

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs001-0		30			
hs001-1	0.0001	10	0	4.32E-005	0.00E+000
hs001-1	0.001	15	0	4.32E-004	0.00E+000
hs001-1	0.01	48	0	4.34E-003	0.00E+000
hs001-2	0.0001	5	0	7.69E-005	0.00E+000
hs001-2	0.001	6	0	7.68E-004	0.00E+000
hs001-2	0.01	7	0	7.64E-003	0.00E+000
hs001-3	0.0001	5	0	6.10E-005	0.00E+000
hs001-3	0.001	6	0	6.10E-004	0.00E+000
hs001-3	0.01	7	0	6.11E-003	0.00E+000
hs002-0		28			
hs002-1	0.0001	6	0	4.75E-005	0.00E+000
hs002-1	0.001	8	0	4.75E-004	0.00E+000
hs002-1	0.01	13	0	4.77E-003	0.00E+000
hs002-2	0.0001	3	0	8.41E-005	0.00E+000
hs002-2	0.001	4	0	8.41E-004	0.00E+000
hs002-2	0.01	5	0	8.35E-003	0.00E+000
hs002-3	0.0001	3	0	6.92E-005	0.00E+000
hs002-3	0.001	4	0	6.92E-004	0.00E+000
hs002-3	0.01	7	0	6.94E-003	0.00E+000
hs003-0		6			
hs003-1	0.0001	4	0	7.49E-005	0.00E+000
hs003-1	0.001	4	0	7.49E-004	0.00E+000
hs003-1	0.01	5	0	7.49E-003	0.00E+000
hs003-2	0.0001	4	0	1.33E-004	0.00E+000
hs003-2	0.001	4	0	1.33E-003	0.00E+000
hs003-2	0.01	5	0	1.33E-002	0.00E+000
hs003-3	0.0001	4	0	1.06E-004	0.00E+000
hs003-3	0.001	4	0	1.06E-003	0.00E+000
hs003-3	0.01	5	0	1.06E-002	0.00E+000
hs004-0		7			
hs004-1	0.0001	3	0	6.55E-005	0.00E+000
hs004-1	0.001	3	0	6.55E-004	0.00E+000
hs004-1	0.01	7	0	6.57E-003	0.00E+000
hs004-2	0.0001	4	0	7.92E-005	0.00E+000
hs004-2	0.001	5	0	7.92E-004	0.00E+000
hs004-2	0.01	6	0	7.89E-003	0.00E+000
hs004-3	0.0001	4	0	4.61E-005	0.00E+000
hs004-3	0.001	5	0	4.61E-004	0.00E+000
hs004-3	0.01	6	0	4.62E-003	0.00E+000
hs005-0		9			
hs005-1	0.0001	4	0	7.49E-005	0.00E+000
hs005-1	0.001	6	0	7.48E-004	0.00E+000
hs005-1	0.01	7	0	7.44E-003	0.00E+000
hs005-2	0.0001	4	0	2.31E-005	0.00E+000
hs005-2	0.001	5	0	2.31E-004	0.00E+000
hs005-2	0.01	6	0	2.31E-003	0.00E+000
hs005-3	0.0001	4	0	4.26E-005	0.00E+000
hs005-3	0.001	6	0	4.26E-004	0.00E+000
hs005-3	0.01	7	0	4.27E-003	0.00E+000
hs006-0		7			
hs006-1	0.0001	4	0	7.68E-005	5.03E-005
hs006-1	0.001	4	0	7.68E-004	5.03E-004
hs006-1	0.01	5	0	7.64E-003	5.03E-003
hs006-2	0.0001	4	0	3.79E-005	5.57E-005
hs006-2	0.001	5	0	3.79E-004	5.57E-004
hs006-2	0.01	5	0	3.79E-003	5.57E-003
hs006-3	0.0001	3	1	5.88E-005	1.91E-005
hs006-3	0.001	4	0	5.92E-004	1.92E-004
hs006-3	0.01	5	0	5.91E-003	1.92E-003
hs007-0		13			
hs007-1	0.0001	4	0	9.55E-005	1.40E-005
hs007-1	0.001	5	0	9.55E-004	1.39E-004
hs007-1	0.01	5	0	9.48E-003	1.40E-003
hs007-2	0.0001	3	0	3.59E-005	1.55E-005
hs007-2	0.001	4	0	3.59E-004	1.55E-004
hs007-2	0.01	5	0	3.59E-003	1.55E-003
