Usage Report for Fiscal Year 2019

Project Title:

Development of a non-destructive method for bridge inspection with reflecting imaging based on compact neutron source

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1. Background and purpose of the project, relationship of the project with other projects

Concrete structure has been widely used in the modern buildings (such as bridges, high ways and so on). It is important to inspect the health condition of the concrete structure, especially when the buildings are in service for a long time or have suffered from natural disaster (like earthquake). Our group is dedicated to develop the non-destructive methods based on compact neutron source for bridge/highway inspection, such as reflecting imaging, prompt gamma analysis, computer tomography and so on, which can show the void, water and corrosion situation of steel in the concrete structure. During the research process, in order to design and improve the experiment system, as well as deeply understand the experiment data, Monte Carlo simulation is needed. Geant4 code is an useful tool for simulating neutron transportation in the whole compact neutron source, large thickness concrete and the whole experiment hall. However, such simulation always needs large amount of computation resources. Therefore, we applied the super computer account for the simulation.

2. Specific usage status of the system and calculation method

The Geant4 software has been installed successfully on the Hokusai system under the help of the HOKUSAI system administrator. And also root software can be compiled with Geant4 for simulation data process. At present, we can parallel Geant4 code with multithread mode, and then we merge the data from different nodes by root software. The parallel computation with MPI between different nodes still needs to be solved, which is related to editing of code in geant4. We are trying to achieve the parallel computation between different nodes with MPI in Geant4, and it is hopefully to be solved in recent months

3. Result

We established the simulation model of RIKEN accelerator-driven compact neutron source (RANS) (including accelerator part), RANS experimental hall, including new beam dump of RANS and RANS-II shielding shelter by Geant4 code, which are the main components to be considered for the important back ground estimation of RANS experiments. The visualization image of the model is shown in figure1.

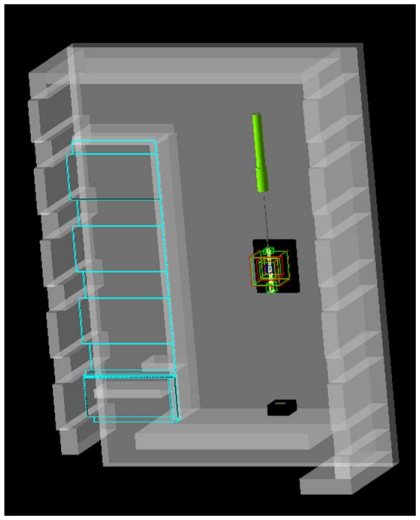

Figure 1. RANS experiment simulation model established by Geant4

Then we used the above model to simulate the neutron energy spectrum at 5m away from the moderator surface, which is shown in figure2. From the result, it can be observed that the intensity of thermal neutron peak (~50meV) with experimental hall is nearby 3 time as that without experimental hall, which can be regarded as the background reflected by the experimental hall. Therefore, the existing of experimental hall has serious impact on

the experiment data, and it is important to add the proper shielding materials to stop such background in the experiment. The related simulation including experimental hall can provide the reference for the shielding design.

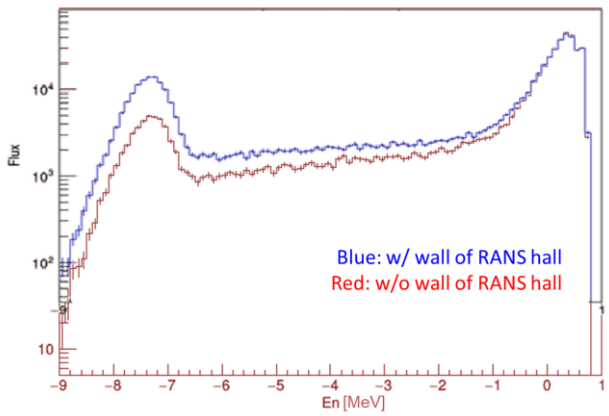

Figure 2. Neutron energy spectrum at 5m away from the moderator (4cm thickness) surface

4. Conclusion

We have established the experiment simulation model of RANS and experimental hall by geant4 code, which can be used to conduct related simulation about experiment on RANS.

5. Schedule and prospect for the future

(1). Calculate the equivalent dose distribution in whole experimental hall with Geant4 code, and then make a comparison with Phits results;

(2). Establish the new RANS configuration including cold neutron source model, and calculate the energy spectrum and equivalent dose at the concerned position;

(3). Conduct the related simulation about reflecting imaging and linear scanning CT, and try to provide the reference for shielding design to reduce the influence of background in the experiment.

6. If no job was executed, specify the reason.

Fiscal Year 2019 List of Publications Resulting from the Use of the supercomputer

[Poster presentation]

Mingfei Yan, Yasuo Wakabayashi, Yoshie Otake, Yujiro Ikeda, Atsushi Taketani, Takao Hashiguchi, Sheng Wang, Binbin Tian, Takaoki Takanashi, Tomohiro Kobayashi, and Baolong Ma. Reconstruction on fast neutron CT for concrete structure inspection with a pixel-type detector by applying linear scanning method, UCANS-8, July 8-10th, 2019, Paris.