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ONE WORLD OPTIMIZATION SEMINAR

January 24th 2022 @ 15:30 CET (Central European Time)

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Nonlinear Forward-Backward Splitting with Projection or Momentum Correction

Abstract. We introduce the concept of a nonlinear forward-backward map, where the backward part is based on a nonlinear resolvent construction that allows for the kernel in the resolvent to be a nonlinear single-valued maximal monotone operator. This generalizes the standard resolvent as well as the Bregman resolvent, whose resolvent kernels are gradients of convex functions. The nonlinear forward-backward map applies to monotone inclusion problems with two maximal monotone operators where one in addition is cocoercive. A naive application of the mapping may result in a divergent method and a correction step is needed to guarantee convergence. We propose one projection correction approach and one momentum correction approach. The two resulting algorithms serve together as a very general algorithmic framework that paves the way for devising new operator splitting methods and provides a new understanding for its many special cases, which include, e.g.,: forward-backward-forward splitting, forward-backward-half-forward splitting, synchronous projective splitting, asymmetric forward-backward adjoint splitting, the proximal alternating predictor corrector method, the forward-reflected-backward method, the forward-reflected-Douglas-Rachford method, as well as standard forward-backward splitting and therefore the Chambolle–Pock method, Douglas–Rachford splitting, ADMM (with dual step-size 1), the proximal gradient method, and the Condat–Vũ method. The framework also allows to easily construct extensions or variations of some of the above methods to include a cocoercive term (if absent) or to replace the projection correction (if used) by momentum correction, which is one way to arrive at the forward-reflected-backward method by Malitsky and Tam from the forward-backward-forward method by Tseng.

The link of the zoom-room of the meeting and the corresponding password will be announced the day before the talk on the mailing list of the seminar, to which one can subscribe on <https://owos.univie.ac.at>.