Numerical Flow Visualization

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Numerical simulations using recent computers produce large amount of data. To understand the results and find underlying physics, postprocessing of the such simulation data is critically important. Visualization is the most common postprocessing method for the computed data. Simple graph plots or contour plots were used frequently in old days (and they are still very useful), but new tools become required with the growth of the data size. Fortunately, development of computers accelerates the capability of the graphic representation of the data both from hardware and software view points. With the graphic representation, important features of the data can be easily understood and it helps our understanding the contents of the data through visualized images.

Now, there are many commercial software available for the computational flow visualization. However, most of them focus on showing nice color graphics and do not consider importance of analyzing the data. The graphics used for creating nice pictures are called "presentation graphics". On the other hand, graphics for the genuine research are called "research graphics". In the presentation, visualization software and its graphic interface are discussed. Of course, emphasis is laid on the "research graphics".

In research graphics, most emphasized point is good response that is necessary for the researchers to deduce underlying physics hiding in the data. Mostly, sophisticated images are (of course useful, but) not as important as quick response. Low quality images may be better than sophisticated images if obtained quickly. Suppose it takes two days to obtain nice pictures that use sophisticated renderings, it would not be useful for the research.

In the presentation, some of the ideas that are useful for the research are shown. One example is the simulation of experimental flow visualization. Using this technique, we can quantitatively compare the computations with the experiment. The detail will be shown at the presentation. Second example is a "feature probe". When CFD becomes an engineering tool and many people start using CFD simulations just as a tool for the analysis, the software may be required to have additional capability. The same is true when the data is too large and the researchers cannot imagine what to plot or where to look at. Here, "feature probe" is required. Feature probe is an intelligent system that tells the user what to do. With the feature probe, researchers can focus on the region that should be analyzed. These special features of the visualization software used for the postprocessing of the computed results would be a big help for the research of fluid dynamics.