

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 1				
Problem/n	SHCGMcc-MAX NI/NF/T/ $\ g^*\ $	SHCGMcc-MIN NI/NF/T/ $\ g^*\ $	SHCGMcc-MED NI/NF/T/ $\ g^*\ $	SHCGMcc-AVG NI/NF/T/ $\ g^*\ $
cosine/600	16/66/0.019/4.75e-06	43/100/0.011/7.63e-06	43/100/0.016/5.46e-06	24/77/0.015/6.12e-06
cosine/3000	17/68/0.013/9.73e-06	67/134/0.022/9.90e-06	65/132/0.022/9.48e-06	23/75/0.013/6.64e-06
cosine/10000	23/81/0.033/3.89e-06	39/100/0.044/9.88e-06	40/101/0.045/8.50e-06	36/96/0.039/9.83e-06
dixmaana/6000	16/74/0.118/4.53e-06	14/74/0.091/2.17e-06	13/70/0.085/5.33e-06	16/74/0.089/3.14e-06
dixmaana/9000	16/76/0.142/4.59e-06	21/81/0.154/4.14e-06	12/68/0.127/2.53e-06	12/71/0.135/9.70e-06
dixmaanb/4800	11/66/0.090/7.09e-06	19/76/0.074/4.46e-06	15/75/0.076/5.60e-06	14/72/0.071/6.50e-07
dixmaanb/24000	16/83/0.380/5.38e-06	18/77/0.354/9.38e-06	16/77/0.351/4.32e-06	15/76/0.351/3.38e-06
dixmaanc/270	13/62/0.018/4.91e-06	14/66/0.006/6.45e-06	19/72/0.006/2.85e-06	15/67/0.006/1.04e-06
dixmaanc/2700	22/81/0.052/3.17e-06	25/88/0.054/3.85e-06	48/111/0.062/7.66e-06	25/87/0.050/2.54e-06
dixmaand/1200	20/72/0.038/3.12e-06	22/76/0.022/9.51e-06	17/73/0.021/2.75e-06	16/69/0.019/2.57e-06
dixmaand/9000	14/74/0.142/9.38e-06	17/78/0.154/7.23e-06	17/76/0.150/5.80e-06	14/76/0.149/9.11e-06
dixmaane/2400	372/691/0.518/8.59e-06	440/498/0.283/8.20e-06	420/478/0.271/8.23e-06	327/480/0.255/8.96e-06
dixmaane/4800	450/832/0.853/9.65e-06	500/567/0.585/9.08e-06	478/550/0.580/9.45e-06	387/571/0.588/9.88e-06
dixmaanf/6000	539/1004/2.675/8.49e-06	510/571/2.059/8.95e-06	577/638/2.268/8.89e-06	541/799/1.866/6.08e-06
dixmaanf/15000	1658/3039/27.109/8.45e-06	1706/1967/18.982/9.94e-06	1652/1885/19.138/8.60e-06	1332/1928/19.508/7.74e-06
dixmaang/6000	476/886/3.702/8.88e-06	728/812/3.007/8.11e-06	733/817/2.493/8.09e-06	379/559/2.177/8.93e-06
dixmaang/12000	1745/3126/25.406/5.91e-06	1435/1715/14.142/9.95e-06	1380/1660/13.588/9.68e-06	1145/1633/12.890/9.57e-06
dixmaanh/6000	1140/2013/8.018/9.96e-06	1201/1516/6.496/7.88e-06	1211/1518/6.328/8.12e-06	948/1392/5.972/9.85e-06
dixmaanh/15000	1177/2167/20.323/6.44e-06	858/943/8.434/9.88e-06	941/1014/9.042/9.84e-06	723/1063/8.704/8.40e-06
dixmaani/360	1870/3464/0.784/9.68e-06	1299/1355/0.418/9.48e-06	1464/1520/0.442/8.69e-06	2222/3232/0.846/8.90e-06
dixmaanj/3000	274/501/0.577/9.96e-06	929/1051/1.238/8.86e-06	992/1104/1.271/8.57e-06	321/483/0.628/9.70e-06
dixmaanj/15000	414/731/6.891/8.91e-06	848/921/8.641/9.64e-06	281/356/3.162/9.82e-06	773/1129/10.219/6.53e-06
dixmaank/6000	242/423/1.668/3.89e-06	679/839/2.216/7.84e-06	678/852/2.505/7.97e-06	393/574/1.176/4.18e-06
