BOF Summary SC13

"High Precision Arithmetic Operations: Libraries and Applications"

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We have organized a Birds of a Feather Session entitled "High Precision Arithmetic Operations: Libraries and Applications" in Supercomputing Conference '13 on November 20 12:15-1:15 at Room 301/302/303. An aim of our BOF was that researchers working on high precision arithmetic techniques and applications met face-to-face and presented recent progress. We have asked the following three speakers to present their recent work on high precision arithmetic operations:

(1) Maho Nakata (RIKEN)
"The MPACK library: A multiple precision version of BLAS and LAPACK"

(2) Daisuke Takahashi (University of Tsukuba)
"High Precision Arithmetic Operations: Libraries and Applications"

(3) David H. Bailey (Lawrence Berkeley National Laboratory)
"Conquering Numerical Error"

The slides of the talks are available at our web site for the BOF: http://suchix.kek.jp/mpcomp/bof_SC13.html

We have more than 50 participants in our BOF session when the session begun. The session organizers have handed the questionnaire sheet to every participant. Also we have prepared the online version of the questionnaire (http://goo.gl/1SxRFe).

Before three talks, Naohito Nakasato gave a brief opening talk. Dr. Nakata introduced the MPACK library and explained concepts behind the library and implementation details followed by the performance evaluations on GPU. Dr. Takahashi presented new high precision arithmetic libraries on GPU

with a triple precision format and CUMP (CUDA implementation of GNU Multiple Precision algorithms). Finally, Dr. Bailey explained fundamental reasons why we need high precision arithmetic operations, i.e., numerical reproducibility, and presented many real world applications such as planetary-orbit calculations, supernova calculations, and climate modeling etc. Dr. Bailey has also introduced us the application of the high precision arithmetic in experimental mathematics and effectiveness of techniques developed by him and his colleagues. The three talks gave us an excellent overview of the current state-of-the-art development of this field. In all talks, we have discussion for a few questions/comments from the audience. We concluded the BOF by asking the participants to return the questionnaire sheet or to answer later with the on-online questionnaire.

Photo during the session

After the BOF, we have collected the sheets (13 sheets) and found a few answers on the on-line questionnaire. We summarize answers for the questionnaire as follows;

(a) Is your application numerically unstable in a standard precision (i.e. double precision)?

Yes 6 / No 4 / Both 1

(b) How many digits do you want to solve your numerically unstable problem?

DD(30 digits) 5 / QD(60 digits) 4/ More(arbitrary digits) 4

(c) What compiler/library/software support do you want to practically use high precision arithmetic?

Compiler with flags, ifort, xlf, MKL, BLAS, LAPACK, MPRF, Binary128 format

(d) Do you want the support in hardware for high precision arithmetic?

Yes 9 / No 2

Based on the questionnaire result, more than half participants (including session leaders and speakers ourselves!) have practical problems that require high precision arithmetic operations. To our surprise, many of them need really high precision as 60 digits being available with the quad-double (QD) scheme. To satisfy these requirements, we practically need support in vendor compilers and standard numerical libraries. Still there is no hardware level support in commercially available processors, however, there is strong demand from users for such support to speed-up high precision arithmetic operations. As noted by Dr. Bailey in his talk, the numerical reproducibility preserved by high precision techniques is being even more important in extremely parallel processing in now and future.

After the success of the first BOF on this subject, we are convinced of the importance of effort to engage researchers interested on high precision arithmetic operations at Supercomputing Conference.