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A coupled water wave-induced hydrodynamics / shape optimizer model: towards an assisted design of coastal structures

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Shape optimization belongs to inverse problem category in numerical analysis. It means that once satisfactory simulation tools are developed enough, they may be used in an inverse way like a help tool for the design of structures. This type of technics has given good results in aeronautics: given a modelled flow around a plane wing, a shape optimizer program determines the best possible wing shape with respect to a given set of physical criteria.

In coastal engineering, groins, tombolos, breakwaters and many others structures are used to decimate water waves or to control sediment flow, and their shape are determined since many years taking into account both simple hydrodynamical assumptions and structure strength laws. We point out the fact that shape optimization technics may be efficiently applied to coastal engineering and may result in useful tools to design new coastal structures.

The global semi-deterministic optimizer BMO developed at the University Montpellier II was coupled with the Helmholtz equation in the context of a monochromatic water wave propagating on a deep water plane seabottom towards emerged vertical structures. Thanks to this simple (but poorly realistic) case, a complete methodology based on the determination of a “cost function” is described.

Possible applications of shape optimization technics to coastal engineering are presented: groin and tombolo curvature optimization, artificial sand bar design.