dixmaank/12000	152/298/1.975/4.05e-06	1057/1366/9.534/9.80e-06	307/384/2.928/8.89e-06	719/1075/8.253/7.38e-06
dixmaanl/1200	254/472/0.357/9.60e-06	2010/2114/1.315/8.11e-06	2403/2504/1.653/9.99e-06	482/711/0.325/8.79e-06
dixmaanl/2400	81/153/0.114/8.73e-06	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN
dixon3dq/50	884/1622/0.086/9.32e-06	479/528/0.029/9.83e-06	433/486/0.017/9.67e-06	590/860/0.030/6.80e-06
dixon3dq/150	NaN/NaN/NaN/NaN	1404/1452/0.076/7.95e-06	1194/1243/0.076/9.95e-06	2041/2974/0.205/9.99e-06
dqdrtic/300	132/279/0.020/8.61e-06	73/195/0.013/9.02e-06	71/232/0.015/5.33e-06	77/198/0.015/1.20e-06
dqdrtic/5000	41/147/0.230/6.30e-06	57/165/0.261/4.36e-06	44/148/0.198/2.99e-06	33/138/0.209/4.22e-06
dqdrtic/9000	130/282/0.044/5.54e-06	114/382/0.050/6.07e-06	113/310/0.038/6.81e-06	73/185/0.023/3.63e-06
edensch/500	28/85/0.023/8.86e-06	43/101/0.023/6.31e-06	43/101/0.032/6.31e-06	27/84/0.032/6.67e-06
edensch/1000	33/103/0.071/2.80e-06	46/113/0.044/9.91e-06	46/113/0.034/9.91e-06	44/104/0.043/4.84e-06
edensch/4000	35/105/0.113/8.38e-06	72/161/0.274/9.83e-06	76/177/0.217/7.86e-06	38/108/0.131/6.96e-06
eg2/100	1501/3154/0.187/4.48e-06	175/658/0.049/4.14e-06	156/458/0.030/2.57e-06	882/2078/0.097/8.89e-06
fletcher/100	37/89/0.011/4.57e-06	47/117/0.004/9.77e-06	47/117/0.004/9.38e-06	30/85/0.004/7.00e-07
fletcher/500	39/105/0.008/7.13e-06	226/1493/0.066/7.49e-06	92/376/0.021/5.08e-06	37/110/0.008/2.77e-06
fletcher/2000	45/139/0.011/3.99e-06	70/257/0.016/9.47e-06	82/354/0.021/5.66e-06	54/313/0.029/9.89e-06
freuroth/460	728/5569/0.302/7.33e-06	NaN/NaN/NaN/NaN	563/5098/0.306/9.92e-06	308/2447/0.171/9.22e-06
genrose/100	1286/2103/0.085/9.49e-06	740/845/0.073/8.03e-06	688/805/0.061/7.52e-06	786/1069/0.050/6.01e-06
himmelbg/700	2/15/0.018/1.35e-29	2/15/0.002/1.35e-29	2/15/0.003/1.35e-29	2/15/0.004/1.35e-29
himmelbg/2400	2/10/0.004/5.14e-20	2/10/0.004/5.12e-20	2/10/0.005/5.14e-20	2/10/0.005/5.13e-20
liarwhd/6000	902/2022/0.270/4.46e-06	180/498/0.066/7.42e-06	139/443/0.040/7.72e-06	345/789/0.083/3.18e-06
liarwhd/3000	1120/2303/0.220/8.29e-06	156/454/0.064/9.90e-06	175/478/0.048/5.74e-06	637/1310/0.148/8.44e-06
penalty1/100	17/101/0.013/1.61e-06	17/101/0.005/1.51e-06	17/101/0.005/1.61e-06	17/101/0.006/2.03e-06
penalty1/1000	27/196/0.144/3.24e-06	31/199/0.231/7.81e-06	29/199/0.215/3.29e-06	28/193/0.152/9.18e-06
quartc/4000	54/162/0.272/9.01e-06	60/171/0.271/8.25e-06	56/168/0.278/9.95e-06	55/161/0.247/9.35e-06
quartc/8000	57/161/0.649/8.56e-06	63/178/0.413/9.79e-06	72/195/0.497/4.80e-06	62/174/0.383/3.87e-06
