Shape optimization algorithms for interface identification

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In many applications, which are modeled by partial differential equations (PDEs), there is a small number of materials or parameters distinguished by interfaces to be identified. While classical approaches in the field of optimal control yield continuous solutions, a spatially distributed, binary variable is closer to the desired application. It is thus favorable, to treat the shape of the interface between an active and inactive control as the variable. Moreover, since the involved materials may form complex contours, high resolutions are required in the underlying finite element method.

We investigate a combination of classical PDE constrained optimization methods and a rounding strategy based on shape optimization for the identification of interfaces. The goal is to identify the location of pollution sources in fluid flows represented by a control that is either active or inactive. While the most intuitive approach would be to treat this as a combinatorial problem and to decide cell by cell whether it is polluted or not, computational complexity and mesh-dependent solutions are major drawbacks. These issues can be circumvented by the algorithm we present here. Moreover, it is shown how the topology of an inaccurate initial guess for the pollutant locations can be corrected during the shape optimization, which is a typical problem in that field.

References

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