

Notes: ‘n’ represents the dimension of the corresponding problem. ‘NI’ represents the total number of iterations. ‘NF’ represents the number of the function evaluation. ‘T’ represents the running time of the algorithm. ‘ $\|g^*\|$ ’ represents the gradient value for the solution. The values of ‘NI’, ‘NF’, ‘T’ and ‘ $\|g^*\|$ ’ are set as ‘NaN’ if and only if the number of iterations is greater than 3000.

Table 1: Numerical results for Test 2				
Problem/n	SHCGMcc-MIN	PRP	HS	LS
	NI/NF/T/ $\ g^*\ $	NI/NF/T/ $\ g^*\ $	NI/NF/T/ $\ g^*\ $	NI/NF/T/ $\ g^*\ $
cosine/600	43/100/0.024/7.63e-06	34/210/0.012/1.80e-06	73/298/0.017/7.31e-06	1269/5457/0.206/8.33e-06
cosine/3000	67/134/0.021/9.90e-06	31/170/0.022/7.86e-06	66/214/0.028/9.86e-06	284/1406/0.188/3.30e-06
cosine/10000	40/101/0.043/8.81e-06	41/236/0.093/7.37e-06	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN
dixmaana/6000	14/74/0.170/2.17e-06	34/214/0.760/3.98e-06	28/172/0.419/1.76e-06	31/178/0.345/5.57e-06
dixmaana/9000	21/81/0.364/4.14e-06	28/151/0.718/4.91e-06	35/242/1.207/1.90e-06	29/156/0.926/7.07e-06
dixmaanb/4800	19/76/0.185/4.46e-06	24/172/0.265/1.93e-06	28/162/0.242/8.34e-06	29/172/0.279/2.86e-06
dixmaanb/24000	18/77/1.042/9.35e-06	36/220/3.080/7.74e-06	28/168/2.170/3.25e-06	51/330/4.721/4.84e-06
dixmaanc/270	14/66/0.062/6.45e-06	38/233/0.035/3.19e-06	30/185/0.027/5.27e-06	44/299/0.048/5.04e-06
dixmaanc/2700	25/88/0.081/3.85e-06	27/150/0.129/8.70e-06	24/129/0.125/9.41e-06	65/446/0.383/5.72e-06
dixmaand/1200	22/76/0.072/9.51e-06	30/159/0.070/6.63e-06	28/112/0.046/8.83e-06	38/238/0.097/5.81e-06
dixmaand/9000	17/78/0.360/7.23e-06	28/148/0.859/9.66e-06	29/148/0.822/4.52e-06	49/329/1.466/7.03e-06
dixmaane/2400	440/498/0.474/8.20e-06	384/1383/1.059/9.68e-06	314/509/0.400/9.18e-06	366/1413/1.082/9.11e-06
dixmaane/4800	500/567/1.264/9.08e-06	520/1876/4.435/7.62e-06	482/729/1.609/8.96e-06	651/2353/5.980/6.46e-06
dixmaanf/6000	510/571/2.071/8.95e-06	582/2067/6.829/9.83e-06	344/581/1.922/7.78e-06	643/2274/8.679/7.28e-06
dixmaanf/15000	1690/1953/18.423/9.98e-06	878/3146/29.324/8.00e-06	619/1011/8.855/6.21e-06	711/2435/21.320/7.87e-06
dixmaang/6000	728/812/1.738/8.11e-06	490/1751/3.256/8.06e-06	293/483/0.886/8.90e-06	371/1394/2.483/9.77e-06
dixmaang/12000	1457/1745/8.757/9.83e-06	526/2081/12.070/9.37e-06	560/894/6.516/5.08e-06	793/2745/19.667/9.51e-06
dixmaanh/6000	1167/1476/3.069/8.23e-06	636/2485/6.187/7.24e-06	361/605/1.777/7.91e-06	567/1990/4.904/9.12e-06
dixmaanh/15000	858/943/9.056/9.88e-06	1111/4013/38.536/9.56e-06	527/837/7.831/6.06e-06	968/3620/33.343/7.48e-06
dixmaani/360	1299/1355/0.363/9.48e-06	1436/5250/1.162/8.55e-06	1683/2659/0.587/7.91e-06	2786/9725/2.211/8.16e-06
