

On the Block Chebyshev Davidson Algorithm for PSVD

Zheng Wang

April 21, 2014

1 Numerical Studies

We test the `bchdav_svd` algorithm on the matrices 'Nytimes' and 'News20' to study the effect of three important parameters: polynomial degree (*polym*), block size (*blk*) and maximum active subspace dimension (*vimax*). In our experiment, maximum subspace dimension (*vomax*) is set to a large number such that no outer restart occurs.

1.1 Effect of the polynomial degree

With all other parameters fixed, increasing the polynomial degree would

1. increase #mat-vec-product each time the filter is used;
2. reduce #iteration, reorthogonalization cost and refinement cost (due to larger eigenvalue gaps).

Therefore, if we start from a small *polym* and gradually increase it, total CPU time cost would probably first reduce and then increase after some large *polym*.

Table (1.1) summarizes parameters used to test the effect of *polym* on the convergence. Fig.(1.1) – Fig.(1.4) show the results of our experiments. The numerical results are consistent with our expectation except for *polym* = 12 in Fig.(1.2). When *polym* goes from 10 to 12, both #mat-vec-product and #iteration grow rapidly. We also want to mention that in these 4 tests, `bchdav_svd` does not converge when *polym* is larger than 12.

1.2 Effect of the block size

1.3 Effect of the maximum active subspace dimension

Matrix	k	blk	vimax	polym
News20	100	20	100	1:1:12
Nytimes	100	20	100	2:2:12
Nytimes	100	10	60	2:2:10
Nytimes	100	5	40	2:2:10

Table 1.1: parameters used to test the effect of polynomial degree

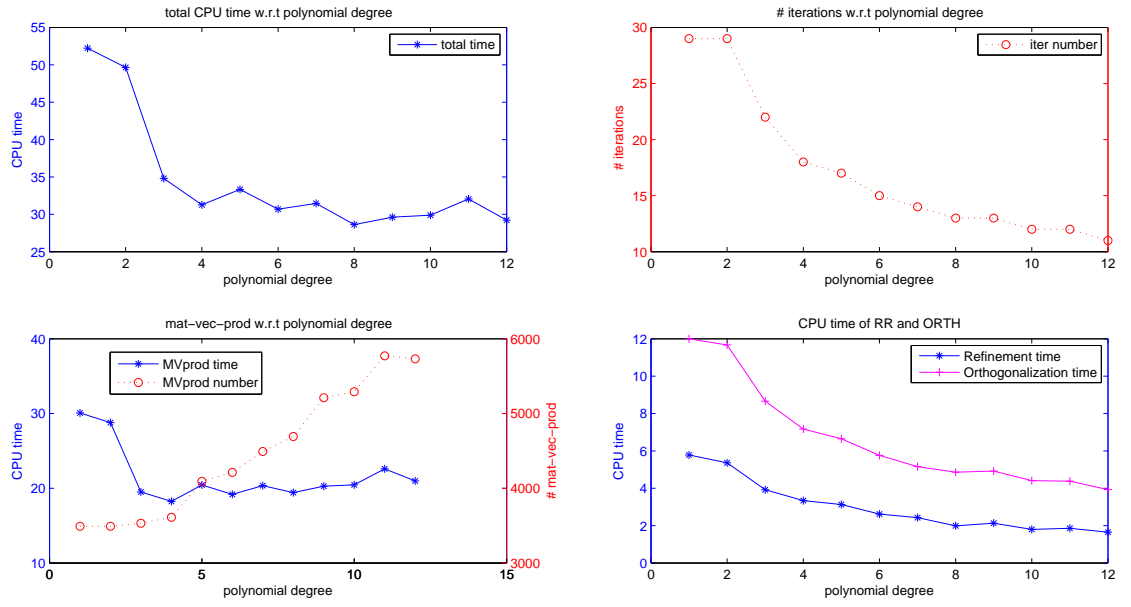


Figure 1.1: The effect of polym on converging 100 largest singular triplets for News20 with $blk = 20$, $v_{imax} = 100$.

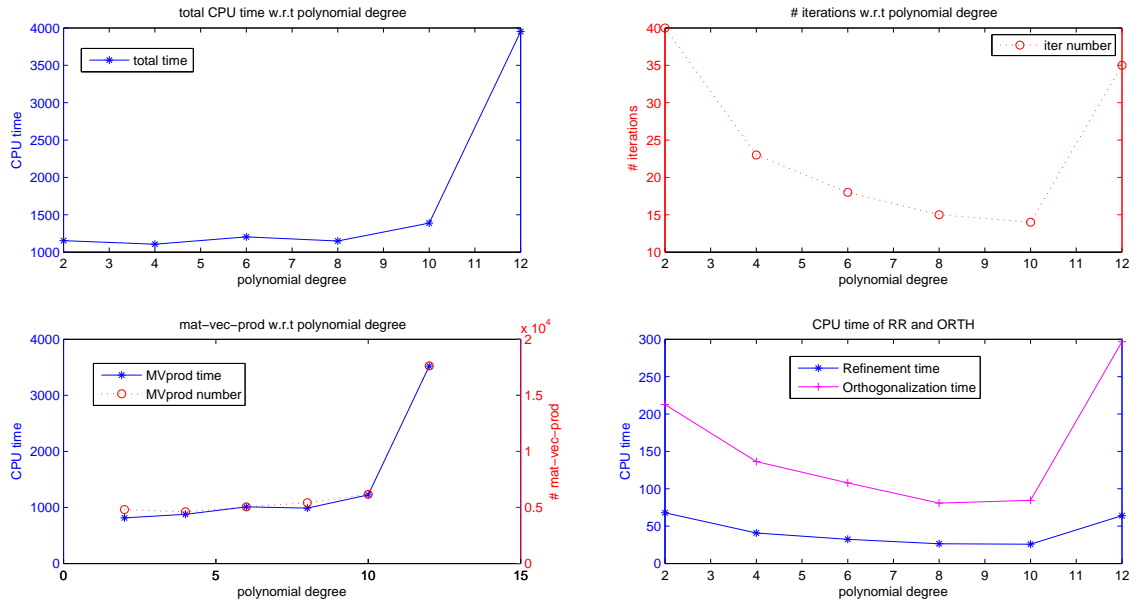


Figure 1.2: The effect of polym on converging 100 largest singular triplets for Nytimes with $blk = 20$, $v_{imax} = 100$.

