

Interactive comment on “Behavior of the iterative ensemble-based variational method in nonlinear problems” by Shin’ya Nakano

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I appreciate the referee # 1 for taking time for reviewing the manuscript. The main criticism raised by this referee is that the iterative algorithm discussed in this paper is virtually the same as the standard Levenberg-Marquardt method if the ensemble spread is taken to be small. I agree that the result on convergence in Section 5 would be mostly trivial from the viewpoint of the Levenberg-Marquardt approach.

On the other hand, if an ensemble approximation is used in a high-dimensional problem, the objective function is approximated onto a subspace with lower dimension. Therefore, the ensemble-based method does not completely mimic the Levenberg-Marquardt method. If the ensemble members are distributed in a particular subspace,

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it would behave as the standard Levenberg-Marquardt method in the subspace, which can provide a suboptimal result. However, when the ensemble members are distributed in a different subspace in each iteration, the iterative algorithm can attain the local maximum in the full vector space, which can be regarded as a maximum in any N -dimensional subspace. Although this fact might not look surprising, I think it is not necessarily recognized how it can work when the ensemble members are distributed in a different subspace in each iteration.

I understand the contrast with the standard Levenberg-Marquardt method seemed to be vague because the issue of the low rank approximation in high dimensional problems was not described in the introduction section. However, the behavior of the iterative ensemble-based method is not necessarily the same as that of the standard Levenberg-Marquardt method as described above. It is also demonstrated by the experiments in Section 7.

The latter part of Section 5 describes heuristic treatments and I agree that it contains some speculative arguments. However, I think these treatments might be required in some practical applications.

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