dixmaanj/3000	929/1051/1.224/8.78e-06	532/1971/2.397/5.50e-06	352/602/0.691/9.51e-06	523/1852/1.803/8.62e-06
dixmaanj/15000	848/921/8.736/9.64e-06	749/2755/25.742/8.69e-06	465/750/7.002/9.30e-06	635/2242/19.807/9.45e-06
dixmaank/6000	669/825/1.881/8.17e-06	369/1544/3.247/9.61e-06	354/570/1.076/9.84e-06	556/1904/3.561/9.56e-06
dixmaank/12000	1003/1278/8.848/9.94e-06	461/1776/9.757/9.58e-06	416/684/4.709/7.54e-06	622/2152/14.617/8.99e-06
dixmaanl/1200	2010/2114/0.986/8.11e-06	326/1327/0.542/9.48e-06	232/393/0.164/8.56e-06	1052/3890/1.649/9.54e-06
dixmaanl/2400	NaN/NaN/NaN/NaN	456/1792/1.297/8.43e-06	286/470/0.334/8.51e-06	406/1643/1.176/8.33e-06
dixon3dq/50	479/528/0.024/9.83e-06	572/2266/0.075/9.67e-06	399/620/0.019/9.83e-06	605/2128/0.062/8.57e-06
dixon3dq/150	1404/1452/0.049/7.95e-06	2340/8491/0.254/8.73e-06	1441/2244/0.068/7.85e-06	2409/8417/0.254/8.31e-06
dqdrtic/300	72/225/0.014/7.22e-06	151/743/0.023/3.11e-06	67/239/0.008/4.39e-06	104/496/0.015/4.56e-06
dqdrtic/5000	53/160/0.225/8.64e-06	47/184/0.249/5.78e-06	56/197/0.272/6.46e-06	58/258/0.343/3.56e-06
dqdrtic/9000	107/336/0.041/5.40e-06	95/505/0.052/2.42e-06	73/272/0.028/1.08e-06	127/673/0.067/7.74e-06
edensch/500	43/101/0.026/6.31e-06	51/303/0.046/9.15e-06	43/156/0.024/7.43e-06	58/292/0.043/5.93e-06
edensch/1000	46/113/0.030/9.91e-06	42/192/0.051/7.17e-06	46/156/0.041/9.40e-06	56/383/0.100/9.78e-06
edensch/4000	72/161/0.159/9.83e-06	43/208/0.219/9.77e-06	207/1495/1.510/6.08e-06	39/168/0.169/7.97e-06
eg2/100	177/617/0.033/7.12e-06	467/2311/0.085/9.80e-06	58/259/0.010/8.11e-06	166/1305/0.048/2.20e-06
fletcher/100	47/117/0.019/9.77e-06	44/167/0.005/5.03e-06	40/115/0.004/8.69e-06	60/234/0.009/9.38e-06
fletcher/500	81/217/0.010/6.07e-06	85/509/0.020/1.61e-06	46/147/0.005/5.93e-06	66/427/0.017/3.11e-06
fletcher/2000	65/228/0.013/9.67e-06	81/641/0.036/5.93e-06	280/2021/0.110/7.06e-06	165/1428/0.079/8.43e-06
freuroth/40	263/865/0.050/8.10e-06	173/835/0.027/2.17e-06	153/525/0.017/9.90e-06	125/781/0.025/7.60e-06
genrose/100	740/845/0.040/8.03e-06	1621/6073/0.192/6.95e-06	897/1487/0.047/4.96e-06	1354/5000/0.147/8.50e-06
himmelbg/700	2/15/0.008/1.35e-29	2/15/0.001/1.68e-27	2/15/0.001/1.90e-27	2/15/0.001/1.68e-27
himmelbg/2400	2/10/0.002/5.12e-20	2/10/0.002/3.91e-19	2/10/0.002/1.49e-18	2/10/0.002/3.91e-19
liarwhd/6000	169/513/0.067/2.20e-06	121/701/0.063/7.69e-06	32/168/0.015/4.73e-06	82/572/0.042/6.15e-06
liarwhd/3000	146/418/0.026/3.41e-06	106/637/0.043/1.35e-06	41/214/0.012/9.81e-06	77/574/0.035/1.81e-06
penalty1/100	17/101/0.012/1.51e-06	13/83/0.004/7.77e-06	NaN/NaN/NaN/NaN	385/4209/0.201/1.00e-05
penalty1/1000	31/199/0.112/7.81e-06	293/2088/1.282/7.18e-06	NaN/NaN/NaN/NaN	859/9417/5.854/9.90e-06
