**ABSTRACT**

Data assimilation techniques are applied to the integrated transport simulation (TASK3D) in Large Helical Device (LHD). We employ the ensemble Kalman filter (EnKF) and the ensemble Kalman smoother (EnKS) as data assimilation methods. The time series data of experimentally measured temperature and density profiles are assimilated into the particle and heat transport simulation. The obtained temperature and density profiles and temporal variations agree well with measured ones due to the employed model parameters’ optimization. These results indicate the effectiveness and validity of the data assimilation approach for accurate prediction of the behavior of fusion plasmas and the possibility of advanced transport modeling.

**ASSIMILATION RESULTS**

- We apply ASTI to particle and heat transport of NBI heated plasma in LHD.
- We define the state vector as the following table.
- This assimilation is performed with 1000 ensemble members for assimilation cycle 80 msec.
- Therefore, the state vector is approximated by an ensemble of 1000 members.
- The obtained temperature and density (not shown) profiles and temporal changes agree well with measured ones.
- At almost all times, the error rates of prediction by ASTI (row labeled ‘With DA’) are less than 0.1 in both temperature and density, while those by TASK3D (‘Without DA’) are greater than 0.3. (error rate = (prediction - obs.)/obs.)
- We can confirm that the TASK3D simulation using the smoothed estimates of model parameters by the EnKS can reproduce the experimental time series data with high accuracy. This indicates the validity of the EnKS estimation.
- We have applied ASTI to the experimental time series data of NBI heated plasma in LHD. The obtained density and temperature radial profiles and temporal variations have been agreed well with measured ones. Moreover, we have confirmed that the simulation using the smoothed estimates of model parameters can reproduce the observation time series data with high accuracy.
- We can verify the effectiveness and validity of data assimilation (ASTI) for accurate prediction and analysis of fusion plasma behavior.

**DATA ASSIMILATION SYSTEM**

- We are developing a data assimilation system, ASTI based on the integrated transport simulation code, TASK3D to predict and control the behavior of fusion plasmas with high accuracy [Y. Morishita et al., NIFS20KLPT007, ISM (2019-ISMCRP-2027 & 2020-ISMCRP-2026), and collaborative research on the Remote Experiment Center (REC) of the International Fusion Energy Research Center (IFERC)].
- ASTI can also be used to estimate the variables which cannot be observed and the model parameters that can reproduce experimental time series data.
- We apply ASTI to particle and heat transport of NBI heated plasma in LHD.
- We have developed the data assimilation system, ASTI for the particle and heat transport simulation of LHD plasmas.
- We have applied ASTI to the experimental time series data of NBI heated plasma in LHD. The obtained density and temperature radial profiles and temporal variations have been agreed well with measured ones. Moreover, we have confirmed that the simulation using the smoothed estimates of model parameters can reproduce the observation time series data with high accuracy.
- These results indicate the effectiveness and validity of data assimilation (ASTI) for accurate prediction and analysis of fusion plasma behavior.

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