quartc/50000	87/235/6.233/6.14e-06	85/225/6.179/6.57e-06	117/251/6.910/4.41e-06	86/229/6.547/4.15e-06
tridia/300	924/1681/0.125/7.03e-06	626/693/0.040/9.68e-06	604/671/0.040/8.70e-06	725/1061/0.065/9.42e-06
tridia/2000	NaN/NaN/NaN/NaN	2014/2090/0.209/9.36e-06	1644/1720/0.189/8.81e-06	NaN/NaN/NaN/NaN
woods/1500	446/875/0.081/6.87e-06	111/333/0.022/7.39e-06	95/273/0.013/5.75e-06	180/457/0.022/9.18e-06
woods/2000	305/637/0.033/6.51e-06	224/389/0.025/8.86e-06	215/388/0.030/7.95e-06	212/471/0.025/4.01e-06
bdexp/5000	2/11/0.028/4.40e-111	2/11/0.010/4.39e-111	2/11/0.009/4.40e-111	2/11/0.008/4.40e-111
bdexp/50000	2/16/0.106/3.49e-89	2/16/0.173/3.49e-89	2/16/0.156/3.49e-89	2/16/0.171/3.49e-89
bdexp/5000	2/11/0.013/4.40e-111	2/11/0.013/4.39e-111	2/11/0.016/4.40e-111	2/11/0.017/4.40e-111
exdenschnf/9000	31/98/0.101/2.26e-06	46/117/0.026/5.74e-06	46/117/0.020/7.00e-06	34/96/0.016/7.11e-06
exdenschnf/2800	23/86/0.006/8.75e-06	53/121/0.009/6.40e-06	40/109/0.009/4.37e-06	30/97/0.009/7.61e-06
exdenschnf/6000	23/79/0.013/6.91e-06	36/104/0.016/2.95e-06	36/103/0.017/6.08e-06	26/95/0.014/5.85e-06
exdenschnb/3000	18/74/0.018/9.81e-06	39/97/0.009/5.06e-06	39/97/0.008/4.70e-06	16/70/0.007/5.25e-06
exdenschnb/6000	17/74/0.006/3.04e-06	17/75/0.007/5.65e-06	17/75/0.007/5.65e-06	22/79/0.008/6.37e-06
exdenschnb/24000	17/75/0.021/6.09e-06	18/79/0.021/9.65e-06	18/79/0.020/9.65e-06	24/85/0.023/5.20e-06
genquartic/9000	15/74/0.028/9.51e-06	28/88/0.015/4.99e-06	28/88/0.013/4.99e-06	15/72/0.010/2.54e-06
genquartic/9000	15/74/0.010/9.51e-06	28/88/0.013/4.99e-06	28/88/0.014/4.99e-06	15/72/0.011/2.54e-06
genquartic/50000	22/85/0.056/5.72e-07	17/79/0.048/9.15e-06	19/82/0.043/3.41e-06	20/82/0.044/7.20e-06
biggsb1/300	2140/3943/0.159/8.71e-06	1149/1210/0.079/8.38e-06	1301/1358/0.062/8.12e-06	2638/3857/0.256/8.18e-06
sine/500	403/898/0.092/6.95e-06	224/364/0.044/9.05e-06	189/388/0.039/5.49e-06	125/270/0.020/3.97e-06
sine/1000	28/82/0.019/9.28e-06	51/129/0.028/8.92e-06	57/143/0.030/9.61e-06	34/87/0.011/8.41e-06
sine/2000	101/211/0.076/9.54e-07	NaN/NaN/NaN/NaN	193/474/0.116/9.15e-06	65/159/0.057/9.19e-06
fletchv3/100	2576/4409/0.445/8.82e-06	NaN/NaN/NaN/NaN	2743/5765/0.596/9.73e-06	1479/2439/0.275/7.90e-06
nonscomp/5000	46/114/0.036/5.75e-06	220/310/0.038/9.80e-06	168/263/0.032/9.79e-06	46/118/0.014/6.14e-06
nonscomp/8000	NaN/NaN/NaN/NaN	1730/2302/0.376/9.33e-06	2004/2685/0.448/9.57e-06	NaN/NaN/NaN/NaN
power1/150	NaN/NaN/NaN/NaN	2513/2631/0.100/7.90e-06	1558/1647/0.103/9.88e-06	NaN/NaN/NaN/NaN
raydan1/500	197/351/0.052/8.90e-06	284/342/0.043/9.31e-06	317/375/0.039/8.95e-06	177/271/0.019/7.01e-06