hs007-3	0.0001	4	0	8.60E-005	5.31E-006
hs007-3	0.001	5	0	8.60E-004	5.33E-005
hs007-3	0.01	5	0	8.54E-003	5.33E-004

TABLE 1. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowski test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs008-0		7			
hs008-1	0.0001	4	1	6.13E-005	1.04E-004
hs008-1	0.001	5	0	6.12E-004	1.04E-003
hs008-1	0.01	6	0	6.11E-003	1.04E-002
hs008-2	0.0001	4	2	8.96E-005	8.04E-005
hs008-2	0.001	5	1	8.99E-004	8.05E-004
hs008-2	0.01	6	1	8.93E-003	8.05E-003
hs008-3	0.0001	4	0	3.07E-005	9.27E-005
hs008-3	0.001	5	1	3.07E-004	9.27E-004
hs008-3	0.01	6	0	3.06E-003	9.27E-003
hs009-0		5			
hs009-1	0.0001	9	0	7.97E-006	4.66E-006
hs009-1	0.001	22	0	2.72E-005	1.92E-005
hs009-1	0.01	17	0	2.81E-004	1.67E-004
hs009-2	0.0001	13	0	4.15E-005	1.09E-006
hs009-2	0.001	17	0	4.11E-004	1.53E-005
hs009-2	0.01	19	0	4.15E-003	1.79E-004
hs009-3	0.0001	14	0	6.44E-005	2.28E-006
hs009-3	0.001	19	0	6.21E-004	2.99E-002
hs009-3	0.01	17	0	6.41E-003	6.00E-005
hs010-0		13			
hs010-1	0.0001	4	0	8.48E-005	2.25E-005
hs010-1	0.001	4	0	8.47E-004	2.25E-004
hs010-1	0.01	5	0	8.44E-003	2.25E-003
hs010-2	0.0001	4	0	7.47E-005	4.33E-005
hs010-2	0.001	4	0	7.47E-004	4.33E-004
hs010-2	0.01	5	0	7.50E-003	4.33E-003
hs010-3	0.0001	4	0	3.86E-005	2.79E-005
hs010-3	0.001	4	0	3.85E-004	2.79E-004
hs010-3	0.01	4	0	3.84E-003	2.79E-003
hs011-0		11			
hs011-1	0.0001	3	0	7.67E-005	4.78E-005
hs011-1	0.001	4	0	7.68E-004	4.78E-004
hs011-1	0.01	5	0	7.66E-003	4.80E-003
hs011-2	0.0001	3	0	6.95E-005	9.20E-005
hs011-2	0.001	5	0	6.95E-004	9.20E-004
hs011-2	0.01	7	0	6.96E-003	9.13E-003
hs011-3	0.0001	2	0	3.68E-005	5.91E-005
hs011-3	0.001	3	0	3.69E-004	5.92E-004
hs011-3	0.01	4	0	3.68E-003	5.95E-003
hs012-0		15			
hs012-1	0.0001	2	0	8.41E-005	2.25E-005
hs012-1	0.001	3	0	8.41E-004	2.25E-004
hs012-1	0.01	3	0	8.38E-003	2.25E-003
hs012-2	0.0001	2	1	7.75E-005	4.32E-005
hs012-2	0.001	5	0	7.78E-004	4.33E-004
hs012-2	0.01	6	0	7.81E-003	4.33E-003
hs012-3	0.0001	5	0	4.22E-005	2.79E-005
hs012-3	0.001	6	0	4.21E-004	2.79E-004
hs012-3	0.01	8	0	4.20E-003	2.79E-003
hs014-0		9			
hs014-1	0.0001	6	0	4.35E-005	5.89E-005
hs014-1	0.001	6	0	4.34E-004	5.88E-004
hs014-1	0.01	7	0	4.33E-003	5.91E-003
hs014-2	0.0001	6	0	4.04E-005	6.40E-005
hs014-2	0.001	6	0	4.05E-004	6.39E-004
hs014-2	0.01	7	0	4.06E-003	6.41E-003
hs014-3	0.0001	6	0	3.11E-005	8.36E-005
hs014-3	0.001	6	0	3.12E-004	8.37E-004
hs014-3	0.01	5	0	3.13E-003	8.31E-003

TABLE 2. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs015-0		11			
