

Table 1: Results

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb1a57 698	Classic	$2.096 \times 10^{-11}$		$1.7078 \times 10^{-3}$	
	Quaternion	$2.092 \times 10^{-11}$	$1.8861 \times 10^{-12}$	$1.0276 \times 10^{-3}$	0.602
pdb1b4c 1108	Classic	$5.070 \times 10^{-13}$		$3.5365 \times 10^{-3}$	
	Quaternion	$5.498 \times 10^{-13}$	$1.0757 \times 10^{-12}$	$2.5634 \times 10^{-3}$	0.725
pdb1ba5 320	Classic	$9.359 \times 10^{-13}$		$3.6012 \times 10^{-4}$	
	Quaternion	$1.070 \times 10^{-12}$	$4.1376 \times 10^{-12}$	$2.7669 \times 10^{-4}$	0.768
pdb1d1n 594	Classic	$1.005 \times 10^{-11}$		$5.9682 \times 10^{-4}$	
	Quaternion	$9.672 \times 10^{-12}$	$1.2689 \times 10^{-12}$	$4.7694 \times 10^{-4}$	0.799
pdb1dp3 332	Classic	$7.704 \times 10^{-13}$		$2.9789 \times 10^{-4}$	
	Quaternion	$8.939 \times 10^{-13}$	$1.4697 \times 10^{-12}$	$2.3080 \times 10^{-4}$	0.775
pdb1du1 122	Classic	$8.225 \times 10^{-13}$		$1.0246 \times 10^{-4}$	
	Quaternion	$1.258 \times 10^{-12}$	$1.2376 \times 10^{-12}$	$7.8000 \times 10^{-5}$	0.761
pdb1eii 806	Classic	$1.393 \times 10^{-11}$		$8.2178 \times 10^{-4}$	
	Quaternion	$1.365 \times 10^{-11}$	$1.1331 \times 10^{-11}$	$6.5466 \times 10^{-4}$	0.797
pdb1fcl 338	Classic	$4.542 \times 10^{-12}$		$4.5137 \times 10^{-4}$	
	Quaternion	$4.515 \times 10^{-12}$	$8.0786 \times 10^{-13}$	$3.4246 \times 10^{-4}$	0.759
pdb1fd6 344	Classic	$3.182 \times 10^{-12}$		$3.4143 \times 10^{-4}$	
	Quaternion	$3.193 \times 10^{-12}$	$3.3846 \times 10^{-13}$	$2.6441 \times 10^{-4}$	0.774
pdb1hf9 496	Classic	$1.157 \times 10^{-11}$		$9.6480 \times 10^{-3}$	
	Quaternion	$1.180 \times 10^{-11}$	$3.9332 \times 10^{-12}$	$6.1200 \times 10^{-3}$	0.634
pdb1i2u 266	Classic	$5.562 \times 10^{-13}$		$2.5459 \times 10^{-4}$	
	Quaternion	$5.607 \times 10^{-13}$	$1.5136 \times 10^{-13}$	$2.0184 \times 10^{-4}$	0.793
pdb1i2v 266	Classic	$2.418 \times 10^{-13}$		$2.7989 \times 10^{-4}$	
	Quaternion	$2.519 \times 10^{-13}$	$6.9127 \times 10^{-14}$	$2.2032 \times 10^{-4}$	0.787
pdb1ijc 380	Classic	$1.408 \times 10^{-11}$		$5.5728 \times 10^{-4}$	
	Quaternion	$1.426 \times 10^{-11}$	$2.4877 \times 10^{-12}$	$4.1998 \times 10^{-4}$	0.754
pdb1jlz 140	Classic	$5.594 \times 10^{-13}$		$1.2392 \times 10^{-4}$	
	Quaternion	$5.965 \times 10^{-13}$	$1.3105 \times 10^{-12}$	$9.5602 \times 10^{-5}$	0.771
pdb1jw3 842	Classic	$5.936 \times 10^{-13}$		$8.6446 \times 10^{-4}$	
	Quaternion	$5.897 \times 10^{-13}$	$3.9013 \times 10^{-13}$	$6.7580 \times 10^{-4}$	0.782
pdb1k0v 440	Classic	$1.893 \times 10^{-13}$		$4.6703 \times 10^{-4}$	
	Quaternion	$1.894 \times 10^{-13}$	$1.3433 \times 10^{-13}$	$3.5593 \times 10^{-4}$	0.762
pdb1k2h 1120	Classic	$5.491 \times 10^{-13}$		$2.9241 \times 10^{-3}$	
	Quaternion	$5.199 \times 10^{-13}$	$2.2039 \times 10^{-13}$	$1.9975 \times 10^{-3}$	0.683
pdb1k36 278	Classic	$8.820 \times 10^{-12}$		$2.6454 \times 10^{-4}$	
	Quaternion	$1.081 \times 10^{-11}$	$2.8981 \times 10^{-11}$	$1.9812 \times 10^{-4}$	0.749
pdb1k37 278	Classic	$4.711 \times 10^{-13}$		$3.8419 \times 10^{-4}$	
	Quaternion	$4.988 \times 10^{-13}$	$1.5479 \times 10^{-13}$	$2.7588 \times 10^{-4}$	0.718
pdb1kuw 62	Classic	$9.229 \times 10^{-14}$		$5.8623 \times 10^{-5}$	
	Quaternion	$1.130 \times 10^{-13}$	$7.3457 \times 10^{-14}$	$4.3799 \times 10^{-5}$	0.747
pdb1kz0 98	Classic	$4.404 \times 10^{-14}$		$9.2082 \times 10^{-5}$	
	Quaternion	$5.880 \times 10^{-14}$	$2.4335 \times 10^{-13}$	$6.9233 \times 10^{-5}$	0.752
pdb1kz2 98	Classic	$2.119 \times 10^{-14}$		$1.0225 \times 10^{-4}$	
	Quaternion	$2.886 \times 10^{-14}$	$2.6112 \times 10^{-14}$	$7.2798 \times 10^{-5}$	0.712
pdb1kz5 74	Classic	$4.081 \times 10^{-14}$		$7.3916 \times 10^{-5}$	
	Quaternion	$4.738 \times 10^{-14}$	$4.8348 \times 10^{-14}$	$5.2574 \times 10^{-5}$	0.711
pdb1lvz 68	Classic	$6.336 \times 10^{-14}$		$6.5156 \times 10^{-5}$	
	Quaternion	$7.315 \times 10^{-14}$	$7.3919 \times 10^{-14}$	$4.6871 \times 10^{-5}$	0.719
pdb1m4e 122	Classic	$5.949 \times 10^{-13}$		$1.3874 \times 10^{-4}$	
	Quaternion	$5.972 \times 10^{-13}$	$1.1702 \times 10^{-13}$	$8.5423 \times 10^{-5}$	0.616
pdb1ma2 104	Classic	$8.695 \times 10^{-12}$		$2.3923 \times 10^{-4}$	
	Quaternion	$8.758 \times 10^{-12}$	$4.7062 \times 10^{-13}$	$1.0667 \times 10^{-4}$	0.446
pdb1ma4 104	Classic	$7.247 \times 10^{-14}$		$4.1287 \times 10^{-4}$	
	Quaternion	$7.981 \times 10^{-14}$	$1.8851 \times 10^{-13}$	$1.7248 \times 10^{-4}$	0.418
pdb1ma5	Classic	$8.169 \times 10^{-13}$		$1.5005 \times 10^{-4}$	

Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
104	Quaternion	$9.044 \times 10^{-13}$	$5.0234 \times 10^{-13}$	$7.2148 \times 10^{-5}$	0.481
pdblma6	Classic	$6.283 \times 10^{-13}$		$1.4103 \times 10^{-4}$	
104	Quaternion	$8.522 \times 10^{-13}$	$3.3052 \times 10^{-12}$	$7.0075 \times 10^{-5}$	0.497
pdblmpe	Classic	$2.617 \times 10^{-11}$		$8.1131 \times 10^{-3}$	
1352	Quaternion	$2.624 \times 10^{-11}$	$7.1261 \times 10^{-13}$	$3.4902 \times 10^{-3}$	0.430
pdblnd9	Classic	$3.026 \times 10^{-13}$		$4.5081 \times 10^{-4}$	