raydan1/1000	324/579/0.055/9.55e-06	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN	244/351/0.048/8.69e-06
raydan2/1000	15/70/0.016/6.53e-06	15/70/0.013/6.53e-06	15/70/0.012/6.53e-06	15/70/0.016/6.53e-06
raydan2/2000	12/63/0.024/5.09e-06	12/63/0.022/5.09e-06	12/63/0.024/5.09e-06	12/63/0.024/5.09e-06
raydan2/5000	10/71/0.023/1.06e-06	10/71/0.031/1.06e-06	10/71/0.026/1.06e-06	10/71/0.025/1.06e-06
diagonal1/800	453/2996/0.524/6.00e-06	966/7246/1.051/9.12e-06	658/4620/0.691/9.92e-06	966/8569/1.482/6.77e-06
diagonal1/2000	1740/15842/4.547/7.69e-06	NaN/NaN/NaN/NaN	2996/29170/8.441/9.52e-06	2479/24095/6.571/9.94e-06
diagonal2/5000	829/1553/0.708/9.55e-06	403/625/0.315/8.58e-06	400/618/0.274/9.35e-06	536/839/0.413/5.55e-06
diagonal2/10000	833/1520/1.309/7.39e-06	601/953/0.827/9.86e-06	588/888/0.795/9.51e-06	758/1154/1.049/9.88e-06
diagonal3/500	208/395/0.031/9.33e-06	1271/10542/0.947/9.04e-06	899/7222/0.692/9.47e-06	766/6691/0.566/8.60e-06
diagonal3/1000	539/2900/0.392/5.88e-06	1819/16588/2.221/9.73e-06	1140/9629/1.452/9.60e-06	1096/9447/1.269/7.59e-06
diagonal3/2000	757/4547/1.124/9.78e-06	NaN/NaN/NaN/NaN	2069/18930/4.448/9.84e-06	NaN/NaN/NaN/NaN
osb2/11	1125/2058/0.243/9.74e-06	418/735/0.085/6.67e-06	410/741/0.079/6.78e-06	692/1126/0.142/9.00e-06
ie/150	12/46/0.463/9.08e-06	16/52/0.547/8.93e-06	16/52/0.641/8.93e-06	10/44/0.521/6.35e-06
ie/500	13/52/5.539/8.30e-06	12/45/4.500/7.38e-06	12/45/4.441/7.38e-06	10/48/4.991/2.79e-06
singx/500	2713/5468/2.512/8.48e-06	231/592/0.244/7.11e-06	210/505/0.266/9.26e-06	1166/2413/1.108/4.34e-06
singx/1000	NaN/NaN/NaN/NaN	161/399/0.988/7.11e-06	375/878/2.183/9.07e-06	1169/2363/6.014/9.52e-06
singx/2000	NaN/NaN/NaN/NaN	239/596/7.202/7.55e-06	338/818/9.469/8.51e-06	1377/2730/6.317/8.61e-06
lin/50	10/57/0.075/2.08e-06	10/57/0.021/2.08e-06	10/57/0.012/2.08e-06	10/57/0.011/2.08e-06
lin/100	13/63/0.021/8.86e-07	13/63/0.021/8.86e-07	13/63/0.022/8.86e-07	13/63/0.022/8.86e-07
pen1/200	419/2854/0.247/9.80e-06	62/350/0.027/9.42e-06	183/954/0.077/9.34e-06	380/2591/0.202/4.23e-06
pen1/1000	139/751/7.914/7.99e-06	103/614/4.075/6.72e-06	143/1045/7.870/6.41e-06	205/1112/5.574/3.10e-06
pen2/160	NaN/NaN/NaN/NaN	268/635/0.077/9.99e-06	298/943/0.118/9.90e-06	NaN/NaN/NaN/NaN
rosex/500	174/446/0.290/7.69e-06	73/289/0.225/7.99e-06	79/299/0.203/9.24e-06	241/506/0.343/5.41e-06
rosex/1000	430/915/3.879/6.46e-06	85/256/0.989/4.11e-06	83/296/1.143/2.64e-06	159/369/1.454/7.08e-06
trid/400	87/165/0.085/1.19e-06	154/209/0.082/7.96e-06	151/206/0.083/7.95e-06	78/142/0.059/7.87e-06
trid/800	38/92/0.169/5.74e-06	127/182/0.363/8.68e-06	127/182/0.367/8.68e-06	43/97/0.198/7.11e-06