Nonlin. Processes Geophys. Discuss.,
doi:10.5194/npg-2016-55-RC1, 2016

Nonlinear Processes in Geophysics Discussions
Open Access

Interactive comment on "Conditional nonlinear optimal perturbations based on the particle swarm optimization and their applications to the predictability problems" *by* Qin Zheng et al.

Anonymous Referee #1

Received and published: 21 December 2016

General comment

The authors applied the particle swarm optimization (PSO) algorithm to solve the conditional nonlinear optimal perturbation (CNOP) and the lower bound of maximum predictable time (LBMPT). The results obtained by the PSO algorithm were compared to those by the traditional optimization algorithm (such as, a gradient descent algorithm based on the adjoint model, ADJ). The authors found that the PSO algorithm had advantage to compute the CNOP when the initial perturbation was large or the prediction time was long for the strong nonlinearity of the dynamical model on the prediction variable. Authors attempted to obtain the CNOP using the PSO algorithm. Considering the applications of CNOP, it is an interesting work.

Printer-friendly version

Discussion paper

Major remarks (1): Please state the advantages of the PSO algorithm in detail, especially comparing to the ADJ algorithm. On the other hand, the genetic algorithm (GA) was also applied to compute the CNOP by authors. And, the authors have published some related articles (Zheng et al. 2012, 2014). The authors should explain the difference between PSO and GA in detail for readers. It is better to compare the numerical results with the ones by using the three methods (PSO, GA, and ADJ algorithms) in the revised manuscript.

(2): The initial guess population size of the PSO algorithm is 60 for 40 optimization processes. The size is enough for the PSO algorithm. However, how many the number of the initial guess values is for the ADJ algorithm? 40 optimization processes and an initial guess values? Is it fair to obtain the CNOP using the PSO and ADJ algorithm? In general, the global CNOP could be obtained by choosing a number of initial guess values using the ADJ algorithm. It is important to choose the initial guess values using the optimization method. The computation results of the CNOP could be divided into three types using a number of initial guess values for the ADJ algorithm. The first one is the global CNOP. The second one is the local CNOP. The last one fails to compute the optimal value. In table 1 and 2, the authors showed the proportion of the global CNOP and local CNOP using 40 times. It is reasonable and not shortcoming for calculating the CNOP using the ADJ algorithm. It is acceptable to obtain the global CNOP without all initial guess values.

Specific remarks:

(1): Page 8, line 27-Page 9, line 1: Please introduce how to separate small quadrate patches. (2): Page 9, line 5-8: “The population size of the PSO M = 60, the maximum evolutional generation is set as 200, inertia weight =0.729 ïĄů and accelerating factors c1=2.05,c2=2.05. The norms measuring IC errors and prediction errors are both 2 L -norm, and the radius of the constraint ball is 8.201*10ˆ(-3)”. Please explain the reasons to choosing of the parameter. Whether are the results dependent on the choosing of the parameter or not? (3): Page 9, line 14: The authors emphasized the importance of the impact of the strong nonlinearity. Please tell the readers that how to define the strong nonlinearity for the dynamical system. (4): The computational cost is considered as the index to calculate the optimal value. The computational cost (such as computation time, iteration times) should be shown by the PSO, GA and ADJ algorithms. (5): When the optimization time increases, please show the numerical results of computing CNOP being similar to Table 1 and 2 (6): The value of the PSO algorithm is that it is applicable to obtain the CNOP in high dimensional and more complex model. In the section of discussion, this issue should be further discussed. (7): Which ADJ algorithm is applied in the manuscript? The spectral projected gradient (SPG), the sequential quadratic programming (SQP), limited memory BFGS (L-BFGS)? The algorithm employed in the manuscript should be introduced. Please show the references of these algorithms.

Interactive comment on Nonlin. Processes Geophys. Discuss., doi:10.5194/npg-2016-55, 2016.