Theory for `lset-opt` package

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1 Definitions

grid A two-dimensional regularly-spaced $m \times n$ set of points.

ϕ, ϕ_i, or $\phi(x, y)$ Level-set function defined on grid. The zero-crossing of ϕ defines the contour of the shapes on the grid.

2 Initialization

Given a candidate level-set function, $\hat{\phi}$, a regularized ϕ is computed in the following way:

1. If any element of $\hat{\phi}$, $\hat{\phi}_i$, is exactly equal to 0, then let $\hat{\phi}_i = \epsilon$ where ϵ is the smallest positive number available.
2. For all $\hat{\phi}_i$ not adjacent to a boundary point, fix the corresponding ϕ_i as

$$\phi_i = \operatorname{sign}(\hat{\phi}_i) = \begin{cases} -1 & \hat{\phi}_i < 0, \\ +1 & \hat{\phi}_i > 0. \end{cases} \tag{1}$$

3. To determine the remaining ϕ_i, solve the following:

$$\begin{aligned} \text{minimize} \quad & \|D\phi\|^2 && (2) \\ \text{subject to} \quad & A\phi = 0, && (3) \end{aligned}$$

where