A bilevel approach for point spread function calibration

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In inverse problems applications, the forward model operator which encodes the information related to the acquisition process, may be poorly known. This problem is particularly relevant in microscopy or astronomical imaging, where the data can be subject to the action of an unknown point spread function. In this talk, we address the problem of point spread function calibration by means of a bilevel approach, which solves a nested optimization problem where a variational model acts as a constraint. A special attention is devoted to automatic strategies for the selection of hyperparameters. In particular, in the lower-level problem, the considered variational model is based on a Tikhonov regularization combined with a residual whiteness principle for the automatic selection of the regularization parameter. On the other hand, in the upper-level problem, a suitable regularized objective, exploiting statistical information on the point spread function, is minimized by means of a gradient projection scheme combined with spectral selection strategies for the appropriate choice of the step length. Numerical tests on different imaging problems will be presented.