Progress in Global Optimization and Shape Design

P. Azerad[1], **F. Bouchette**[2], **D. Isèbe**[1],
B. Ivorra[1], **and B. Mohammadi**[1]

Abstract: We consider a function to minimize $J : \Omega \rightarrow \mathbb{R}$ with $\Omega \subset \mathbb{R}$. We make the following assumptions: $J \in C^2(\Omega, \mathbb{R})$ and is coercive. Its minimum J_m exists.

Most deterministic minimization algorithms can be seen as discrete dynamical systems coming from a discretization of first or second order Cauchy problems. If one knows the infimum J_m, global optimization can be considered as Boundary Value Problem (BVP) for these problems as below:

$$T > 0 \text{ given}, \ \ddot{x} + \dot{x} = -\nabla_x J, \ x(0) = x_0, \ J(x(T)) = J_m$$

which can be solved using any BVP solution method like for example a shooting method:

$$T > 0 \text{ given}, \ \ddot{x} + \dot{x} = -\nabla_x J, \ x(0) = x_0, \ \dot{x}(0) = v$$

where v is a new variable to be found by the minimization of $h(v) = J(x_v(T)) - J_m$. x_v is solution of the system when $\dot{x}(0) = v$. This leads to an original Semi-Deterministic Algorithm (**SDA**) which we would like to use in various shape optimization problems.

Application to Shape optimization of a Fast-Microfluidic-Mixer

We focus on the shape optimization of a pressure driven microfluidic mixer designed for fast mixing of protein solutions. In order to reduce the device mixing time, we modify the shape subject to given functioning conditions using our SDA and an Hybrid Genetic Algorithm (**HGA**). Both optimization methods have led to the same mixing time reduction by a factor of 8. But SDA has over-performed the **HGA** in term of computational complexity.

Application to Shape optimization of Coastal Structures

We want to determine the shape of coastal structures reducing erosion effects minimizing wave amplitude over the domain. We consider three optimization configurations (rectangular groins, zigzag and Y-shaped structures) and we obtain optimized shapes producing up to 60% reduction in the functional in comparison with the unprotected coastline.

[1] Mathematics & Modelling Institute CC51, 34090 Montpellier, France
mohamadi@math.univ-montp2.fr

[2] ISTEEM, Montpellier University, 34090 Montpellier, France