

Notes: ‘n’ represents the dimension of the corresponding problem. ‘NI’ represents the total number of iterations. ‘NF’ represents the number of the function evaluation. ‘Time’ represents the running time of the algorithm. ‘||g*||’ represents the gradient value for the solution. The values of ‘NI’, ‘NF’, ‘Time’ and ‘||g*||’ are set as ‘NaN’ if and only if the number of iterations is greater than 2000.

Table 1: Numerical results for the constrained optimization problems							
Problem/n	SCGMrf1 NI/NF/Time/ g*	SCGMrf2 NI/NF/Time/ g*	SCGMrf3 NI/NF/Time/ g*	SCGMrf-NG NI/NF/Time/ g*	HZ NI/NF/Time/ g*	KD NI/NF/Time/ g*	MTTLS NI/NF/Time/ g*
cosine/4070	27/113/0.037/2.22e-07	20/85/0.020/9.07e-07	26/90/0.019/4.35e-07	25/104/0.023/5.73e-08	27/100/0.020/8.37e-07	34/107/0.022/1.13e-07	73/296/0.052/8.02e-07
cosine/43000	27/94/0.133/2.04e-07	19/84/0.131/7.93e-07	29/99/0.159/8.62e-07	39/146/0.202/3.62e-07	37/118/0.176/1.19e-07	41/122/0.179/1.76e-07	587/1992/2.629/1.87e-07
dixmaana/96000	16/87/1.525/8.36e-07	15/85/1.499/3.74e-07	18/90/1.585/6.28e-07	17/89/2.131/8.14e-07	20/102/2.235/8.62e-07	24/102/2.034/6.99e-07	20/88/1.730/1.66e-07
dixmaana/120000	19/89/2.471/5.64e-07	22/94/2.800/7.96e-07	22/92/2.133/8.62e-07	22/95/2.172/8.61e-08	23/95/2.190/2.03e-07	20/95/2.061/1.01e-07	19/90/1.950/7.59e-07
dixmaanb/24900	18/90/0.477/1.49e-07	20/88/0.423/7.86e-07	16/80/0.398/1.84e-07	18/90/0.442/7.86e-09	21/89/0.425/9.34e-07	21/108/0.526/7.76e-07	25/94/0.459/6.57e-07
dixmaanb/43500	20/89/0.725/4.80e-07	17/81/0.645/3.97e-08	15/73/0.614/3.99e-07	21/91/0.760/1.25e-07	22/91/0.786/2.37e-07	14/82/0.689/9.27e-07	25/94/0.789/1.27e-07
dixmaanb/53700	20/84/0.868/2.02e-07	20/88/0.914/9.01e-07	23/91/1.175/3.72e-07	23/93/0.981/8.81e-08	24/94/0.929/2.61e-07	19/87/0.845/3.28e-07	22/90/0.911/5.12e-07
dixmaanc/30300	18/93/0.563/9.86e-07	16/81/0.484/3.45e-07	19/89/0.506/6.28e-07	20/101/0.578/2.95e-07	22/92/0.540/4.40e-07	19/90/0.513/3.69e-07	25/96/0.573/4.56e-07
dixmaanc/150000	17/91/2.628/4.53e-07	17/89/2.472/9.37e-07	16/89/2.515/8.48e-07	17/91/2.539/4.36e-07	23/95/2.706/2.41e-07	20/92/2.697/3.13e-08	28/102/3.218/7.38e-07
dixmaanc/300000	22/95/5.820/9.92e-07	21/94/5.531/3.97e-07	16/90/4.999/6.69e-07	22/95/5.253/8.99e-07	22/95/5.430/8.41e-07	22/104/5.992/7.37e-07	25/97/5.943/3.69e-07
dixmaand/300	21/93/0.029/8.34e-08	14/71/0.010/5.25e-07	15/73/0.008/8.34e-07	21/93/0.011/1.98e-07	22/80/0.008/6.91e-07	19/79/0.009/8.51e-07	21/80/0.008/5.40e-07
dixmaand/7200	20/87/0.152/4.23e-07	16/79/0.131/9.95e-07	18/85/0.142/1.87e-07	20/87/0.145/3.82e-07	21/89/0.148/1.88e-07	18/87/0.156/3.26e-07	22/91/0.165/2.22e-07
dixmaand/13650	17/85/0.256/1.04e-08	19/82/0.246/9.60e-07	18/86/0.254/1.51e-07	17/85/0.257/1.62e-08	26/96/0.298/2.28e-07	18/87/0.267/8.72e-07	22/88/0.273/5.77e-07