quartc/4000	56/163/0.207/5.25e-06	58/263/0.328/6.27e-06	49/177/0.207/7.04e-06	68/299/0.434/9.49e-06
quartc/8000	62/174/0.399/7.43e-06	63/259/0.601/6.66e-06	77/214/0.475/6.61e-07	67/260/0.602/4.00e-06
quartc/50000	89/223/3.385/8.28e-06	97/408/6.357/5.31e-06	105/292/4.877/6.18e-06	102/397/6.235/8.18e-06
tridia/300	626/693/0.040/9.68e-06	941/3522/0.111/8.19e-06	483/758/0.025/9.09e-06	882/3006/0.113/9.40e-06
tridia/2000	2014/2090/0.175/9.36e-06	2538/9097/0.496/9.69e-06	2044/3166/0.159/8.47e-06	2748/9576/0.493/7.10e-06
woods/1500	150/398/0.055/9.17e-06	447/2112/0.108/9.19e-06	174/518/0.021/5.09e-06	188/898/0.032/9.50e-06
woods/2000	177/322/0.027/6.08e-06	517/2223/0.106/4.80e-06	177/510/0.025/7.84e-06	222/1042/0.054/9.12e-06
bdexp/5000	2/11/0.041/4.39e-111	2/11/0.010/2.19e-79	NaN/NaN/NaN/NaN	2/11/0.007/2.19e-79
bdexp/50000	2/16/0.087/3.49e-89	2/16/0.086/6.83e-37	NaN/NaN/NaN/NaN	2/16/0.101/6.83e-37
bdexp/5000	2/11/0.012/4.39e-111	2/11/0.014/2.19e-79	NaN/NaN/NaN/NaN	2/11/0.014/2.19e-79
exdenschnf/9000	46/117/0.095/5.81e-06	32/173/0.027/9.82e-06	32/179/0.023/9.00e-06	67/478/0.062/9.60e-06
exdenschnf/2800	54/123/0.009/8.46e-06	39/212/0.013/3.33e-06	42/265/0.016/9.91e-06	69/563/0.035/7.23e-06
exdenschnf/6000	36/104/0.015/3.09e-06	36/225/0.022/5.43e-06	31/139/0.014/7.86e-06	39/224/0.024/7.17e-06
exdenschnb/3000	39/97/0.016/5.06e-06	38/199/0.013/8.90e-06	30/177/0.009/1.18e-06	34/247/0.013/9.53e-06
exdenschnb/6000	17/75/0.007/5.65e-06	25/155/0.013/5.21e-06	26/146/0.012/9.55e-06	48/285/0.020/6.42e-06
exdenschnb/24000	18/79/0.018/9.65e-06	26/162/0.032/4.79e-07	28/151/0.031/7.90e-06	47/296/0.059/9.92e-06
genquartic/9000	28/88/0.027/4.99e-06	48/320/0.040/4.77e-06	88/445/0.057/9.63e-06	40/219/0.030/4.75e-06
genquartic/9000	28/88/0.013/4.99e-06	48/320/0.040/4.77e-06	88/445/0.051/9.63e-06	40/219/0.025/4.75e-06
genquartic/50000	17/79/0.042/9.15e-06	28/132/0.065/4.67e-06	NaN/NaN/NaN/NaN	54/326/0.157/7.97e-06
biggsb1/300	1149/1210/0.053/8.38e-06	1723/6327/0.225/8.90e-06	1431/2198/0.100/8.51e-06	2702/9423/0.356/6.74e-06
sine/500	228/371/0.057/9.88e-06	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN
sine/1000	58/144/0.024/9.85e-06	102/455/0.061/5.78e-06	NaN/NaN/NaN/NaN	36/210/0.025/6.79e-06
sine/2000	1742/2524/0.511/6.95e-06	258/1041/0.201/3.68e-06	NaN/NaN/NaN/NaN	263/1324/0.302/9.53e-06
fletchv3/50	NaN/NaN/NaN/NaN	492/1323/0.060/2.29e-06	676/1473/0.068/4.00e-06	430/1455/0.067/3.71e-06
nonscomp/5000	220/310/0.063/9.80e-06	86/452/0.040/9.65e-06	481/1559/0.132/5.88e-06	87/375/0.029/9.90e-06
nonscomp/8000	1966/2599/0.367/7.91e-06	64/261/0.029/6.88e-06	132/396/0.041/8.67e-06	75/350/0.035/8.88e-06
power1/150	2477/2593/0.089/8.29e-06	2815/10480/0.371/5.88e-06	2519/3981/0.164/9.49e-06	2726/9301/0.354/9.27e-06