296	Quaternion	$3.845 \times 10^{-13}$	$4.7137 \times 10^{-13}$	$2.2590 \times 10^{-4}$	0.501
pdblne5	Classic	$1.214 \times 10^{-12}$		$3.6696 \times 10^{-4}$	
254	Quaternion	$1.384 \times 10^{-12}$	$7.5582 \times 10^{-13}$	$1.8293 \times 10^{-4}$	0.498
pdblnmj	Classic	$1.237 \times 10^{-14}$		$2.6603 \times 10^{-4}$	
170	Quaternion	$1.424 \times 10^{-14}$	$1.3921 \times 10^{-14}$	$1.3008 \times 10^{-4}$	0.489
pdblo53	Classic	$3.999 \times 10^{-13}$		$1.4899 \times 10^{-4}$	
92	Quaternion	$4.545 \times 10^{-13}$	$6.5350 \times 10^{-13}$	$6.9913 \times 10^{-5}$	0.469
pdbloqp	Classic	$7.045 \times 10^{-14}$		$3.0062 \times 10^{-3}$	
580	Quaternion	$8.315 \times 10^{-14}$	$9.0066 \times 10^{-14}$	$1.6903 \times 10^{-3}$	0.562
pdblplw	Classic	$2.830 \times 10^{-14}$		$4.5461 \times 10^{-5}$	
32	Quaternion	$3.122 \times 10^{-14}$	$4.9118 \times 10^{-14}$	$2.2201 \times 10^{-5}$	0.488
pdblplx	Classic	$1.574 \times 10^{-13}$		$4.2650 \times 10^{-5}$	
32	Quaternion	$2.060 \times 10^{-13}$	$1.7973 \times 10^{-13}$	$2.0929 \times 10^{-5}$	0.491
pdblpv0	Classic	$2.409 \times 10^{-13}$		$4.4412 \times 10^{-4}$	
278	Quaternion	$2.723 \times 10^{-13}$	$1.0662 \times 10^{-13}$	$2.0904 \times 10^{-4}$	0.471
pdblpzz	Classic	$5.644 \times 10^{-12}$		$6.4490 \times 10^{-3}$	
724	Quaternion	$5.871 \times 10^{-12}$	$9.9935 \times 10^{-12}$	$3.5690 \times 10^{-3}$	0.553
pdblqlk	Classic	$9.019 \times 10^{-10}$		$1.0829 \times 10^{-2}$	
1108	Quaternion	$9.019 \times 10^{-10}$	$1.3287 \times 10^{-12}$	$5.9579 \times 10^{-3}$	0.550
pdblr57	Classic	$1.847 \times 10^{-13}$		$9.6998 \times 10^{-4}$	
614	Quaternion	$2.054 \times 10^{-13}$	$1.4866 \times 10^{-13}$	$4.8680 \times 10^{-4}$	0.502
pdblry3	Classic	$4.938 \times 10^{-13}$		$6.3087 \times 10^{-4}$	
386	Quaternion	$5.910 \times 10^{-13}$	$4.7678 \times 10^{-13}$	$3.0993 \times 10^{-4}$	0.491
pdbls4h	Classic	$4.300 \times 10^{-9}$		$1.0674 \times 10^{-4}$	
80	Quaternion	$4.300 \times 10^{-9}$	$1.1103 \times 10^{-12}$	$5.3186 \times 10^{-5}$	0.498
pdbls4j	Classic	$1.520 \times 10^{-13}$		$1.2866 \times 10^{-4}$	
80	Quaternion	$2.230 \times 10^{-13}$	$1.6407 \times 10^{-13}$	$6.7311 \times 10^{-5}$	0.523
pdbls6j	Classic	$6.073 \times 10^{-13}$		$7.9899 \times 10^{-4}$	
524	Quaternion	$7.660 \times 10^{-13}$	$5.9201 \times 10^{-13}$	$4.0640 \times 10^{-4}$	0.509
pdblsa8	Classic	$9.340 \times 10^{-13}$		$9.9482 \times 10^{-4}$	
638	Quaternion	$1.034 \times 10^{-12}$	$1.0370 \times 10^{-12}$	$5.2774 \times 10^{-4}$	0.530
pdblt2y	Classic	$1.887 \times 10^{-13}$		$2.3413 \times 10^{-4}$	
152	Quaternion	$2.396 \times 10^{-13}$	$2.3861 \times 10^{-13}$	$1.4533 \times 10^{-4}$	0.621
pdblt5q	Classic	$3.877 \times 10^{-14}$		$2.5394 \times 10^{-4}$	
180	Quaternion	$5.093 \times 10^{-14}$	$5.3231 \times 10^{-14}$	$1.3255 \times 10^{-4}$	0.522
pdbltot	Classic	$6.148 \times 10^{-14}$		$5.0126 \times 10^{-4}$	
314	Quaternion	$6.853 \times 10^{-14}$	$2.8392 \times 10^{-14}$	$3.1670 \times 10^{-4}$	0.632
pdblv6r	Classic	$6.835 \times 10^{-13}$		$1.9619 \times 10^{-4}$	
128	Quaternion	$6.970 \times 10^{-13}$	$3.1917 \times 10^{-13}$	$1.1899 \times 10^{-4}$	0.607
pdblv92	Classic	$1.463 \times 10^{-13}$		$4.3360 \times 10^{-4}$	
278	Quaternion	$1.630 \times 10^{-13}$	$5.6062 \times 10^{-14}$	$2.6571 \times 10^{-4}$	0.613
pdblvd7	Classic	$3.741 \times 10^{-9}$		$2.0593 \times 10^{-4}$	
140	Quaternion	$3.741 \times 10^{-9}$	$5.8433 \times 10^{-13}$	$1.2499 \times 10^{-4}$	0.607
pdblvd9	Classic	$1.290 \times 10^{-12}$		$2.4388 \times 10^{-4}$	
140	Quaternion	$1.554 \times 10^{-12}$	$9.0327 \times 10^{-13}$	$1.4591 \times 10^{-4}$	0.598
pdblvdb	Classic	$9.108 \times 10^{-13}$		$1.9946 \times 10^{-4}$	
140	Quaternion	$1.083 \times 10^{-12}$	$3.8641 \times 10^{-13}$	$1.1987 \times 10^{-4}$	0.601
pdblvpc	Classic	$8.500 \times 10^{-15}$		$4.1694 \times 10^{-4}$	
272	Quaternion	$1.002 \times 10^{-14}$	$8.5436 \times 10^{-15}$	$2.6033 \times 10^{-4}$	0.624

Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb1wnk 140	Classic	$4.112 \times 10^{-12}$		$2.0699 \times 10^{-4}$	
	Quaternion	$4.632 \times 10^{-12}$	$2.2335 \times 10^{-11}$	$1.2347 \times 10^{-4}$	0.596
pdb1wo4 152	Classic	$9.957 \times 10^{-13}$		$2.3205 \times 10^{-4}$	
	Quaternion	$9.639 \times 10^{-13}$	$2.3523 \times 10^{-12}$	$1.4194 \times 10^{-4}$	0.612
pdb1wo5 152	Classic	$5.257 \times 10^{-9}$		$2.3551 \times 10^{-4}$	
	Quaternion	$5.258 \times 10^{-9}$	$4.9063 \times 10^{-12}$	$1.4405 \times 10^{-4}$	0.612
pdb1x60 476	Classic	$1.076 \times 10^{-12}$		$7.9397 \times 10^{-4}$	
	Quaternion	$1.179 \times 10^{-12}$	$3.9684 \times 10^{-13}$	$4.9474 \times 10^{-4}$	0.623
pdb1x9v 544	Classic	$8.975 \times 10^{-13}$		$2.7541 \times 10^{-2}$	
	Quaternion	$9.632 \times 10^{-13}$	$1.3900 \times 10^{-13}$	$1.4581 \times 10^{-2}$	0.529
pdb1y5c 68	Classic	$8.980 \times 10^{-9}$		$9.7438 \times 10^{-5}$	
	Quaternion	$8.980 \times 10^{-9}$	$2.9085 \times 10^{-13}$	$5.8897 \times 10^{-5}$	0.604
pdb1yx7 500	Classic	$8.116 \times 10^{-10}$		$1.1530 \times 10^{-3}$	
