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Strong convergence of splitting algorithms by Ryu, by Malitsky-Tam, and by Campoy applied to normal cones of linear subspaces

Finding a zero of a sum of maximally monotone operators is a fundamental problem in modern optimization and nonsmooth analysis. Assuming that the resolvents of the operators are available, this problem can be tackled with the Douglas-Rachford algorithm. However, when dealing with three or more operators, one must work in a product space with as many factors as there are operators. In ground-breaking recent work by Ryu and by Malitsky and Tam, it was shown that the number of factors can be reduced by one. A similar reduction was achieved recently by Campoy through a clever reformulation originally proposed by Kruger. All three splitting methods guarantee weak convergence to some solution of the underlying sum problem; strong convergence holds in the presence of uniform monotonicity. In this paper, we provide a case study when the operators involved are normal cone operators of subspaces and the solution set is thus the intersection of the subspaces. Even though these operators lack strict convexity, we show that striking conclusions are available in this case: strong (instead of weak) convergence and the solution obtained is (not arbitrary but) the projection onto the intersection. Numerical experiments to illustrate our results are also provided.