dixmaane/90	92/198/0.032/9.08e-07	89/182/0.018/8.41e-07	84/183/0.017/5.15e-07	108/238/0.018/6.98e-07	129/263/0.022/9.94e-07	92/172/0.011/2.53e-07	90/176/0.010/8.84e-07
dixmaane/2100	496/1054/0.592/3.38e-07	425/863/0.474/7.56e-07	386/863/0.442/4.04e-07	499/1074/0.549/8.09e-07	469/974/0.476/9.45e-07	325/625/0.326/8.54e-07	379/687/0.333/8.77e-07
dixmaanf/6	22/70/0.017/4.69e-07	23/71/0.001/9.63e-07	21/72/0.001/7.39e-07	28/78/0.002/9.08e-07	34/87/0.002/2.85e-07	22/69/0.001/8.26e-07	24/75/0.002/6.14e-07
dixmaanf/15	40/95/0.003/6.01e-07	40/92/0.002/6.58e-07	34/84/0.002/9.79e-07	43/96/0.002/9.11e-07	54/111/0.002/9.21e-07	37/91/0.003/8.28e-07	41/99/0.003/4.24e-07
dixmaanf/60	65/151/0.008/6.59e-07	73/158/0.007/4.02e-07	73/158/0.007/4.02e-07	94/202/0.007/8.25e-07	79/176/0.007/8.25e-07	58/120/0.004/6.03e-07	64/126/0.005/9.14e-07
dixmaang/150	100/209/0.031/9.36e-07	102/215/0.013/9.68e-07	95/216/0.014/8.80e-07	98/223/0.015/7.94e-07	130/265/0.020/6.17e-07	99/197/0.015/5.13e-07	98/189/0.013/8.97e-07
dixmaanhn/9	32/85/0.017/7.61e-07	35/88/0.002/9.59e-07	32/85/0.002/6.42e-07	29/81/0.003/8.96e-07	40/106/0.002/5.26e-07	33/84/0.002/9.98e-07	37/92/0.002/7.99e-07
dixmaanhn/90	85/171/0.009/9.74e-07	80/168/0.011/9.16e-07	74/158/0.009/9.45e-07	82/181/0.010/9.62e-07	81/180/0.008/9.67e-07	72/149/0.009/6.54e-07	75/155/0.008/6.91e-07
dixmaanhn/150	100/223/0.023/9.11e-07	91/202/0.015/8.04e-07	93/210/0.016/8.33e-07	120/264/0.017/9.80e-07	95/222/0.013/9.40e-07	90/190/0.021/9.04e-07	100/211/0.021/9.30e-07
dixmaani/9	72/165/0.021/8.53e-07	83/174/0.003/4.48e-07	64/143/0.004/7.27e-07	86/200/0.004/8.62e-07	102/223/0.005/7.04e-07	78/166/0.003/8.10e-07	65/132/0.004/7.38e-07
dixmaani/45	222/492/0.035/9.13e-07	575/1181/0.053/8.02e-07	295/659/0.022/8.84e-07	355/791/0.032/9.07e-07	321/700/0.023/7.06e-07	317/607/0.026/6.11e-07	291/534/0.029/4.75e-07
dixmaank/3000	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN	294/637/0.424/8.52e-07	661/1482/0.984/9.06e-07	1320/2841/1.855/9.26e-07	1574/3087/2.034/7.75e-07	NaN/NaN/NaN/NaN
dixmaank/6000	466/986/1.439/8.94e-07	490/994/1.434/9.16e-07	393/868/1.153/9.25e-07	411/893/1.157/9.87e-07	872/1832/2.313/9.71e-07	140/290/0.366/7.21e-07	162/298/0.391/6.60e-07
dixmaank/12000	331/688/1.743/7.46e-07	480/958/2.514/7.57e-07	372/826/2.057/5.20e-07	517/1141/2.843/9.27e-07	740/1550/3.981/7.71e-07	616/1221/3.095/3.79e-07	575/1191/3.275/9.70e-07
dixmaank/21000	969/2055/8.714/8.61e-07	1207/2496/10.496/8.81e-07	918/2116/8.959/6.14e-07	792/1749/7.351/8.13e-07	885/1908/7.992/8.23e-07	NaN/NaN/NaN/NaN	777/1435/5.995/9.69e-07
dixmaank/24000	520/1093/5.044/9.65e-07	507/1016/4.769/5.80e-07	560/1148/5.347/9.94e-07	520/1105/5.220/6.76e-07	884/1954/10.077/9.82e-07	608/1185/6.351/7.21e-07	1062/2152/10.530/8.56e-07
