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**Data assimilation based on 4DVar for structural materials**[1] HIROMICHI NAGAO, SHIN-ICHI ITO, TADASHI KASUYA, JUNYA INOUE, The University of Tokyo — Data assimilation (DA) is a computational technique to integrate numerical simulation models and observation data based on Bayesian statistics. One key issue is the implementation of DA in massive simulation models under the constraints of limited computation time and resources. We propose a new DA methodology based on the four-dimensional variation method (4DVar) for massive models that produces optimum estimates and their uncertainties within the reasonable computational limitations. The uncertainties are given as diagonal elements of the inverse of Hessian matrix, which is the covariance matrix of a Gaussian that approximates the posterior distribution in the neighborhood of the optimum. Conventional algorithms for deriving the Hessian inverse require $O(CN^2+N^3)$ computations and $O(N^2)$ memory, where $N$ is the dimension of the model and $C$ is the number of computations needed to simulate time series. The proposed method using a second-order adjoint method allows us to directly evaluate the diagonal elements of the Hessian inverse without computing all elements. This drastically reduces the number of computations to $O(C)$ and the amount of memory to $O(N)$. We report an initial result when our method is applied to practical experimental data of structural materials.

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Hiromichi Nagao
The University of Tokyo

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