

Restricted normal cones and the method of alternating projections

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The method of alternating projections (MAP) is a common method for solving feasibility problems. While employed traditionally to subspaces or to convex sets, little was known about the behavior of the MAP in the nonconvex case until 2009, when Lewis, Luke, and Malick derived local linear convergence results provided that a condition involving normal cones holds and at least one of the sets is superregular (a property less restrictive than convexity). However, their results failed to capture very simple classical convex instances such as two lines in three-dimensional space. In this paper, we extend and develop the Lewis-Luke-Malick framework so that not only any two linear subspaces but also any two closed convex sets whose relative interiors meet are covered. We also allow for sets that are more structured such as unions of convex sets. The key tool required is the restricted normal cone, which is a generalization of the classical Mordukhovich normal cone. We thoroughly study restricted normal cones from the viewpoint of constraint qualifications and regularity. Numerous examples are provided to illustrate the theory.

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