# §18. Performance Improvement in Real-Time Mapping of Thomson Scattering Data to Flux Coordinates in LHD

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Flux coordinates are more useful than Cartesian coordinates for analyzing the plasma behavior in the Large Helical Device (LHD). Therefore, the authors developed the equilibrium database to map the Cartesian coordinates to the flux coordinate. Using the database, Suzuki has developed TSMAP (Thomson Scattering MAPping). This is a PV-Wave application to map electron temperature profile measured by Thomson scattering to the flux coordinate. The system adopts client-server architecture; TSMAP asks the server the flux coordinates of interest positions and conditions, the server looks for the flux coordinates calculated in advance. If no exact data found, the server interpolates the calculated values. The profiles calculated by TSMAP are fundamental data to analyze the plasma physics during the experiment. Therefore, they are required as soon as possible. However, the execution of TSMAP needs the computational power, and the performance of a typical personal computer is not high enough to catch up with the 3-minute plasma discharge cycle.

In order to increase the performance, the authors adopt the parallel computing approach. First, the authors used 6 virtual PC to calculate the profiles of different plasma shots simultaneously (Fig 1) [1]. It currently takes more than 600 s for TSMAP to complete the calculation. Although the calculation speed does not change, the total calculation speed increases and manages to keep up with the experiment sequence. Using virtual machines makes it easy to enhance the performance simply by copying the virtual machine images. However, this method does not reduce the calculation time for single-shot data. Therefore,

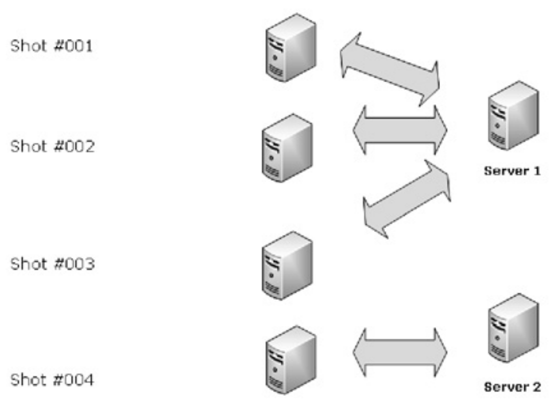


Fig. 1. Each computer calculates mapping data for a given shot number.

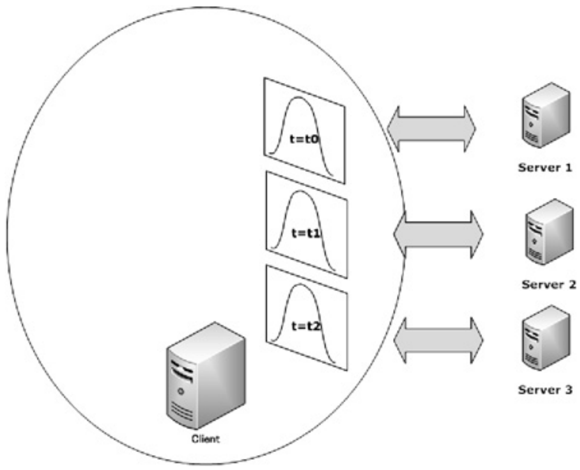


Fig. 2. Each process calculates the mapping data for a given time frame of the same shot number.

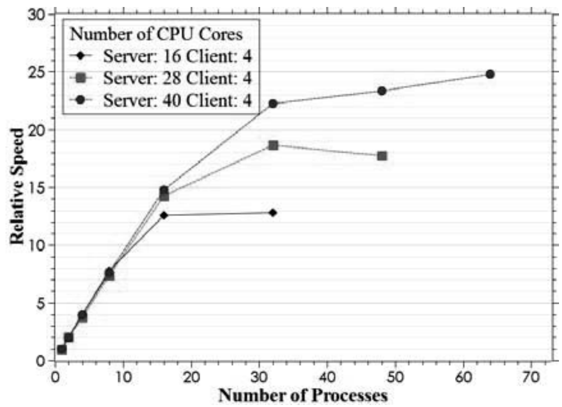


Fig. 3. Relative calculation speed vs. number of processes.

it is necessary to enhance the calculation speed for a single shot.

Because the calculation of a certain time is independent of the calculation of other times, these calculations can be executed simultaneously (Fig 2). The new system was developed using this idea to run the multiple processes simultaneously [2]. Because it is difficult to write parallel computing program in PV-Wave, the program is rewritten in Python. Fig. 3 shows the results of this system. As the number of processes increases, the calculation speed increases, and it becomes 25 times faster than that of the current system, or 25 s.

1) Emoto, M., et al: 21st International Toki Conference, Toki, Japan (2011)
2) Emoto, M., et al: 8th IAEA Technical Meeting on Control, Data Acquisition, and Remote Participation for Fusion Research, San Francisco, USA (2011)