Topological Optimization with Big Steps

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Using persistent homology to guide optimization has emerged as a novel application of topological data analysis. Existing methods treat persistence calculation as a black box and backpropagate gradients only onto the simplices involved in particular pairs. We show how the cycles and chains used in the persistence calculation can be used to prescribe gradients to larger subsets of the domain. In particular, we show that in a special case, which serves as a building block for general losses, the problem can be solved exactly in linear time. We present empirical experiments that show the practical benefits of our algorithm: the number of steps required for the optimization is reduced by an order of magnitude.

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