	Quaternion	$8.125 \times 10^{-10}$	$7.6614 \times 10^{-12}$	$7.0746 \times 10^{-4}$	0.614
pdb1yx8 500	Classic	$7.276 \times 10^{-12}$		$9.4071 \times 10^{-4}$	
	Quaternion	$8.217 \times 10^{-12}$	$1.0819 \times 10^{-11}$	$5.8516 \times 10^{-4}$	0.622
pdb1yxr 464	Classic	$5.838 \times 10^{-10}$		$6.7687 \times 10^{-4}$	
	Quaternion	$5.839 \times 10^{-10}$	$2.5240 \times 10^{-13}$	$4.1626 \times 10^{-4}$	0.615
pdb2a2y 1072	Classic	$1.150 \times 10^{-12}$		$3.1010 \times 10^{-2}$	
	Quaternion	$1.151 \times 10^{-12}$	$3.7416 \times 10^{-13}$	$1.7439 \times 10^{-2}$	0.562
pdb2a4j 580	Classic	$2.085 \times 10^{-14}$		$1.0563 \times 10^{-3}$	
	Quaternion	$2.727 \times 10^{-14}$	$1.4394 \times 10^{-14}$	$6.4214 \times 10^{-4}$	0.608
pdb2adl 868	Classic	$1.752 \times 10^{-11}$		$3.5641 \times 10^{-2}$	
	Quaternion	$1.787 \times 10^{-11}$	$3.0093 \times 10^{-12}$	$2.3248 \times 10^{-2}$	0.652
pdb2adn 868	Classic	$6.693 \times 10^{-12}$		$1.9119 \times 10^{-3}$	
	Quaternion	$6.465 \times 10^{-12}$	$2.4957 \times 10^{-12}$	$1.1481 \times 10^{-3}$	0.601
pdb2ajj 170	Classic	$5.641 \times 10^{-14}$		$2.5994 \times 10^{-4}$	
	Quaternion	$6.584 \times 10^{-14}$	$1.2744 \times 10^{-13}$	$1.5702 \times 10^{-4}$	0.604
pdb2ajm 170	Classic	$1.183 \times 10^{-13}$		$2.7954 \times 10^{-4}$	
	Quaternion	$1.555 \times 10^{-13}$	$8.9439 \times 10^{-13}$	$1.6885 \times 10^{-4}$	0.604
pdb2ajn 170	Classic	$1.076 \times 10^{-13}$		$2.7914 \times 10^{-4}$	
	Quaternion	$1.217 \times 10^{-13}$	$1.5981 \times 10^{-13}$	$1.6719 \times 10^{-4}$	0.599
pdb2ajo 170	Classic	$1.183 \times 10^{-13}$		$2.7899 \times 10^{-4}$	
	Quaternion	$1.555 \times 10^{-13}$	$8.9439 \times 10^{-13}$	$1.6861 \times 10^{-4}$	0.604
pdb2akk 446	Classic	$1.288 \times 10^{-13}$		$1.4448 \times 10^{-3}$	
	Quaternion	$1.270 \times 10^{-13}$	$1.1725 \times 10^{-13}$	$8.4721 \times 10^{-4}$	0.586
pdb2bzb 748	Classic	$9.365 \times 10^{-14}$		$1.4315 \times 10^{-2}$	
	Quaternion	$1.224 \times 10^{-13}$	$1.5097 \times 10^{-13}$	$7.7992 \times 10^{-3}$	0.545
pdb2c0s 386	Classic	$3.028 \times 10^{-13}$		$6.2433 \times 10^{-4}$	
	Quaternion	$3.379 \times 10^{-13}$	$7.2067 \times 10^{-13}$	$3.8866 \times 10^{-4}$	0.623
pdb2dci 120	Classic	$2.366 \times 10^{-14}$		$1.7238 \times 10^{-4}$	
	Quaternion	$2.950 \times 10^{-14}$	$1.3479 \times 10^{-13}$	$1.0593 \times 10^{-4}$	0.615
pdb2eem 206	Classic	$5.190 \times 10^{-13}$		$3.6143 \times 10^{-4}$	
	Quaternion	$5.461 \times 10^{-13}$	$4.0208 \times 10^{-13}$	$2.1835 \times 10^{-4}$	0.604
pdb2fva 494	Classic	$1.047 \times 10^{-12}$		$1.0303 \times 10^{-3}$	
	Quaternion	$1.194 \times 10^{-12}$	$1.5803 \times 10^{-12}$	$6.1618 \times 10^{-4}$	0.598
pdb2fvf 494	Classic	$3.106 \times 10^{-13}$		$7.4317 \times 10^{-4}$	
	Quaternion	$3.445 \times 10^{-13}$	$2.8750 \times 10^{-13}$	$4.6101 \times 10^{-4}$	0.620
pdb2fxz 80	Classic	$1.489 \times 10^{-12}$		$1.2207 \times 10^{-4}$	
	Quaternion	$1.749 \times 10^{-12}$	$2.0430 \times 10^{-12}$	$7.5061 \times 10^{-5}$	0.615
pdb2g9j 848	Classic	$3.282 \times 10^{-12}$		$4.9852 \times 10^{-2}$	
	Quaternion	$3.535 \times 10^{-12}$	$2.1668 \times 10^{-12}$	$2.6562 \times 10^{-2}$	0.533
pdb2g9l 224	Classic	$6.366 \times 10^{-14}$		$3.5082 \times 10^{-4}$	
	Quaternion	$8.672 \times 10^{-14}$	$2.8081 \times 10^{-13}$	$2.1658 \times 10^{-4}$	0.617

Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb2h5m 614	Classic	$9.692 \times 10^{-13}$		$9.9657 \times 10^{-4}$	
	Quaternion	$1.032 \times 10^{-12}$	$4.1376 \times 10^{-12}$	$6.2269 \times 10^{-4}$	0.625
pdb2hep 252	Classic	$1.191 \times 10^{-12}$		$3.9601 \times 10^{-4}$	
	Quaternion	$1.268 \times 10^{-12}$	$5.5848 \times 10^{-13}$	$2.3695 \times 10^{-4}$	0.598
pdb2j0z 752	Classic	$3.192 \times 10^{-10}$		$2.3683 \times 10^{-1}$	
	Quaternion	$3.197 \times 10^{-10}$	$4.5324 \times 10^{-12}$	$1.4497 \times 10^{-1}$	0.612
pdb2j10 752	Classic	$5.870 \times 10^{-10}$		$4.3767 \times 10^{-3}$	
	Quaternion	$5.873 \times 10^{-10}$	$9.5552 \times 10^{-13}$	$2.4477 \times 10^{-3}$	0.559
pdb2j11 752	Classic	$7.191 \times 10^{-10}$		$3.7834 \times 10^{-3}$	
	Quaternion	$7.194 \times 10^{-10}$	$1.6970 \times 10^{-12}$	$2.1799 \times 10^{-3}$	0.576
pdb2jmy 92	Classic	$9.834 \times 10^{-13}$		$1.4579 \times 10^{-4}$	
	Quaternion	$9.967 \times 10^{-13}$	$5.0812 \times 10^{-13}$	$8.8216 \times 10^{-5}$	0.605
pdb2jn5 74	Classic	$3.147 \times 10^{-9}$		$1.0386 \times 10^{-4}$	
	Quaternion	$3.160 \times 10^{-9}$	$1.4394 \times 10^{-11}$	$6.2820 \times 10^{-5}$	0.605
pdb2jnk 842	Classic	$4.387 \times 10^{-10}$		$1.3640 \times 10^{-3}$	
	Quaternion	$4.388 \times 10^{-10}$	$3.9471 \times 10^{-13}$	$8.6217 \times 10^{-4}$	0.632
pdb2jpn 476	Classic	$6.730 \times 10^{-14}$		$1.1801 \times 10^{-3}$	
	Quaternion	$6.983 \times 10^{-14}$	$1.9605 \times 10^{-13}$	$6.8326 \times 10^{-4}$	0.579
pdb2jua 614	Classic	$1.740 \times 10^{-11}$		$1.0169 \times 10^{-3}$	
	Quaternion	$1.882 \times 10^{-11}$	$1.4391 \times 10^{-11}$	$6.2303 \times 10^{-4}$	0.613
pdb2jvd 288	Classic	$3.339 \times 10^{-14}$		$4.7167 \times 10^{-4}$	
