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**Efficiency of Randomized Coordinate Descent Methods on  
Minimization Problems with a Composite Objective  
Function**

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In this work we develop a randomized block-coordinate descent method for minimizing the sum of a smooth and a simple nonsmooth block-separable convex function and establish iteration complexity bounds. This extends recent results of Nesterov (Efficiency of coordinate descent methods on huge-scale optimization problems 2010), which cover the smooth case, to composite minimization, while improving the complexity and simplifying the analysis. In the smooth case we allow for arbitrary norms and probability vectors.

Using both synthetic and real data, we demonstrate numerically that the method is able to solve various optimization problems with a billion variables. Such problems can be found, for example, in Compressed Sensing (lasso), Statistics (group lasso), Machine Learning (L1-regularized logistic or L2 loss function) and Engineering (truss topology design).

For the L1-regularized least squares problem we implement a GPU-accelerated parallel version of our algorithm (CUDA) and observe speedups of up to two orders of magnitude when compared with an efficient serial code (C).