Column reduced digital nets

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For many applications in finance, statistics and uncertainty quantification, we are interested in approximation of integrals of the form $\int_D f(\boldsymbol{x}^\top A)\mathrm{d}\mu(\boldsymbol{x})$ by quasi Monte Carlo (QMC) rules

$$\frac{1}{N}\sum_{k=0}^{N-1} f(\boldsymbol{x}_k^\top A),$$

where A is a matrix and $\boldsymbol{x}_k$ are points corresponding to the QMC rule. In [1], the authors looked at QMC rules which could speed up the computation of $\boldsymbol{x}_k^\top A$. In addition to reduced lattices, they also looked at row-reduced digital nets.

In this work, we extend some of the results from [1] to column-reduced digital nets and highlight some advantages over row-reduced digital nets. In particular, given a (t, m, s)-digital net that is derived from a (t, s)-sequence, we derive some bounds for the t-value of the column-reduced net, which we use in our error analysis and also look at the speed up of the computational cost with some numerical experiments.

[1] J. Dick, A. Ebert, L. Herrmann, P. Kritzer, M. Longo (2023). *The fast reduced QMC matrix-vector product.* J. Comput. Appl. Math. 440, 115642.