	Quaternion	$3.898 \times 10^{-14}$	$2.1712 \times 10^{-14}$	$2.8141 \times 10^{-4}$	0.597
pdb2jwe 984	Classic	$2.695 \times 10^{-11}$		$1.6909 \times 10^{-3}$	
	Quaternion	$2.734 \times 10^{-11}$	$1.0970 \times 10^{-12}$	$1.0624 \times 10^{-3}$	0.628
pdb2jws 338	Classic	$1.251 \times 10^{-13}$		$5.6601 \times 10^{-4}$	
	Quaternion	$1.543 \times 10^{-13}$	$2.8647 \times 10^{-13}$	$3.4449 \times 10^{-4}$	0.609
pdb2jwu 338	Classic	$4.421 \times 10^{-12}$		$7.6507 \times 10^{-4}$	
	Quaternion	$4.373 \times 10^{-12}$	$6.2322 \times 10^{-13}$	$4.5845 \times 10^{-4}$	0.599
pdb2jxf 182	Classic	$1.399 \times 10^{-13}$		$2.8468 \times 10^{-4}$	
	Quaternion	$1.734 \times 10^{-13}$	$5.8450 \times 10^{-13}$	$1.6879 \times 10^{-4}$	0.593
pdb2jz5 548	Classic	$2.860 \times 10^{-13}$		$1.0063 \times 10^{-3}$	
	Quaternion	$2.854 \times 10^{-13}$	$1.7635 \times 10^{-13}$	$6.1011 \times 10^{-4}$	0.606
pdb2k2a 422	Classic	$3.798 \times 10^{-14}$		$7.2133 \times 10^{-4}$	
	Quaternion	$5.134 \times 10^{-14}$	$1.3435 \times 10^{-13}$	$4.5278 \times 10^{-4}$	0.628
pdb2k2f 1268	Classic	$2.639 \times 10^{-13}$		2.9933	
	Quaternion	$2.818 \times 10^{-13}$	$7.2949 \times 10^{-14}$	1.5659	0.523
pdb2k36 896	Classic	$1.922 \times 10^{-13}$		$1.4278 \times 10^{-3}$	
	Quaternion	$2.045 \times 10^{-13}$	$1.2563 \times 10^{-13}$	$8.9244 \times 10^{-4}$	0.625
pdb2k37 356	Classic	$1.921 \times 10^{-13}$		$5.7554 \times 10^{-4}$	
	Quaternion	$2.525 \times 10^{-13}$	$4.0204 \times 10^{-13}$	$3.5444 \times 10^{-4}$	0.616
pdb2k3i 656	Classic	$3.810 \times 10^{-13}$		$1.4433 \times 10^{-3}$	
	Quaternion	$4.009 \times 10^{-13}$	$2.4790 \times 10^{-13}$	$8.6964 \times 10^{-4}$	0.603
pdb2k6s 494	Classic	$2.100 \times 10^{-13}$		$1.2378 \times 10^{-3}$	
	Quaternion	$2.651 \times 10^{-13}$	$4.8726 \times 10^{-13}$	$7.1448 \times 10^{-4}$	0.577
pdb2k7o 1096	Classic	$1.279 \times 10^{-13}$		$4.8228 \times 10^{-3}$	
	Quaternion	$1.416 \times 10^{-13}$	$4.6393 \times 10^{-13}$	$2.7638 \times 10^{-3}$	0.573
pdb2kbn 1268	Classic	$2.165 \times 10^{-13}$		1.1020	
	Quaternion	$2.230 \times 10^{-13}$	$2.6963 \times 10^{-13}$	$6.7994 \times 10^{-1}$	0.617
pdb2kdh 434	Classic	$1.947 \times 10^{-11}$		$7.8981 \times 10^{-4}$	
	Quaternion	$2.228 \times 10^{-11}$	$7.6317 \times 10^{-11}$	$4.7942 \times 10^{-4}$	0.607
pdb2kdl 338	Classic	$2.301 \times 10^{-13}$		$5.4839 \times 10^{-4}$	
	Quaternion	$2.927 \times 10^{-13}$	$3.1526 \times 10^{-13}$	$3.3213 \times 10^{-4}$	0.606
pdb2kdm 338	Classic	$3.191 \times 10^{-12}$		$5.3480 \times 10^{-4}$	
	Quaternion	$3.284 \times 10^{-12}$	$9.9439 \times 10^{-13}$	$3.3159 \times 10^{-4}$	0.620

Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb2kdp 428	Classic	$2.621 \times 10^{-13}$		$6.8306 \times 10^{-4}$	
	Quaternion	$2.865 \times 10^{-13}$	$1.0772 \times 10^{-13}$	$4.2205 \times 10^{-4}$	0.618
pdb2kdr 170	Classic	$6.617 \times 10^{-14}$		$2.7330 \times 10^{-4}$	
	Quaternion	$8.490 \times 10^{-14}$	$6.1679 \times 10^{-14}$	$1.5899 \times 10^{-4}$	0.582
pdb2kes 290	Classic	$4.468 \times 10^{-14}$		$5.0386 \times 10^{-4}$	
	Quaternion	$5.425 \times 10^{-14}$	$2.3286 \times 10^{-14}$	$2.9163 \times 10^{-4}$	0.579
pdb2kib 352	Classic	$2.533 \times 10^{-12}$		$6.0079 \times 10^{-3}$	
	Quaternion	$2.539 \times 10^{-12}$	$1.3388 \times 10^{-12}$	$3.2111 \times 10^{-3}$	0.534
pdb2kjn 158	Classic	$1.125 \times 10^{-9}$		$2.4788 \times 10^{-4}$	
	Quaternion	$1.125 \times 10^{-9}$	$1.3817 \times 10^{-13}$	$1.4894 \times 10^{-4}$	0.601
pdb2kjo 158	Classic	$2.284 \times 10^{-13}$		$2.3357 \times 10^{-4}$	
	Quaternion	$2.421 \times 10^{-13}$	$6.7185 \times 10^{-14}$	$1.4172 \times 10^{-4}$	0.607
pdb2kjr 572	Classic	$3.247 \times 10^{-12}$		$1.4415 \times 10^{-3}$	
	Quaternion	$3.251 \times 10^{-12}$	$4.0637 \times 10^{-13}$	$8.5930 \times 10^{-4}$	0.596
pdb2kko 1300	Classic	$1.191 \times 10^{-13}$		$8.6106 \times 10^{-3}$	
	Quaternion	$1.285 \times 10^{-13}$	$2.9766 \times 10^{-14}$	$4.8727 \times 10^{-3}$	0.566
pdb2kl5 662	Classic	$1.820 \times 10^{-13}$		$1.0275 \times 10^{-3}$	
	Quaternion	$2.020 \times 10^{-13}$	$1.3796 \times 10^{-13}$	$6.4496 \times 10^{-4}$	0.628
pdb2klz 276	Classic	$3.439 \times 10^{-14}$		$4.7020 \times 10^{-4}$	
	Quaternion	$4.443 \times 10^{-14}$	$6.4874 \times 10^{-14}$	$2.7869 \times 10^{-4}$	0.593
pdb2ko1 1060	Classic	$1.150 \times 10^{-12}$		$1.2485 \times 10^{-2}$	
	Quaternion	$1.151 \times 10^{-12}$	$7.8450 \times 10^{-13}$	$7.0322 \times 10^{-3}$	0.563
pdb2koz 200	Classic	$1.075 \times 10^{-9}$		$3.0575 \times 10^{-4}$	
	Quaternion	$1.075 \times 10^{-9}$	$8.8024 \times 10^{-13}$	$1.9136 \times 10^{-4}$	0.626
pdb2kp0 200	Classic	$4.893 \times 10^{-12}$		$3.0698 \times 10^{-4}$	
	Quaternion	$5.588 \times 10^{-12}$	$4.2756 \times 10^{-12}$	$1.8959 \times 10^{-4}$	0.618
pdb2ksg 290	Classic	$3.215 \times 10^{-14}$		$4.3551 \times 10^{-4}$	
	Quaternion	$3.967 \times 10^{-14}$	$2.4678 \times 10^{-14}$	$2.6495 \times 10^{-4}$	0.608
pdb2kt8 458	Classic	$3.314 \times 10^{-12}$		$7.0930 \times 10^{-4}$	
