Sparse regularization path by differential inclusion

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Abstract: A new sparse regularization path is obtained from a system of differential inclusions that involve both primal and dual variables. We show that sign-consistent sparse solutions can be found on the new path under conditions similar for the LASSO path, but the solutions on the new path are unbiased. The new path satisfies a minimax optimal l2-error bound and is empirically much better than LASSO while slightly better than *debiased* LASSO. Numerically, there is a significant speed advantage to compute the new path over sampling the LASSO path at multiple locations. The new path can be computed either exactly by tracking its break points or approximately by running a very simple explicit iteration. The latter reduces to linearized Bregman iteration, which is embarrassingly parallel and can be extended to the distributed and decentralized settings. The idea also generalizes from sparsity to other notions such as low-rankness and beyond.

This is joint work with Stan Osher, Feng Ruan, Jiechao Xiong, Ming Yan, and Yuan Yao.