

New shape derivative formula for solving a free boundary problem of Bernoulli's type

Azeddine Sadik

*Laboratory of Mathematics and Applications, Faculty of Sciences and
Technics Beni Mellal, Morocco*

`sadik.ufrnantes@gmail.com`

Abdesslam Boulkhemair

*Laboratory of Mathematics Jean Leray, Faculty of Sciences and Technics
Nantes, France*

`boulkhemair-a@univ-nantes.fr`

Abdelkrim Chakib

*Laboratory of Mathematics and Applications, Faculty of Sciences and
Technics Beni Mellal, Morocco*

`chakib.ufrnantes@gmail.com`

In this paper, we deal with a new numerical method for the approximation of a class of free boundary problem reformulated as a shape optimization one, which consist in minimizing an appropriate cost functional. We start by showing the existence of the shape derivative of the cost functional and express it by means of support functions, using the formulas proposed in [Boulkhemair, A. and Chakib, A., 2014. On a shape derivative formula with respect to convex domains. *Journal of Convex Analysis*, 21(1), pp.67-87.], for a family of convex domains. Then the numerical discretization is performed using the boundary element method in order to avert the remeshing task required when one use the finite element method. Finally, we give some numerical results, based on the gradient method, showing the efficiency of the proposed approach.