	Quaternion	$3.535 \times 10^{-12}$	$7.1394 \times 10^{-13}$	$4.4313 \times 10^{-4}$	0.625
pdb2kuh 404	Classic	$2.016 \times 10^{-14}$		$6.8106 \times 10^{-4}$	
	Quaternion	$2.492 \times 10^{-14}$	$4.0485 \times 10^{-14}$	$4.3151 \times 10^{-4}$	0.634
pdb2kwh 338	Classic	$1.408 \times 10^{-13}$		$5.2925 \times 10^{-4}$	
	Quaternion	$1.825 \times 10^{-13}$	$2.9549 \times 10^{-13}$	$3.1747 \times 10^{-4}$	0.600
pdb2kxa 144	Classic	$1.325 \times 10^{-12}$		$2.1473 \times 10^{-4}$	
	Quaternion	$1.351 \times 10^{-12}$	$3.5240 \times 10^{-13}$	$1.3425 \times 10^{-4}$	0.625
pdb2kyb 362	Classic	$1.321 \times 10^{-11}$		$1.6400 \times 10^{-3}$	
	Quaternion	$1.373 \times 10^{-11}$	$2.6755 \times 10^{-12}$	$9.2684 \times 10^{-4}$	0.565
pdb2l3m 428	Classic	$1.028 \times 10^{-12}$		$6.7557 \times 10^{-4}$	
	Quaternion	$9.340 \times 10^{-13}$	$6.9725 \times 10^{-13}$	$4.1986 \times 10^{-4}$	0.621
pdb2l3n 626	Classic	$3.025 \times 10^{-14}$		$4.0176 \times 10^{-3}$	
	Quaternion	$3.634 \times 10^{-14}$	$4.4517 \times 10^{-14}$	$2.2465 \times 10^{-3}$	0.559
pdb2l45 116	Classic	$2.236 \times 10^{-14}$		$1.8187 \times 10^{-4}$	
	Quaternion	$3.033 \times 10^{-14}$	$8.5325 \times 10^{-14}$	$1.1228 \times 10^{-4}$	0.617
pdb2l5r 138	Classic	$3.529 \times 10^{-14}$		$2.4104 \times 10^{-4}$	
	Quaternion	$4.432 \times 10^{-14}$	$1.4398 \times 10^{-14}$	$1.4613 \times 10^{-4}$	0.606
pdb2l6q 374	Classic	$4.959 \times 10^{-9}$		$5.7492 \times 10^{-4}$	
	Quaternion	$6.131 \times 10^{-9}$	$1.7792 \times 10^{-8}$	$3.4945 \times 10^{-4}$	0.608
pdb2l6r 374	Classic	$7.323 \times 10^{-10}$		$6.1184 \times 10^{-4}$	
	Quaternion	$7.325 \times 10^{-10}$	$2.4265 \times 10^{-11}$	$3.7345 \times 10^{-4}$	0.610
pdb2l98 434	Classic	$3.273 \times 10^{-13}$		$6.8739 \times 10^{-4}$	
	Quaternion	$3.638 \times 10^{-13}$	$8.9102 \times 10^{-13}$	$4.2127 \times 10^{-4}$	0.613
pdb2lci 806	Classic	$2.579 \times 10^{-13}$		$1.3251 \times 10^{-3}$	
	Quaternion	$2.404 \times 10^{-13}$	$8.2767 \times 10^{-14}$	$8.1420 \times 10^{-4}$	0.614

Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb2lde 152	Classic	$3.153 \times 10^{-14}$		$2.2579 \times 10^{-4}$	
	Quaternion	$3.762 \times 10^{-14}$	$4.1691 \times 10^{-14}$	$1.3643 \times 10^{-4}$	0.604
pdb2le2 676	Classic	$2.064 \times 10^{-13}$		$1.2162 \times 10^{-2}$	
	Quaternion	$2.042 \times 10^{-13}$	$7.7661 \times 10^{-14}$	$6.8292 \times 10^{-3}$	0.562
pdb2le7 122	Classic	$2.112 \times 10^{-14}$		$1.8287 \times 10^{-4}$	
	Quaternion	$2.749 \times 10^{-14}$	$3.9789 \times 10^{-14}$	$1.1091 \times 10^{-4}$	0.606
pdb2ler 68	Classic	$1.315 \times 10^{-14}$		$9.8364 \times 10^{-5}$	
	Quaternion	$1.532 \times 10^{-14}$	$2.1465 \times 10^{-14}$	$5.9976 \times 10^{-5}$	0.610
pdb2lgi 338	Classic	$1.068 \times 10^{-12}$		$5.3405 \times 10^{-4}$	
	Quaternion	$1.052 \times 10^{-12}$	$1.8917 \times 10^{-13}$	$3.3074 \times 10^{-4}$	0.619
pdb2lhc 338	Classic	$5.829 \times 10^{-10}$		$5.7812 \times 10^{-4}$	
	Quaternion	$5.830 \times 10^{-10}$	$2.1362 \times 10^{-12}$	$3.4725 \times 10^{-4}$	0.601
pdb2lhd 338	Classic	$1.930 \times 10^{-12}$		$7.2693 \times 10^{-4}$	
	Quaternion	$2.033 \times 10^{-12}$	$2.3902 \times 10^{-12}$	$4.3294 \times 10^{-4}$	0.596
pdb2lhe 338	Classic	$4.963 \times 10^{-11}$		$6.9959 \times 10^{-4}$	
	Quaternion	$4.967 \times 10^{-11}$	$4.8488 \times 10^{-13}$	$4.2128 \times 10^{-4}$	0.602
pdb2lhg 338	Classic	$6.459 \times 10^{-14}$		$5.4166 \times 10^{-4}$	
	Quaternion	$7.322 \times 10^{-14}$	$5.9754 \times 10^{-14}$	$3.4252 \times 10^{-4}$	0.632
pdb2lix 162	Classic	$4.842 \times 10^{-14}$		$2.5511 \times 10^{-4}$	
	Quaternion	$5.614 \times 10^{-14}$	$7.8975 \times 10^{-14}$	$1.5798 \times 10^{-4}$	0.619
pdb2lld 242	Classic	$1.937 \times 10^{-13}$		$3.8603 \times 10^{-4}$	
	Quaternion	$2.214 \times 10^{-13}$	$2.2642 \times 10^{-13}$	$2.4657 \times 10^{-4}$	0.639
pdb2lm9 578	Classic	$6.254 \times 10^{-14}$		$9.2867 \times 10^{-4}$	
	Quaternion	$7.713 \times 10^{-14}$	$1.5079 \times 10^{-13}$	$5.5919 \times 10^{-4}$	0.602
pdb2lmf 140	Classic	$1.282 \times 10^{-13}$		$2.0512 \times 10^{-4}$	
	Quaternion	$1.462 \times 10^{-13}$	$7.9808 \times 10^{-14}$	$1.2216 \times 10^{-4}$	0.596
pdb2ln3 500	Classic	$1.292 \times 10^{-13}$		$8.2481 \times 10^{-4}$	
	Quaternion	$1.359 \times 10^{-13}$	$8.4114 \times 10^{-14}$	$5.0672 \times 10^{-4}$	0.614
pdb2lo2 230	Classic	$2.068 \times 10^{-14}$		$3.5286 \times 10^{-4}$	
	Quaternion	$2.571 \times 10^{-14}$	$3.6944 \times 10^{-14}$	$2.1708 \times 10^{-4}$	0.615
pdb2lqp 428	Classic	$2.950 \times 10^{-13}$		$6.8026 \times 10^{-4}$	
	Quaternion	$3.085 \times 10^{-13}$	$4.7561 \times 10^{-13}$	$4.1891 \times 10^{-4}$	0.616
pdb2lr0 806	Classic	$3.549 \times 10^{-12}$		$1.3663 \times 10^{-3}$	
	Quaternion	$3.440 \times 10^{-12}$	$6.0485 \times 10^{-13}$	$8.4248 \times 10^{-4}$	0.617
pdb2lrh 806	Classic	$5.631 \times 10^{-13}$		$1.3271 \times 10^{-3}$	
	Quaternion	$6.564 \times 10^{-13}$	$3.2048 \times 10^{-13}$	$8.1453 \times 10^{-4}$	0.614
pdb2ls9 152	Classic	$1.122 \times 10^{-13}$		$2.1166 \times 10^{-4}$	
