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A phase field approximation for the Reifenberg Plateau's problem : existence and regularity of solutions

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The goal of this work is to use a phase field method to approximate the notorious Plateau problem, which consists of finding a surface of minimum area that spans a given curve. To this aim, we want to generalise to Plateau's problem, using a Reifenberg formulation, the functional introduced by M. Bonnivard, A. Lemenant, and F. Santambrogio for Steiner's problem (searching for the shortest path connecting a given set of points). The novelty of this approach is to deal with the topological constraint by penalising a geodesic distance. This geodesic distance is defined by minimizing the surface created by a path in a space of closed curves connecting two curves. The approach is based on the study of a decoupled functional depending on both the phase and a given closed curve. I will present, in particular, the existence result for this decoupled functional. Then, following an approach proposed by M. Bonnivard, E. Bretin, and A. Lemenant in the case of Steiner's problem, I will present numerical simulations for Plateau's problem that illustrate the method's applicability in practice.

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