dixmaank/90000	751/1574/26.821/8.53e-07	427/873/14.342/4.54e-07	247/531/8.625/8.44e-07	603/1301/20.401/5.48e-07	426/944/14.797/9.06e-07	NaN/NaN/NaN/NaN	NaN/NaN/NaN/NaN
dixon3dq/4	33/89/0.009/8.52e-07	46/97/0.004/4.30e-07	33/76/0.002/9.60e-07	50/106/0.004/9.68e-07	58/117/0.004/6.53e-07	40/87/0.003/5.02e-07	38/99/0.003/5.02e-07
dixon3dq/8	70/146/0.005/3.19e-07	89/193/0.006/8.45e-07	84/192/0.006/8.68e-07	123/258/0.008/6.86e-07	99/218/0.006/9.38e-07	64/133/0.004/7.94e-07	85/206/0.006/9.83e-07
dqdrtic/1000000	67/235/1.974/9.27e-07	72/226/1.933/9.35e-07	117/332/2.824/9.59e-07	119/346/2.781/9.52e-07	152/422/3.599/6.73e-07	95/298/2.387/4.01e-07	92/343/2.668/4.01e-07
dqdrtic/2200000	85/280/5.006/7.45e-07	101/310/5.823/6.51e-07	91/280/4.892/9.24e-07	117/345/6.089/6.12e-07	74/242/4.210/7.66e-07	86/285/5.194/8.20e-07	82/316/5.966/8.44e-07
dqdrtic/4700000	71/246/9.198/9.03e-08	80/252/9.197/4.99e-07	101/289/10.920/9.85e-07	79/267/9.493/7.99e-07	106/300/11.916/6.94e-07	81/271/10.310/6.17e-07	68/276/9.385/1.09e-07
dqrctic/64	14/77/0.006/4.24e-07	17/76/0.003/1.55e-07	16/76/0.002/1.43e-07	18/80/0.004/5.60e-07	25/89/0.002/7.73e-07	20/79/0.002/7.73e-07	43/269/0.002/7.73e-07
dqrctic/6800	37/151/0.227/6.40e-07	36/150/0.228/2.60e-07	44/151/0.226/4.04e-07	49/159/0.237/2.66e-07	67/199/0.301/7.12e-07	53/168/0.256/1.01e-07	118/471/0.700/3.97e-07
dqrctic/8000	41/163/0.281/2.84e-07	37/156/0.273/1.97e-07	39/152/0.265/2.25e-07	46/166/0.288/1.34e-07	58/175/0.307/7.32e-07	58/175/0.307/7.32e-07	191/737/1.319/8.93e-07
edensch/500	35/119/0.018/8.06e-07	30/90/0.009/4.40e-07	30/96/0.010/6.18e-07	39/148/0.015/9.38e-07	41/107/0.012/9.39e-07	49/292/0.030/8.93e-07	52/265/0.027/8.43e-07
edensch/15000	46/260/0.796/9.68e-07	52/267/0.814/2.03e-07	43/212/0.647/4.37e-07	75/445/0.994/2.28e-07	40/192/0.576/9.11e-07	45/226/0.730/5.03e-07	97/657/2.012/3.88e-07
edensch/35020	50/235/0.803/2.78e-07	69/402/2.791/3.98e-07	56/295/2.032/8.59e-07	84/611/4.206/4.36e-07	60/233/1.613/2.57e-07	139/435/3.149/5.12e-07	82/435/3.149/5.12e-07
eg2/7	44/104/0.005/7.39e-07	33/94/0.001/4.10e-07	36/94/0.002/5.07e-07	45/102/0.003/8.02e-07	90/240/0.004/9.97e-07	48/115/0.001/9.89e-07	67/282/0.002/9.98e-07
fletcher/5000	90/451/0.062/5.70e-07	89/540/0.033/9.98e-07	117/842/0.044/6.16e-07	150/1154/0.054/8.77e-07	124/788/0.037/1.11e-07	107/760/0.034/8.94e-07	391/3698/0.157/5.65e-07
fletcher/100000	90/358/0.296/5.63e-07	139/1226/0.935/5.69e-07	103/210/0.183/7.25e-07	231/1977/1.500/4.00e-07	267/2385/1.784/2.70e-07	268/1779/1.302/1.66e-07	332/3231/2.281/9.20e-07
