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Development of oil behavior visualization technology using X-ray CT, and confirmation of the effectiveness of particle method CFD.

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It is important to reduce CO_2 emissions in order to address the issue of global warming, and fuel-efficient transaxle (T/A) technology is required. In order to develop an efficient T/A, it is very important to have a design technology that achieves appropriate lubrication by gear agitation. However, it is difficult to accurately measure oil behavior due to gear agitation. Although we can visualize the oil through transparent cases, we can only see the oil flow on the surface. We are also making predictions using particle method CFD. However, it cannot be verified because the oil behavior inside the T/A cannot be measured.

In this study, in order to measure oil behavior due to gear agitation, we invented a measuring device that combines medical X-ray CT and a drive device [Fig.1]. In addition, we reduced noise with resin T/A in order to see oil behavior more clearly. The resin T/A was designed to allow testing under the highest vehicle speed conditions. Moreover, it is difficult to detect oil by X-ray CT because the oil in the T/A often contains bubbles. Therefore, we conducted a basic experiment in which the bubble ratio was changed and created an imaging filter in order to accurately distinguish the oil.

By applying these improvement methods, we were able to measure the deepest oil behavior inside the T/A [Fig.2]. Furthermore, we also verified the particle method CFD. Compared with the images from the X-ray CT measurements, it was found that the results of the particle method CFD were approximately the same. However, when we examine the results in detail, it was found that there was a difference in the behavior of the oil blown by the gear and the amount of oil in a sump. By repeating basic tests and determining the parameters to be optimized [Fig.3], we were able to improve the accuracy of the particle method CFD [Fig.4].

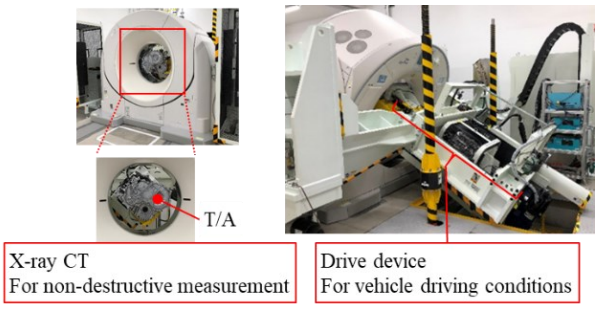

Fig.1 Device that measures oil behavior in a transaxle

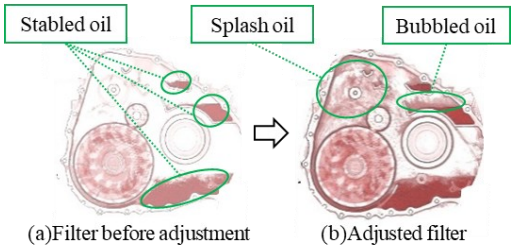

Fig.2 Visualization of oil behavior using X-ray CT

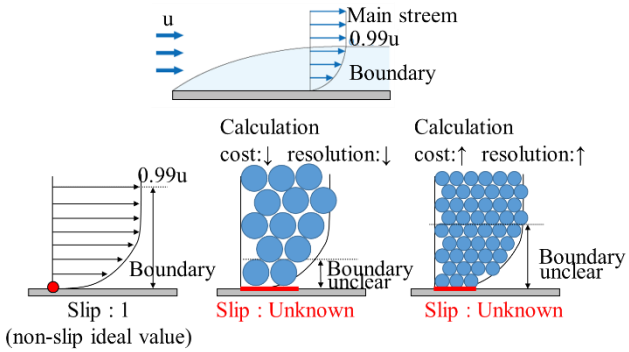

Fig.3 Parameters to optimize for particle method CFD

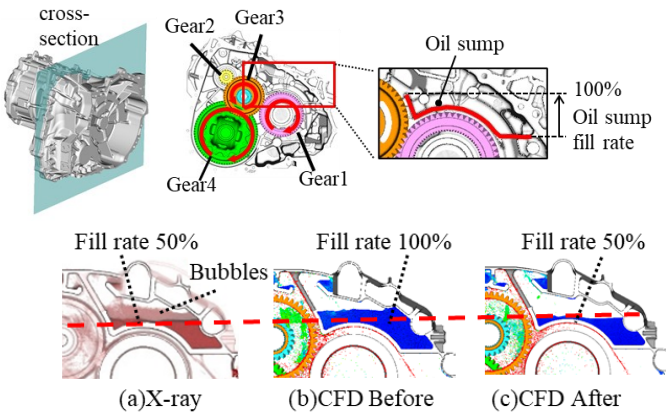

Fig.4 Improving the accuracy of particle method CFD