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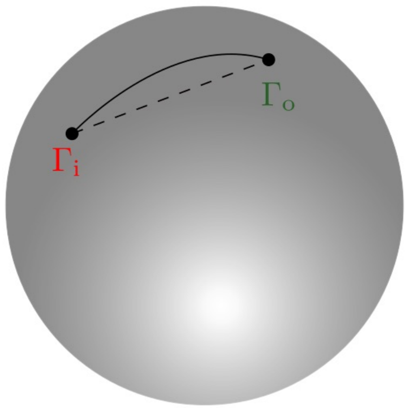
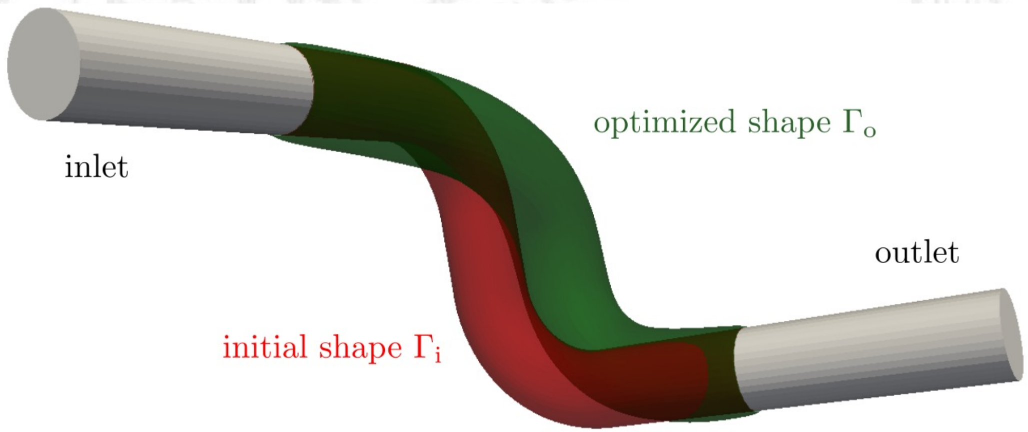
Parameter-free shape optimization:
an engineering view on differentiation with respect to a shape

In the last decade, parameter-free approaches to shape optimization problems have matured to a state where they provide a versatile tool for complex engineering applications. However, sensitivity distributions obtained from shape derivatives in this context cannot be directly used as a shape update in gradient-based optimization strategies. Instead, an auxiliary problem has to be solved to obtain a gradient from the sensitivity. While several choices for these auxiliary problems were investigated mathematically, the complexity of the concepts behind their derivation has often prevented their application in engineering. An example is the concept of a shape space as a Riemannian manifold, where differences between shapes are measured by geodesics. From this rather abstract view, however, shape updates can be derived that yield admissible shapes and at the same time provide a domain update, i.e. an update of the interior of a shape. This avoids the application of mesh morphing techniques as an extra step within the optimization iterations.
In this presentation, an explanation of several approaches to compute shape updates is given from an engineering perspective. The corresponding auxiliary problems are introduced in a formal way and compared by means of numerical examples. To this end, a test case and exemplary applications from computational fluid dynamics are considered.





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