Explainable Bilevel Optimization: an Application to the Helsinki Deblur Challenge

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Accurate assessment of image quality is the utmost importance in various imaging applications, including medical diagnostics, remote sensing, computer vision, and denoising-deblurring tasks in general. In this presentation, we propose a novel approach using Support Vector machines for Regression (SVR) to predict quality measure scores specifically for imaging tasks. Several times in the literature, methods trained as SVR have been used as performance measure predictor, both in the context of imaging [1] and Deep Learning [2]. SVR, known for its ability to handle non-linear relationships and high-dimensional data, is leveraged to develop a reliable predictor for quality evaluations. On the other hand, variational models are a classical tool for many imaging problems, but they do have known limitations, as the absence of general guidelines for selecting the hyperparameters they depend on. Bilevel optimization schemes have been proposed in order to overcome this issue and learn a satisfying set of hyperparameters [3]. In particular, they offer a high level of interpretability while keeping the amount of data required low. We use our performance predictor, based on SVR, to set the hyperparameters of an optimization scheme obtained by unrolling a fixed number of FISTA-like iterations applied to the minimization of a suitable energy functional [4, 5]. Model-based data-augmentation strategies have been adopted to overcome issues related to the richness and the significance of the training dataset. The resulting SVR-based quality measure score predictor showed encouraging performances on an extensive numerical experimentation, validating its potential for accurate and efficient quality assessment in imaging applications.

References

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