PCA-based inversion codes: inverting fast and reliably

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I should review PCA-based inversion: its fundamentals and its two present
uses: one as a fast inversion code for on-line inversion as used in THEMIS
today, two as inversion code for sophisticated radiative transfer, as in the
inversion of He D3 profiles from prominences. In the first case it is the
extreme speed and reproducibility aspects of these algorithms which is put
to good use in a very fast (with no much precision though) inversion
running during the observation, providing feedback on the observations.
In the second case I will show how difficult transfer problems can be solved
in advance and let PCA "learn" the solutions before applying them to real
observations cases. A good example is spectropolarimetry of the He D3 lines
in prominences where the subtle atomic models and radiative transfer and
scattering conditions are too time-consuming for typical trial-and-error
methods.
Finally I should discuss on the necessity of the interpretation of inversion
results and the dangers of taking solutions at face value.

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