Regularization of autoconvolution equations and other ill-posed problems of quadratic structure

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Abstract

Recent progress in regularization of nonlinear equations in Hilbert and Banach spaces focusses on linearization techniques. Classical concepts are applied to some kind of derivative of a nonlinear mapping and, to get desired convergence results, one assumes that the derivative describes the nonlinearity sufficiently accurate. But such assumtions on the nonlinearity structure sometimes cannot be satisfied. For example, this seems to be the case for autoconvolution equations.

We present a different approach for developing regularization techniques by exploiting the quadratic structure of autoconvolution equations. It turns out that to some extent classical techniques for linear ill-posed inverse problems can be applied to such quadratic problems. This can be achived by splitting of a linear mapping containing all ill-posedness phenomena and leaving a well-posed quadratic mapping which can be inverted easily.

Autoconvolution equations appear for example in the recently developed SD SPIDER method for characterizing ultrashort laser pulses. Here one additionally has to cope with complexvalued functions and a kernel function in the autoconvolution equation.