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Solving DWF Dirac Equation Using Multi-splitting Preconditioned Conjugate Gradient with Tensor Cores on NVIDIA GPUs

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We show that using the multi-splitting algorithm as a preconditioner for the domain wall Dirac linear operator, arising in lattice QCD, effectively reduces the inter-node communication cost, at the expense of performing more on-node floating point and memory operations. Correctly including the boundary \textit{snake} terms, the preconditioner is implemented in the QUDA framework, where it is found that utilizing kernel fusion and the tensor cores on NVIDIA GPUs is necessary to achieve a sufficiently performant preconditioner. A reduced-dimension (reduced-L_s) strategy is also proposed and tested for the preconditioner. We find the method achieves lower time to solution than regular CG at high node count despite the additional local computational requirements from the preconditioner. This method could be useful for supercomputers with more on-node flops and memory bandwidth than inter-node communication bandwidth.

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