The “CUtil” Package for GPU-Accelerated Computing

Kazutaka Doi[1,*†], Kei Sakabe[†]

1. Fukushima Project Headquarters, National Institute of Radiological Sciences, Japan
[†] Both authors contributed equally to this work
*Contact author: kztkdi@gmail.com

Keywords: GPU computing, CUDA, Windows, parallel computing

Since we made presentation about our package **CUtil** (**CU**DA™ U**til**ity package) in useR! 2011[1], we were reconstructing the library for further improvements. Though **CUtil** package has been developed for providing computing power of graphical processing units (GPUs) for *R* users (especially for Windows® users) easily, our package did not accelerate calculations much compared with standard *R*. Therefore, we have improved our package drastically as follows.

The major time consuming procedure in the previous version was video memory allocation in GPUs, and this kind of operations is suppressed as possible. Because *R* codes appeared frequently in the previous version, which caused performance loss in some part, exposures of *R* codes are minimized. Furthermore, the required time for CPU tasks conducted before and after GPU tasks was not negligible, so our package is now multi-threaded by using Boost C++ library. With other minor improvements not mentioned above, the new version of our package will be ready at the time of the useR! 2014 with following features.

There are three main features in this package. The first feature is the *R*-native GPU function calls. Users can call GPU functions from *R* like other default functions in *R*. The second feature is the functionality to keep data on video memory even after GPU computing is over and the control is returned to *R*. When users call the functions of our package, the given data is automatically transferred to video memory and the pointer to the memory is stored into the *R* object as an external pointer. As the data is kept in the video memory, no time is needed for transfer in further function calls. As it is known that the proportion of time needed for the data transfer is relatively large, this advantage will be beneficial especially for a long series of computations, such as Markov chain Monte Carlo methods in Bayesian statistics. The third feature is the override of default functions. Users can override the default *R* functions by our package's functions. By using this functionality, users can accelerate their own codes by our package with minimum modifications. Other features are that double precision floating-point calculations are fully supported, and complex number computations are also partly supported. Garbage-collection, which enables us to use a small amount of video memory effectively, will be implemented, and the execution will be multi-threaded. This package will require computers with NVIDIA®’s GPU (compute capability is equal to or greater than 2.0). We are now preparing the Windows binary package. Linux® binary package will be available soon.

References

[1] Doi K, Sakabe K (2011). The “CUtil” package which enables GPU computation in R. In *useR! 2011, The R User Conference (Coventry, UK)*, pp. 24.