My preliminary understanding of spectral learning for NLP:

Spectral learning aims to estimate parameters for the models with latent variables by applying SVD on training examples. Compared with the EM algorithm, spectral learning guarantees consistent parameter estimates, which are exempted from local optima, and is much more efficient because of no iterations. The general first step is to perform SVD on the observable variables learned from training examples. Then the singular matrices and values are used to compute the observable representations, which are the transformations of latent probability matrices and sufficient for model inference. Under certain conditions on parameter matrices and the sample complexity, the accuracy of estimates can be guaranteed.

This algorithm can be applied on many NLP models including HMM [4], L-PCFGs [2], LDA [1] etc., while further optimization may be necessary in practice for concrete problems. For example, for L-PCFGs, [3] considered the choices of mapping functions, smooth estimation methods and handling negative values. Spectral learning can achieve similar accuracy with the EM algorithm, while may lag behind other state-of-the-art algorithms. [5] globally optimized the number of latent states and improved the accuracy of L-PCFGs. How to further improve the spectral algorithm with concrete problems is worth exploring in the future, including the selection of features, mapping functions, regularization methods, etc.

Reference

[1] Animashree Anandkumar, Dean P. Foster, Daniel J. Hsu, Sham M. Kakade, and Yi-kai Liu. A spectral algorithm for latent dirichlet allocation. In *NIPS*, 2012.
[2] Shay B. Cohen, Karl Stratos, Michael Collins, Dean P. Foster, and Lyle Ungar. Spectral learning of latent-variable PCFGs. In *ACL*, 2012.
[3] Shay B. Cohen, Karl Stratos, Michael Collins, Dean P. Foster, and Lyle H.Ungar. Experiments with spectral learning of latent-variable PCFGs. In *NAACL* 2013.
[4] Daniel J. Hsu, Sham M. Kakade, and Tong Zhang. A spectral algorithm for learning hidden markov models. In *COLT*, 2009.
[5] Shashi Narayan and Shay B. Cohen. Optimizing spectral learning for parsing. In *ACL*, 2016.