	Quaternion	$1.471 \times 10^{-13}$	$3.7128 \times 10^{-13}$	$1.2974 \times 10^{-4}$	0.613
pdb2lsa 140	Classic	$5.235 \times 10^{-14}$		$2.0973 \times 10^{-4}$	
	Quaternion	$7.034 \times 10^{-14}$	$1.5385 \times 10^{-13}$	$1.3006 \times 10^{-4}$	0.620
pdb2lss 422	Classic	$1.230 \times 10^{-13}$		$6.5717 \times 10^{-4}$	
	Quaternion	$1.455 \times 10^{-13}$	$1.6926 \times 10^{-13}$	$4.1698 \times 10^{-4}$	0.635
pdb2lt3 680	Classic	$7.245 \times 10^{-14}$		$1.0848 \times 10^{-3}$	
	Quaternion	$7.760 \times 10^{-14}$	$5.2634 \times 10^{-14}$	$6.8766 \times 10^{-4}$	0.634
pdb2lu6 86	Classic	$5.356 \times 10^{-15}$		$1.3180 \times 10^{-4}$	
	Quaternion	$6.922 \times 10^{-15}$	$4.1890 \times 10^{-15}$	$7.8526 \times 10^{-5}$	0.596
pdb2lwa 432	Classic	$3.615 \times 10^{-13}$		$6.6402 \times 10^{-4}$	
	Quaternion	$4.427 \times 10^{-13}$	$9.3395 \times 10^{-13}$	$4.1102 \times 10^{-4}$	0.619
pdb2lx0 194	Classic	$1.940 \times 10^{-9}$		$3.1226 \times 10^{-4}$	
	Quaternion	$1.940 \times 10^{-9}$	$2.0923 \times 10^{-13}$	$1.9112 \times 10^{-4}$	0.612
pdb2lxb 892	Classic	$1.542 \times 10^{-13}$		$1.8311 \times 10^{-3}$	
	Quaternion	$1.585 \times 10^{-13}$	$1.6837 \times 10^{-13}$	$1.1032 \times 10^{-3}$	0.602
pdb2lxy 404	Classic	$9.313 \times 10^{-13}$		$8.0258 \times 10^{-4}$	
	Quaternion	$1.025 \times 10^{-12}$	$1.6618 \times 10^{-12}$	$4.8297 \times 10^{-4}$	0.602

Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb2lxx 194	Classic	$2.371 \times 10^{-12}$	$1.9895 \times 10^{-12}$	$3.2047 \times 10^{-4}$	0.620
	Quaternion	$2.792 \times 10^{-12}$		$1.9884 \times 10^{-4}$	
pdb2lzf 820	Classic	$3.217 \times 10^{-14}$	$1.2991 \times 10^{-13}$	$3.6701 \times 10^{-2}$	0.558
	Quaternion	$3.957 \times 10^{-14}$		$2.0489 \times 10^{-2}$	
pdb2m1a 158	Classic	$6.346 \times 10^{-15}$	$6.5801 \times 10^{-15}$	$2.8770 \times 10^{-4}$	0.589
	Quaternion	$7.612 \times 10^{-15}$		$1.6947 \times 10^{-4}$	
pdb2m1j 182	Classic	$1.865 \times 10^{-14}$	$6.6915 \times 10^{-14}$	$2.9298 \times 10^{-4}$	0.605
	Quaternion	$2.212 \times 10^{-14}$		$1.7721 \times 10^{-4}$	
pdb2m2y 110	Classic	$2.699 \times 10^{-13}$	$1.4386 \times 10^{-13}$	$1.6766 \times 10^{-4}$	0.614
	Quaternion	$2.808 \times 10^{-13}$		$1.0300 \times 10^{-4}$	
pdb2m3f 134	Classic	$3.629 \times 10^{-14}$	$5.8107 \times 10^{-14}$	$1.9549 \times 10^{-4}$	0.606
	Quaternion	$4.641 \times 10^{-14}$		$1.1839 \times 10^{-4}$	
pdb2m4j 2178	Classic	$1.463 \times 10^{-11}$	$1.8385 \times 10^{-13}$	$3.0899 \times 10^{-2}$	0.540
	Quaternion	$1.455 \times 10^{-11}$		$1.6683 \times 10^{-2}$	
pdb2m8m 170	Classic	$2.407 \times 10^{-14}$	$1.1738 \times 10^{-13}$	$2.4356 \times 10^{-4}$	0.625
	Quaternion	$3.023 \times 10^{-14}$		$1.5232 \times 10^{-4}$	
pdb2m8o 170	Classic	$1.672 \times 10^{-14}$	$2.4755 \times 10^{-14}$	$2.3852 \times 10^{-4}$	0.634
	Quaternion	$2.039 \times 10^{-14}$		$1.5126 \times 10^{-4}$	
pdb2m97 416	Classic	$4.646 \times 10^{-14}$	$2.0639 \times 10^{-13}$	$6.4149 \times 10^{-4}$	0.632
	Quaternion	$5.841 \times 10^{-14}$		$4.0543 \times 10^{-4}$	
pdb2m9g 1108	Classic	$2.939 \times 10^{-13}$	$5.8913 \times 10^{-13}$	$1.8543 \times 10^{-3}$	0.619
	Quaternion	$3.170 \times 10^{-13}$		$1.1475 \times 10^{-3}$	
pdb2m9r 242	Classic	$3.537 \times 10^{-14}$	$1.6694 \times 10^{-13}$	$3.8746 \times 10^{-4}$	0.579
	Quaternion	$4.406 \times 10^{-14}$		$2.2436 \times 10^{-4}$	
pdb2mdv 460	Classic	$3.178 \times 10^{-12}$	$3.0402 \times 10^{-13}$	$1.7907 \times 10^{-3}$	0.584
	Quaternion	$3.178 \times 10^{-12}$		$1.0462 \times 10^{-3}$	
pdb2me1 164	Classic	$1.886 \times 10^{-13}$	$1.6579 \times 10^{-13}$	$2.4024 \times 10^{-4}$	0.609
	Quaternion	$2.208 \times 10^{-13}$		$1.4629 \times 10^{-4}$	
pdb2me2 164	Classic	$3.667 \times 10^{-13}$	$1.1486 \times 10^{-12}$	$2.5397 \times 10^{-4}$	0.605
	Quaternion	$5.098 \times 10^{-13}$		$1.5353 \times 10^{-4}$	
pdb2me3 164	Classic	$2.593 \times 10^{-9}$	$9.2137 \times 10^{-14}$	$2.3516 \times 10^{-4}$	0.610
	Quaternion	$2.593 \times 10^{-9}$		$1.4335 \times 10^{-4}$	
pdb2me4 164	Classic	$2.854 \times 10^{-9}$	$9.9945 \times 10^{-13}$	$2.7671 \times 10^{-4}$	0.601
	Quaternion	$2.854 \times 10^{-9}$		$1.6638 \times 10^{-4}$	
pdb2mg1 164	Classic	$4.398 \times 10^{-14}$	$1.5805 \times 10^{-13}$	$2.3575 \times 10^{-4}$	0.622
	Quaternion	$5.374 \times 10^{-14}$		$1.4662 \times 10^{-4}$	
pdb2mg2 170	Classic	$1.829 \times 10^{-14}$	$2.5921 \times 10^{-14}$	$2.4349 \times 10^{-4}$	0.630
	Quaternion	$2.480 \times 10^{-14}$		$1.5351 \times 10^{-4}$	
pdb2mg3 170	Classic	$3.541 \times 10^{-14}$	$2.4798 \times 10^{-13}$	$2.5354 \times 10^{-4}$	0.625
	Quaternion	$4.461 \times 10^{-14}$		$1.5851 \times 10^{-4}$	
pdb2mh8 338	Classic	$1.547 \times 10^{-13}$	$2.9903 \times 10^{-13}$	$5.5605 \times 10^{-4}$	0.619
	Quaternion	$1.883 \times 10^{-13}$		$3.4429 \times 10^{-4}$	
pdb2mhw 164	Classic	$6.229 \times 10^{-14}$	$4.9718 \times 10^{-13}$	$2.5108 \times 10^{-4}$	0.626
	Quaternion	$7.129 \times 10^{-14}$		$1.5714 \times 10^{-4}$	
pdb2mi1 84	Classic	$1.827 \times 10^{-12}$	$1.5687 \times 10^{-12}$	$1.3281 \times 10^{-4}$	0.621
