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LAT-PIV 手法を用いた間隙流速測定と CTRW モデルのパラメータ推定
Measurement of pore velocity by using LAT-PIV, and parameter estimation of CTRW

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In recent years, the problem of soil pollution has been concerned in Japan. Soil pollution has some problems. For example, while soil pollution is close to us, but we could hardly to feel the pollution itself. Furthermore, the remediation of ground requires enormous costs and long time. This is the reason why we have to predict and take measures in early stages.

Recently CTRW (: Continuous Time Random Walk) model has been widely attempted to predict the behavior of substances in the groundwater. This model can describe the anomalous diffusion that it is difficult for ADE (Advection-Dispersion Equation) to describe. However, in the CTRW model, it is one of the most difficult problems that the model parameters cannot be fixed a priori.

In this study, we proposed a method to estimate the parameter A of CTRW by using the LAT-PIV (Laser Aided Tomography-Particle image velocimetry) method. LAT-PIV is a method that can visualize the internal structure of porous medium, and the behavior of tracers in fluid. We packed the glass beads of 2mm-5mm and 5mm-10mm in the clear plastic box (10 cm in length, 10 cm in width, 40 cm in height), and then filled the acryl box with silicone oil and tracer particles. Silicone oil is poured with the pomp at constant flow velocity, and razor sheet is irradiated to the plastic box from the side. We can hereby observe the internal behavior of porous medium. We conducted experiments and obtained the histogram of the pore velocity in the porous medium. After that, we calculated the value of A from the shape of histogram.

In this computer program which outputs pore velocity, the pore velocity is calculated by comparing two continuous visualized images. In this process, every image is divided into 1536 parts (48 by 32 parts) and the pore velocity is calculated at each grid. At this time, each grid searches the grid where tracers moved.

However, we found two problems in this process. When searching the exact grid where tracers moved, some unexpected pore velocities are calculated because the glass beads are distributed in various places. To avoid calculating these abnormal velocities, we improved this computer program. The glass points are shown by black pixels in images. We replaced these black points with red pixels that shows pore fluid. Because of this improvement, we succeed in reducing some unexpected pore velocities.

Another problem is that the zero velocity is calculated at the almost black grid (showing almost glass beads), which does not actually show the behavior of tracer particles. To make this computer program not to calculate such zero velocity, we set a certain threshold value. Because of this improvement, each grid became be able to decrease the zero velocity one tenth in comparison with the original.

As a result of analyzing the images by using improved algorism, we obtained some pore velocity distributions. From the pore velocity distribution, we estimated the value of A. When we used the glass beads of 5mm-10mm, the value of A was 0.635, and when we used the glass beads of 2mm-5mm, the values of A were 0.979 and 0.916. From this result, we found that the size of glass beads influences the value of A, on the contrary, the flow rate is not related to the value of A.

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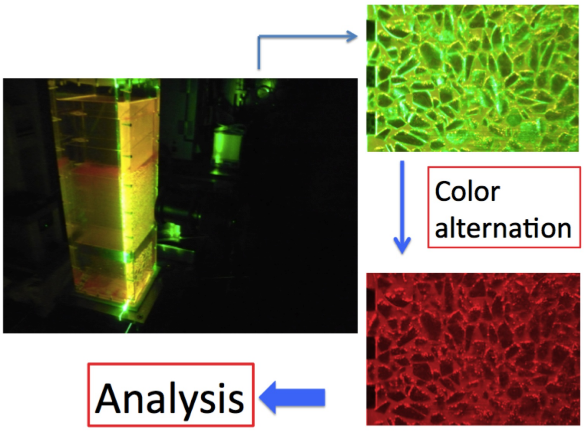
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