waveCUDA: an R package for performing CUDA-accelerated wavelet analysis

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We introduce a new *R* package **waveCUDA** that performs *CUDA*-accelerated Discrete Wavelet Transforms (DWTs). Whilst there are existing libraries available in *R* for wavelet analysis, notably **waveslim**, **wavethresh** and **wmtsa**, these do not use the GPU (Graphics Processing Unit) for accelerated computation. GPUs are highly parallel by construction, and *CUDA* allows programmers to take advantage of this using explicit parallel programming.[1] There are already some *R* packages that do parallel computing using GPUs such as **gputools** and **HiPLARM**.

The DWT, with the exception of the Haar transform, is not parallelisable using the traditional pyramid algorithm. However, Wim Sweldens developed the Wavelet Lifting Scheme which is both parallelisable and allows for calculations to be made in-place in memory.[2] Some authors have successfully written *CUDA*-accelerated DWTs (e.g. [3]) - but **waveCUDA** will provide a suite of functions for *CUDA*-accelerated wavelet analysis in R. This package is in development and will gain features over the course of time. At the time of writing, we have implemented transforms with filter lengths up to 4, with significant speed-ups over serial *C* code.

References

[1] Nvidia (2011). NVIDIA CUDA programming guide.

[2] Sweldens, W. (1996, April). The Lifting Scheme: A Custom-Design Construction of Biorthogonal Wavelets. *Applied and Computational Harmonic Analysis 3*(2), 186–200.

[3] van der Laan, W. (2011). Accelerating wavelet lifting on graphics hardware using CUDA. *IEEE transactions on parallel and distributed systems 22*(1), 132–146.