fletcher/210000	253/2249/4.199/1.12e-07	86/342/0.715/7.46e-07	169/1327/2.557/1.64e-07	199/1699/3.158/6.08e-07	224/2004/4.054/3.72e-07	274/2624/4.846/7.09e-07	191/1785/3.191/3.67e-07
freuroth/2	113/381/0.008/8.33e-07	100/335/0.003/7.09e-07	187/505/0.004/5.01e-07	230/884/0.008/9.23e-07	226/625/0.005/6.48e-07	89/448/0.004/2.00e-07	62/289/0.004/2.00e-07
genrose/4	149/388/0.008/6.30e-07	291/675/0.006/7.33e-07	246/574/0.005/5.09e-07	329/765/0.007/9.74e-07	215/518/0.005/7.28e-07	114/312/0.003/9.02e-07	123/432/0.004/7.59e-07
quartc/8000	41/163/0.294/2.84e-07	37/156/0.275/1.97e-07	39/152/0.266/2.25e-07	46/166/0.293/1.34e-07	63/190/0.332/3.23e-07	58/175/0.311/7.92e-07	191/737/1.319/8.93e-07
quartc/15300	49/171/0.723/2.60e-07	51/184/0.696/2.18e-07	46/169/0.582/3.70e-07	60/196/0.713/8.83e-07	72/221/0.737/2.95e-07	65/205/0.678/7.70e-07	168/839/2.736/7.64e-07
quartc/40000	50/192/1.604/5.66e-07	55/183/1.534/4.65e-07	38/158/1.522/3.25e-07	63/213/1.861/6.07e-07	105/312/2.948/4.07e-07	81/248/2.194/9.90e-07	256/909/8.234/7.53e-07
tridia/7	79/166/0.006/5.80e-07	70/152/0.001/7.87e-07	70/157/0.001/6.75e-07	105/211/0.003/6.81e-07	110/221/0.002/3.86e-07	79/166/0.001/8.15e-07	90/280/0.003/9.36e-07
woods/2500	271/690/0.035/7.74e-07	401/987/0.033/6.08e-07	434/1073/0.023/6.23e-07	555/1304/0.027/7.84e-07	486/1211/0.025/7.29e-07	183/448/0.009/4.73e-07	205/819/0.016/4.79e-07
woods/25000	496/1149/0.258/8.46e-07	402/999/0.206/6.89e-07	321/793/0.149/7.46e-07	438/1090/0.238/1.39e-07	353/848/0.167/9.67e-07	311/741/0.154/9.19e-07	169/657/0.112/6.74e-07
woods/250000	274/699/1.525/7.76e-07	455/1167/2.520/9.55e-07	298/736/1.537/9.11e-07	476/1168/2.326/9.36e-07	382/945/1.887/5.11e-07	386/920/1.801/3.83e-07	488/1845/3.207/5.06e-07
bdexp/10000	2/17/0.023/2.68e-61	2/17/0.013/2.68e-61	2/17/0.011/2.68e-61	2/17/0.010/2.68e-61	2/17/0.009/1.25e-63	2/17/0.010/7.79e-63	2/17/0.009/3.57e-64
bdexp/100000	2/12/0.085/4.58e-106	2/12/0.080/4.58e-106	2/12/0.082/4.58e-106	2/12/0.081/4.58e-106	2/12/0.084/4.50e-106	2/12/0.087/4.50e-106	2/12/0.085/4.45e-106
bdexp/500000	2/12/0.438/1.55e-120	2/12/0.422/1.55e-120	2/12/0.419/1.55e-120	2/12/0.441/1.55e-120	2/12/0.421/1.54e-120	2/12/0.432/1.55e-120	2/12/0.428/1.54e-120
exdenschnf/22000	28/99/0.042/8.17e-07	27/106/0.019/2.94e-07	23/97/0.017/7.27e-07	33/112/0.020/4.48e-07	30/107/0.019/3.52e-07	25/105/0.022/5.82e-07	36/148/0.031/9.49e-08
exdenschnf/1019000	30/116/1.112/9.50e-07	34/121/1.139/8.24e-07	29/114/1.006/7.41e-07	28/126/1.083/5.64e-07	35/121/1.092/9.83e-07	28/135/1.161/5.05e-07	60/234/2.056/7.38e-07
exdenschnf/2250000	27/115/2.294/7.45e-07	26/112/2.252/7.26e-07	41/125/2.623/7.95e-07	27/115/2.290/6.39e-07	38/124/2.497/8.43e-07	27/123/2.435/3.49e-07	53/192/3.787/9.96e-07
exdenschnb/10000	15/80/0.017/8.30e-07	15/80/0.008/8.30e-07	15/80/0.005/8.30e-07	16/			