12-4 Supporting Evaluation of Tera- to Petabyte Scale Data
—Proposal of Novel Data Analysis Method for Large Scale Simulation—

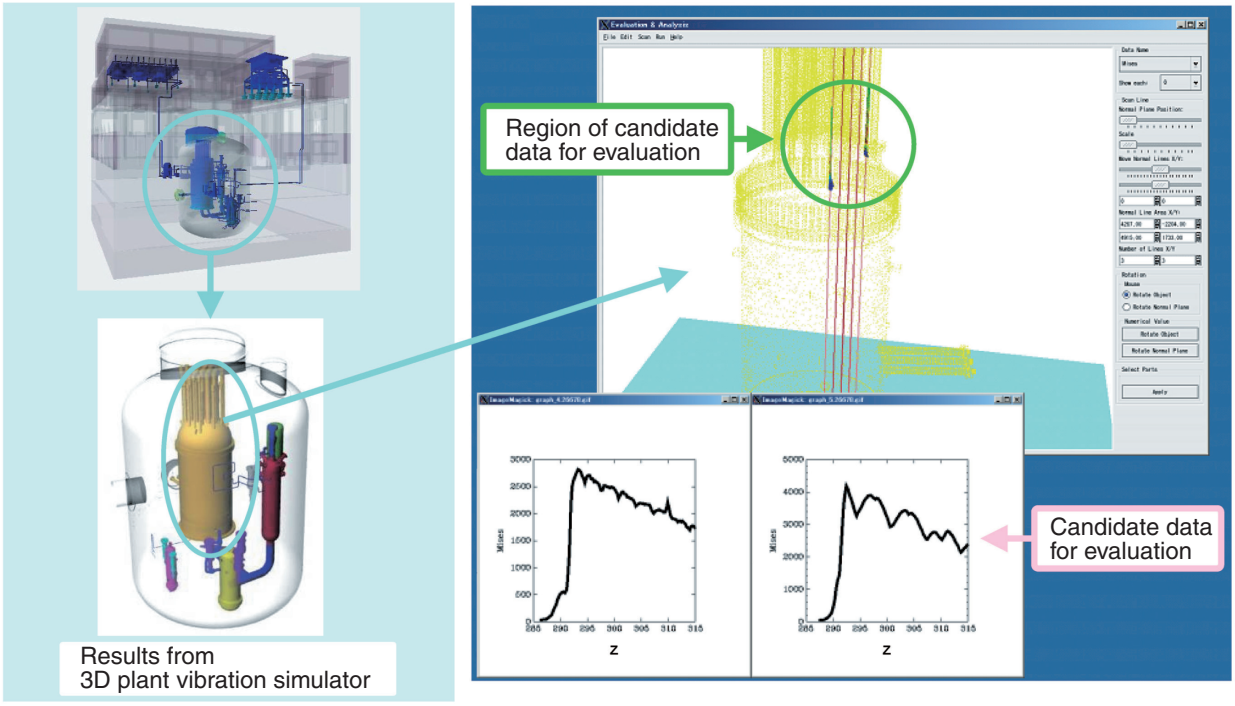

Fig.12-9 Example of application of the novel data analysis method to results from 3D plant vibration simulator
We applied our data analysis method to the results obtained from a 3D plant vibration simulator with which the behavior of a nuclear plant in an earthquake larger than the design anticipated is simulated. As a result, we succeeded in the automatic extraction and visualization of candidate data for evaluation by sensing changes of physical quantities such as stress distribution, and thus identified the regions of potential damage.

We carried out computer science research aiming at establishing a novel data analysis method to evaluate tera to peta byte scale data output from simulations in the nuclear energy field.

In a traditional evaluation of results of large scale simulation, the following processes need to be repeatedly carried out: (1) extracting and visualizing portions of data, (2) extracting and visualizing data of a cross-section, (3) extracting and visualizing distribution information, and (4) evaluating these results. Problems here are the exertions required for extracting relevant information from visualized results by human judgment, and the time required for extraction and visualization. For example, it takes more than one hour just for data-transfer to the computer for the evaluation of just the time data obtained from 3D plant vibration simulator.

To deal with the problem with extracting data, we have developed a function which calculates the rate of change of physical quantities and classifies successive changes according to certain characteristics in order to selectively extract and visual only a portion of the data. Here, we have solved the problems with traditional analysis methods such as the derivation and difference method, where errors of recognition readily occur and uniform analysis is difficult. Analogous to the way persons recognize a spatial profile as a pattern, we utilized a neural network method, which is an information processing method able to develop pattern recognition capability. As a result, we were able to uniformly analyze global and local rate of changes and to classify these characteristics according to a user's instruction.

To deal with the problem of excessive time requirements, we have developed a function which makes computers process with simple operations such as extraction of cross-section. We have realized pattern recognition in a parallel and distributed manner and have reduced data transfer time to a few seconds, by using the grid computing technology for nuclear research which we have developed, the Atomic Energy Grid Infrastructure (AEGIS).

We have succeeded in reducing the effort and time required to analyze data output from the 3D plant vibration simulator, thus helping make it possible to analyze this data (Fig.12-9).

As a result of this R&D, at the International Conference for High Performance Computing, Networking, Storage and Analysis (SC07, SC08) our innovative methodology we proposed was highly regarded, we won prizes two years in a row (Analytics Challenge Finalist).

Reference

Kino, C., Suzuki, Y. et al., Concept Design of Cognitive Methodology Based Data Analysis System —Application to Seismic Analysis Using Finite Element Method—, Transactions of the Japan Society for Computational Engineering and Science, vol.2008, no.18, paper no.20080018, 2008, 8p. (in Japanese).