqrt{\frac{g}{k} \tanh kh}$, $C_g = C \frac{(1+\frac{2kh}{\sinh 2kh})}{2}$, k is the wavenumber, h the depth, C the wave velocity and C_g the group velocity.
The optimization algorithm: We use a Global Recursive Multi-Layer Optimization Algorithm based on a formulation of global minimization problems in term of over-determined boundary value problems [2].
Geotextile tubes modelling:

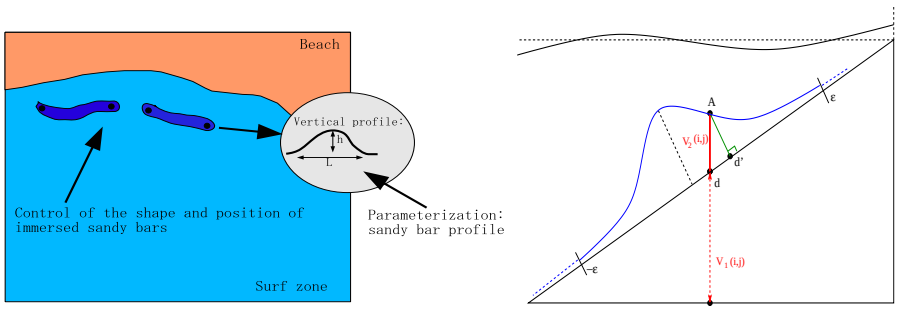

Figure 1: (Left:) Example of geotextiles Tubes in the littoral zone ; (Right:) The geotubes parameterization

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References

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