A New Bottleneck in Large-Scale Numerical Simulations of Transient Phenomena, and Cooperation Between Simulations and the Post-Processes

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ABSTRACT

A new bottleneck in large-scale numerical simulation, particularly of transient phenomena, has begun surfacing[1]. The bottleneck is in its post-processes, that is data handling, i.e., storage I/O, reconstructing the results of parallel calculation, and data transfer from a front-end node of super computer to researcher's PCs. As a solution strategy for the bottleneck, we discuss the effectiveness of cooperated simulation between a numerical simulation and its post-processes[2], and also report an implementation of it for OpenFOAM[3].

In order to clarify the details of the bottleneck, we consider the study process of a numerical study for sounding mechanism of flue musical instruments, e.g., recorder, flute, organ pipe, etc[4]., as an example. The study process is, in general, able to be took as a "plan-do-check-act (PDCA) cycle", where "plan", "do", "check" and "act" can denote pre-process, numerical simulation, post-process (data handling, visualization, etc.) and determination of succeeding calculation conditions, respectively. Recently, the most costly stage of the PDCA cycle in numerical study has been changing from "do" to "check" stage. In the case of a numerical study[4], whose calculations are executed on Fujitsu PRIMERGY CX400 (Intel(R) Xeon(R) CPU E5-2680 @ 2.70GHz, 23616 cores) in R.I.I.T. Kyushu University, "do", i.e., main numerical simulation generates about 5TB in 36Mega files a day. On the other hand, the time occupied by "check", i.e., post-processes for these data exceed 10 days.

Applying cooperated simulation between the numerical simulation and its post-processes, as a kind of pipeline process, to OpenFOAM can tuck almost all the post-processes into the numerical simulation stage. This strategy can also reduce the time cost of post-processes to one tenth on our numerical study.

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