

# Bilevel optimization with single-step inner methods

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## Abstract

We propose a new approach to solving bilevel optimization problems, intermediate between solving full-system optimality conditions with a Newton-type approach, and treating the inner problem as an implicit function. The overall idea is to solve the full-system optimality conditions, but to precondition them to alternate between taking steps of simple conventional methods for the inner problem, the adjoint equation, and the outer problem. We prove the convergence of the approach for combinations of gradient descent and forward-backward splitting with exact and inexact solution of the adjoint equation. We demonstrate good performance on learning the regularization parameter for anisotropic total variation image denoising, and the convolution kernel for image deconvolution.