raydan1/500	279/346/0.041/9.00e-06	261/1055/0.084/8.49e-06	175/315/0.029/7.03e-06	241/971/0.057/6.34e-06
raydan1/1000	379/450/0.055/8.26e-06	310/1076/0.101/9.48e-06	251/435/0.043/5.91e-06	363/1351/0.147/7.04e-06
raydan2/1000	15/70/0.011/6.53e-06	21/151/0.013/1.43e-06	NaN/NaN/NaN/NaN	462/5057/0.556/8.71e-06
raydan2/2000	12/63/0.014/5.09e-06	47/297/0.046/1.46e-06	NaN/NaN/NaN/NaN	662/7271/1.290/2.26e-06
raydan2/5000	10/71/0.027/1.06e-06	13/86/0.024/8.16e-06	NaN/NaN/NaN/NaN	517/5674/1.531/5.33e-06
diagonal1/800	644/4086/0.436/9.64e-06	683/5335/0.661/9.28e-06	NaN/NaN/NaN/NaN	1143/10423/0.531/7.70e-06
diagonal1/1500	2701/25074/4.343/6.87e-06	1977/18672/1.779/9.60e-06	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN
diagonal2/5000	420/622/0.306/9.95e-06	551/2169/0.842/8.59e-06	NaN/NaN/NaN/NaN	577/2029/0.807/7.45e-06
diagonal2/10000	584/875/0.802/9.25e-06	781/2995/2.315/7.92e-06	NaN/NaN/NaN/NaN	998/3676/2.764/8.45e-06
diagonal3/200	193/436/0.025/9.48e-06	220/1169/0.046/8.94e-06	119/275/0.011/8.20e-06	257/1557/0.076/9.74e-06
diagonal3/500	1143/9001/0.671/8.19e-06	614/5099/0.480/9.50e-06	1303/10734/0.891/8.38e-06	1222/11448/0.943/6.46e-06
diagonal3/2000	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN	2533/23863/4.371/7.55e-06
osb2/11	423/752/0.092/8.11e-06	829/3002/0.211/6.94e-06	543/1172/0.082/8.77e-06	854/3319/0.310/7.93e-06
ie/150	16/52/0.518/8.93e-06	33/193/1.729/4.64e-06	27/149/1.270/6.62e-06	41/223/1.996/9.21e-06
ie/500	12/45/3.530/7.38e-06	37/232/19.502/9.21e-06	17/79/6.358/8.54e-06	30/202/16.495/6.62e-06
singx/500	224/571/0.253/7.76e-06	238/1033/0.449/9.40e-06	239/968/0.393/1.64e-06	192/1020/0.412/8.84e-07
singx/1000	247/611/3.059/8.39e-06	266/1299/4.662/7.38e-06	105/368/1.824/4.53e-06	284/1425/5.720/1.02e-06
singx/2000	424/1063/12.708/6.78e-06	431/1958/23.150/4.06e-06	173/755/8.902/7.34e-06	262/1273/18.882/1.94e-06
lin/50	10/57/0.098/2.08e-06	11/73/0.021/3.44e-06	18/70/0.013/5.93e-06	75/719/0.130/1.53e-06
lin/100	13/63/0.022/8.86e-07	12/85/0.029/6.73e-06	31/160/0.050/9.55e-06	72/671/0.197/6.92e-06
pen1/200	106/532/0.106/4.20e-06	NaN/NaN/NaN/NaN	94/644/0.050/7.05e-07	122/910/0.070/7.53e-06
pen1/1000	97/483/4.728/6.41e-06	NaN/NaN/NaN/NaN	297/2355/15.581/8.98e-06	168/1254/8.753/9.15e-06
pen2/160	268/635/0.137/9.99e-06	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN
rosex/500	69/300/0.375/9.54e-06	153/934/1.079/3.56e-06	44/236/0.271/9.70e-07	77/559/0.657/3.82e-06
rosex/1000	95/327/1.987/8.26e-06	102/608/3.474/2.98e-06	43/204/0.940/3.95e-06	49/340/1.848/2.61e-06
trid/400	154/209/0.142/7.96e-06	105/370/0.154/5.10e-06	75/174/0.077/7.55e-06	107/476/0.212/9.93e-06
trid/800	127/182/0.550/8.68e-06	46/192/0.423/7.44e-06	48/147/0.326/7.39e-06	62/314/0.695/9.09e-06