	Quaternion	$2.052 \times 10^{-12}$		$8.2475 \times 10^{-5}$	
pdb2mi7 404	Classic	$6.022 \times 10^{-13}$	$1.3690 \times 10^{-12}$	$5.8600 \times 10^{-4}$	0.611
	Quaternion	$6.817 \times 10^{-13}$		$3.5786 \times 10^{-4}$	
pdb2mij 224	Classic	$1.244 \times 10^{-13}$	$2.8681 \times 10^{-13}$	$3.3831 \times 10^{-4}$	0.611
	Quaternion	$1.522 \times 10^{-13}$		$2.0663 \times 10^{-4}$	
pdb2mix 128	Classic	$4.816 \times 10^{-14}$	$3.7348 \times 10^{-14}$	$1.9065 \times 10^{-4}$	0.623
	Quaternion	$4.684 \times 10^{-14}$		$1.1873 \times 10^{-4}$	
pdb2mj1 110	Classic	$1.309 \times 10^{-13}$	$2.3819 \times 10^{-13}$	$1.7651 \times 10^{-4}$	0.609
	Quaternion	$1.646 \times 10^{-13}$		$1.0746 \times 10^{-4}$	



Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb2mj2 218	Classic	$9.775 \times 10^{-14}$		$3.4006 \times 10^{-4}$	
	Quaternion	$1.196 \times 10^{-13}$	$8.8713 \times 10^{-14}$	$2.0304 \times 10^{-4}$	0.597
pdb2mjg 556	Classic	$5.503 \times 10^{-14}$		$2.1403 \times 10^{-3}$	
	Quaternion	$6.580 \times 10^{-14}$	$7.0670 \times 10^{-14}$	$1.2087 \times 10^{-3}$	0.565
pdb2mji 788	Classic	$3.207 \times 10^{-12}$		$1.2480 \times 10^{-3}$	
	Quaternion	$3.247 \times 10^{-12}$	$2.7336 \times 10^{-13}$	$7.9502 \times 10^{-4}$	0.637
pdb2mle 434	Classic	$1.491 \times 10^{-13}$		$7.0584 \times 10^{-4}$	
	Quaternion	$1.535 \times 10^{-13}$	$3.1271 \times 10^{-13}$	$4.2886 \times 10^{-4}$	0.608
pdb2mlf 434	Classic	$9.918 \times 10^{-14}$		$7.0616 \times 10^{-4}$	
	Quaternion	$1.128 \times 10^{-13}$	$9.2903 \times 10^{-14}$	$4.3297 \times 10^{-4}$	0.613
pdb2mo5 854	Classic	$2.527 \times 10^{-10}$		$1.3908 \times 10^{-3}$	
	Quaternion	$2.527 \times 10^{-10}$	$1.0204 \times 10^{-12}$	$8.7516 \times 10^{-4}$	0.629
pdb2mpu 554	Classic	$9.785 \times 10^{-14}$		$8.9773 \times 10^{-4}$	
	Quaternion	$1.016 \times 10^{-13}$	$1.0352 \times 10^{-13}$	$5.6068 \times 10^{-4}$	0.625
pdb2mra 704	Classic	$2.632 \times 10^{-13}$		$1.4008 \times 10^{-3}$	
	Quaternion	$2.768 \times 10^{-13}$	$1.2867 \times 10^{-13}$	$8.4120 \times 10^{-4}$	0.601
pdb2msu 122	Classic	$7.813 \times 10^{-14}$		$2.0173 \times 10^{-4}$	
	Quaternion	$8.765 \times 10^{-14}$	$3.7025 \times 10^{-14}$	$1.2208 \times 10^{-4}$	0.605
pdb2mty 120	Classic	$1.849 \times 10^{-14}$		$2.1012 \times 10^{-4}$	
	Quaternion	$2.364 \times 10^{-14}$	$9.1457 \times 10^{-14}$	$1.2629 \times 10^{-4}$	0.601
pdb2muh 98	Classic	$2.008 \times 10^{-13}$		$1.4547 \times 10^{-4}$	
	Quaternion	$2.251 \times 10^{-13}$	$1.4292 \times 10^{-13}$	$8.7958 \times 10^{-5}$	0.605
pdb2mvj 156	Classic	$1.534 \times 10^{-13}$		$2.4181 \times 10^{-4}$	
	Quaternion	$1.647 \times 10^{-13}$	$5.5998 \times 10^{-14}$	$1.4392 \times 10^{-4}$	0.595
pdb2mvt 284	Classic	$6.053 \times 10^{-12}$		$5.6681 \times 10^{-4}$	
	Quaternion	$6.226 \times 10^{-12}$	$3.1969 \times 10^{-12}$	$3.3934 \times 10^{-4}$	0.599
pdb2mvx 2360	Classic	$4.728 \times 10^{-9}$		$2.1984 \times 10^{-2}$	
	Quaternion	$4.729 \times 10^{-9}$	$3.7181 \times 10^{-11}$	$1.2119 \times 10^{-2}$	0.551
pdb2mz6 220	Classic	$4.129 \times 10^{-8}$		$2.8851 \times 10^{-2}$	
	Quaternion	$4.129 \times 10^{-8}$	$4.4231 \times 10^{-13}$	$1.5215 \times 10^{-2}$	0.527
pdb2n00 572	Classic	$2.703 \times 10^{-13}$		$7.8567 \times 10^{-4}$	
	Quaternion	$3.467 \times 10^{-13}$	$7.3499 \times 10^{-13}$	$4.9399 \times 10^{-4}$	0.629
pdb2n0b 60	Classic	$7.104 \times 10^{-13}$		$9.1258 \times 10^{-5}$	
	Quaternion	$9.458 \times 10^{-13}$	$8.9441 \times 10^{-13}$	$5.5481 \times 10^{-5}$	0.608
pdb2n0c 60	Classic	$1.293 \times 10^{-13}$		$8.9546 \times 10^{-5}$	
	Quaternion	$1.682 \times 10^{-13}$	$2.8483 \times 10^{-13}$	$5.3031 \times 10^{-5}$	0.592
pdb2n0d 60	Classic	$1.925 \times 10^{-9}$		$8.7136 \times 10^{-5}$	
	Quaternion	$1.926 \times 10^{-9}$	$1.6149 \times 10^{-11}$	$5.3740 \times 10^{-5}$	0.617
pdb2n0e 60	Classic	$3.314 \times 10^{-12}$		$8.9640 \times 10^{-5}$	
	Quaternion	$4.286 \times 10^{-12}$	$8.3573 \times 10^{-12}$	$5.5845 \times 10^{-5}$	0.623
pdb2n0f 60	Classic	$8.103 \times 10^{-9}$		$8.4756 \times 10^{-5}$	
	Quaternion	$8.103 \times 10^{-9}$	$5.8011 \times 10^{-13}$	$5.1625 \times 10^{-5}$	0.609
pdb2n0g 60	Classic	$8.315 \times 10^{-13}$		$1.0130 \times 10^{-4}$	
	Quaternion	$9.618 \times 10^{-13}$	$1.3124 \times 10^{-13}$	$6.0317 \times 10^{-5}$	0.595
pdb2n0h 60	Classic	$7.690 \times 10^{-13}$		$9.3479 \times 10^{-5}$	
	Quaternion	$8.730 \times 10^{-13}$	$1.8191 \times 10^{-13}$	$5.8237 \times 10^{-5}$	0.623
pdb2n35 314	Classic	$3.541 \times 10^{-14}$		$4.9604 \times 10^{-4}$	
	Quaternion	$4.466 \times 10^{-14}$	$1.0752 \times 10^{-13}$	$3.0774 \times 10^{-4}$	0.620
pdb2n3a 574	Classic	$8.761 \times 10^{-14}$		$1.6767 \times 10^{-2}$	
	Quaternion	$1.049 \times 10^{-13}$	$1.0149 \times 10^{-13}$	$8.9551 \times 10^{-3}$	0.534
pdb2n41 638	Classic	$1.812 \times 10^{-13}$		$1.0753 \times 10^{-3}$	
	Quaternion	$1.836 \times 10^{-13}$	$8.2539 \times 10^{-14}$	$6.5707 \times 10^{-4}$	0.611
pdb2n4e 638	Classic	$1.494 \times 10^{-13}$		$1.0563 \times 10^{-3}$	