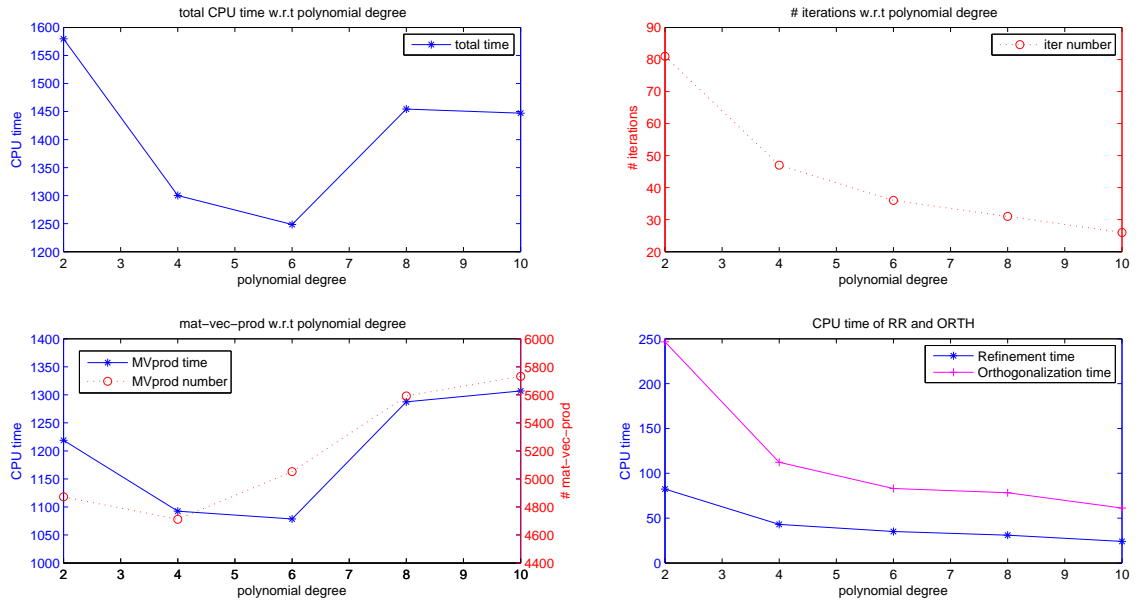


Figure 1.3: The effect of polym on converging 100 largest singular triplets for News20 with $blk = 10$, $vimax = 60$.

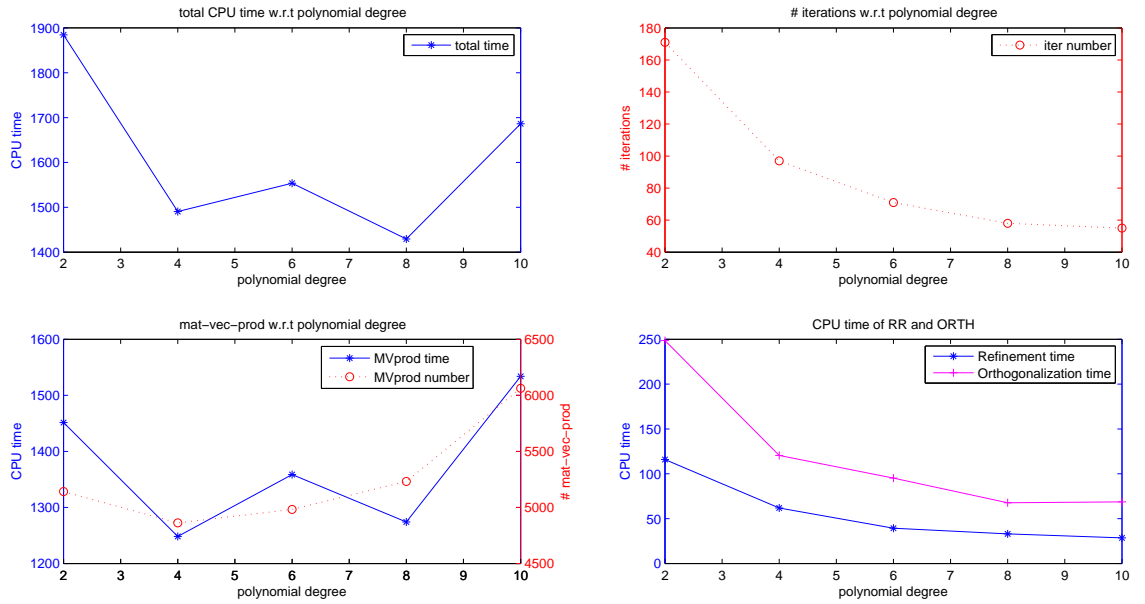


Figure 1.4: The effect of polym on converging 100 largest singular triplets for News20 with $blk = 5$, $vimax = 40$.