	Quaternion	$1.687 \times 10^{-13}$	$1.8433 \times 10^{-13}$	$6.5324 \times 10^{-4}$	0.618



Table 2: Results - continued

Problem Size	Method	MDE	RMSD	Time	Improv time
pdb2n5q 164	Classic	$1.732 \times 10^{-12}$	$1.7589 \times 10^{-12}$	$2.5502 \times 10^{-4}$	0.630
	Quaternion	$1.745 \times 10^{-12}$		$1.6074 \times 10^{-4}$	
pdb2n67 566	Classic	$4.443 \times 10^{-13}$	$6.3487 \times 10^{-14}$	$9.0517 \times 10^{-4}$	0.622
	Quaternion	$4.465 \times 10^{-13}$		$5.6303 \times 10^{-4}$	
pdb2n6n 192	Classic	$4.139 \times 10^{-8}$	$5.0670 \times 10^{-13}$	$3.0612 \times 10^{-4}$	0.629
	Quaternion	$4.139 \times 10^{-8}$		$1.9266 \times 10^{-4}$	
pdb2n7i 224	Classic	$9.212 \times 10^{-13}$	$3.0537 \times 10^{-12}$	$3.4800 \times 10^{-4}$	0.604
	Quaternion	$1.126 \times 10^{-12}$		$2.1033 \times 10^{-4}$	
pdb2n7j 336	Classic	$5.969 \times 10^{-13}$	$1.5144 \times 10^{-13}$	$5.5604 \times 10^{-4}$	0.607
	Quaternion	$6.094 \times 10^{-13}$		$3.3764 \times 10^{-4}$	
pdb2n9b 832	Classic	$1.196 \times 10^{-12}$	$1.1231 \times 10^{-12}$	$7.5212 \times 10^{-3}$	0.539
	Quaternion	$1.238 \times 10^{-12}$		$4.0541 \times 10^{-3}$	
pdb2na9 266	Classic	$5.440 \times 10^{-14}$	$5.4544 \times 10^{-14}$	$3.9985 \times 10^{-4}$	0.599
	Quaternion	$6.690 \times 10^{-14}$		$2.3943 \times 10^{-4}$	
pdb2ndc 110	Classic	$3.365 \times 10^{-14}$	$5.1916 \times 10^{-14}$	$1.7449 \times 10^{-4}$	0.608
	Quaternion	$4.479 \times 10^{-14}$		$1.0603 \times 10^{-4}$	
pdb2nde 110	Classic	$7.022 \times 10^{-14}$	$2.5156 \times 10^{-13}$	$1.5498 \times 10^{-4}$	0.615
	Quaternion	$8.868 \times 10^{-14}$		$9.5265 \times 10^{-5}$	
pdb2ndk 290	Classic	$5.022 \times 10^{-13}$	$2.0516 \times 10^{-12}$	$4.3875 \times 10^{-4}$	0.607
	Quaternion	$6.279 \times 10^{-13}$		$2.6635 \times 10^{-4}$	
pdb2nvj 152	Classic	$2.082 \times 10^{-14}$	$1.4035 \times 10^{-14}$	$2.1106 \times 10^{-4}$	0.628
	Quaternion	$2.293 \times 10^{-14}$		$1.3248 \times 10^{-4}$	
pdb2p6j 314	Classic	$4.795 \times 10^{-14}$	$1.1404 \times 10^{-13}$	$4.9868 \times 10^{-4}$	0.605
	Quaternion	$6.389 \times 10^{-14}$		$3.0174 \times 10^{-4}$	
pdb2p81 266	Classic	$7.881 \times 10^{-13}$	$4.3715 \times 10^{-13}$	$4.0170 \times 10^{-4}$	0.601
	Quaternion	$8.250 \times 10^{-13}$		$2.4128 \times 10^{-4}$	
pdb2pqe 896	Classic	$6.484 \times 10^{-10}$	$8.5673 \times 10^{-12}$	$1.7464 \times 10^{-3}$	0.615
	Quaternion	$6.496 \times 10^{-10}$		$1.0742 \times 10^{-3}$	
pdb2rlg 108	Classic	$5.501 \times 10^{-14}$	$6.8873 \times 10^{-14}$	$1.7141 \times 10^{-4}$	0.603
	Quaternion	$6.973 \times 10^{-14}$		$1.0328 \times 10^{-4}$	
pdb2rlh 108	Classic	$4.772 \times 10^{-14}$	$3.9131 \times 10^{-14}$	$1.8381 \times 10^{-4}$	0.600
	Quaternion	$5.801 \times 10^{-14}$		$1.1035 \times 10^{-4}$	
pdb2rmy 206	Classic	$1.872 \times 10^{-13}$	$3.6453 \times 10^{-13}$	$3.2133 \times 10^{-4}$	0.596
	Quaternion	$2.498 \times 10^{-13}$		$1.9158 \times 10^{-4}$	
pdb2rnd 206	Classic	$2.626 \times 10^{-13}$	$4.9979 \times 10^{-13}$	$3.1245 \times 10^{-4}$	0.603
	Quaternion	$3.581 \times 10^{-13}$		$1.8852 \times 10^{-4}$	
pdb2roo 260	Classic	$2.933 \times 10^{-12}$	$3.5927 \times 10^{-12}$	$9.2680 \times 10^{-4}$	0.569
	Quaternion	$3.525 \times 10^{-12}$		$5.2709 \times 10^{-4}$	
pdb2rql 572	Classic	$2.345 \times 10^{-12}$	$8.7086 \times 10^{-13}$	$1.2692 \times 10^{-3}$	0.594
	Quaternion	$2.496 \times 10^{-12}$		$7.5430 \times 10^{-4}$	
pdb2rut 218	Classic	$4.389 \times 10^{-14}$	$3.5338 \times 10^{-13}$	$3.3457 \times 10^{-4}$	0.611
	Quaternion	$5.014 \times 10^{-14}$		$2.0440 \times 10^{-4}$	
pdb2ruv 224	Classic	$5.776 \times 10^{-14}$	$1.2473 \times 10^{-13}$	$3.4892 \times 10^{-4}$	0.607
	Quaternion	$7.408 \times 10^{-14}$		$2.1174 \times 10^{-4}$	
pdb2rux 218	Classic	$2.671 \times 10^{-14}$	$6.2140 \times 10^{-14}$	$3.5268 \times 10^{-4}$	0.611
	Quaternion	$3.016 \times 10^{-14}$		$2.1558 \times 10^{-4}$	
pdb2ruy 224	Classic	$1.968 \times 10^{-14}$	$6.4254 \times 10^{-14}$	$3.5150 \times 10^{-4}$	0.603
	Quaternion	$2.387 \times 10^{-14}$		$2.1187 \times 10^{-4}$	
pdb2rv3 218	Classic	$3.656 \times 10^{-14}$	$6.3794 \times 10^{-14}$	$3.5977 \times 10^{-4}$	0.605
	Quaternion	$4.118 \times 10^{-14}$		$2.1748 \times 10^{-4}$	
pdb2rv5 212	Classic	$1.145 \times 10^{-14}$	$1.6010 \times 10^{-14}$	$3.3397 \times 10^{-4}$	0.611
	Quaternion	$1.338 \times 10^{-14}$		$2.0422 \times 10^{-4}$	
pdb2y4q 476	Classic	$1.410 \times 10^{-12}$	$2.0648 \times 10^{-13}$	$7.3303 \times 10^{-4}$	0.615
	Quaternion	$1.451 \times 10^{-12}$		$4.5092 \times 10^{-4}$	

```
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function_of_improvement=#16
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precision_virtual=1.0e-8
benchmark_seconds=6000
benchmark_samples_limit=100000
all_solutions=False
list_of_problems=["pdb2k2f", "pdb2kbm", "pdb2j10", "pdb2j11", "pdb2lwa", "pdb2j0z", "pdb2ad1", "pdb1pzz", "pdb2lzf", "pdb2lzf"]
start_time=2023-04-25T10:34:45.483
end_time=2023-04-27T21:52:14.682
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