hs015-1	0.0001	8	0	5.35E-005	5.03E-005
hs015-1	0.001	8	0	5.34E-004	5.03E-004
hs015-1	0.01	8	0	5.32E-003	5.05E-003
hs015-2	0.0001	7	0	2.94E-005	8.94E-005
hs015-2	0.001	8	0	2.93E-004	8.95E-004
hs015-2	0.01	8	0	2.94E-003	9.02E-003
hs015-3	0.0001	7	0	2.97E-005	9.77E-005
hs015-3	0.001	8	0	2.97E-004	9.76E-004
hs015-3	0.01	8	0	2.98E-003	9.68E-003
hs016-0		11			
hs016-1	0.0001	8	0	4.66E-005	9.26E-005
hs016-1	0.001	10	0	4.66E-004	9.26E-004
hs016-1	0.01	12	0	4.65E-003	9.26E-003
hs016-2	0.0001	8	0	2.21E-005	5.50E-005
hs016-2	0.001	10	0	2.21E-004	5.50E-004
hs016-2	0.01	11	0	2.21E-003	5.50E-003
hs016-3	0.0001	4	0	2.35E-005	3.80E-005
hs016-3	0.001	4	0	2.35E-004	3.80E-004
hs016-3	0.01	6	0	2.34E-003	3.80E-003
hs017-0		12			
hs017-1	0.0001	10	0	5.62E-005	6.36E-004
hs017-1	0.001	11	0	5.57E-004	1.03E-003
hs017-1	0.01	12	0	5.57E-003	4.59E-003
hs017-2	0.0001	9	0	4.93E-005	1.38E-003
hs017-2	0.001	10	0	4.68E-004	1.98E-004
hs017-2	0.01	11	0	4.68E-003	1.78E-003
hs017-3	0.0001	10	0	8.47E-005	2.52E-004
hs017-3	0.001	11	0	8.46E-004	3.43E-004
hs017-3	0.01	13	0	8.46E-003	3.03E-003
hs018-0		13			
hs018-1	0.0001	7	0	9.66E-005	7.69E-005
hs018-1	0.001	8	0	9.66E-004	7.69E-004
hs018-1	0.01	8	0	9.58E-003	7.69E-003
hs018-2	0.0001	7	0	9.71E-005	6.86E-005
hs018-2	0.001	8	0	9.70E-004	6.86E-004
hs018-2	0.01	8	0	9.62E-003	6.86E-003
hs018-3	0.0001	7	0	7.98E-005	3.32E-005
hs018-3	0.001	8	0	7.98E-004	3.32E-004
hs018-3	0.01	8	0	7.93E-003	3.32E-003
hs019-0		17			
hs019-1	0.0001	10	0	9.66E-005	6.68E-005
hs019-1	0.001	10	0	9.66E-004	6.70E-004
hs019-1	0.01	13	0	9.57E-003	6.74E-003
hs019-2	0.0001	10	0	9.73E-005	5.36E-005
hs019-2	0.001	9	0	9.72E-004	5.37E-004
hs019-2	0.01	12	0	9.64E-003	5.39E-003
hs019-3	0.0001	8	0	8.01E-005	3.35E-005
hs019-3	0.001	10	0	8.00E-004	3.34E-004
hs019-3	0.01	13	0	7.95E-003	3.34E-003
hs020-0		13			
hs020-1	0.0001	9	0	2.36E-005	9.69E-005
hs020-1	0.001	9	0	2.36E-004	9.68E-004
hs020-1	0.01	9	0	2.35E-003	9.60E-003
hs020-2	0.0001	7	0	4.03E-005	9.77E-005
hs020-2	0.001	10	0	4.03E-004	9.76E-004
hs020-2	0.01	8	0	4.04E-003	9.67E-003
hs020-3	0.0001	7	0	4.62E-005	8.05E-005
hs020-3	0.001	9	0	4.62E-004	8.04E-004
hs020-3	0.01	9	0	4.62E-003	7.98E-003

TABLE 3. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs021-0		13			
hs021-1	0.0001	12	0	7.39E-005	5.03E-005
hs021-1	0.001	12	0	7.39E-004	5.03E-004
hs021-1	0.01	11	0	7.44E-003	5.03E-003
hs021-2	0.0001	12	0	2.21E-005	6.23E-005
hs021-2	0.001	12	0	2.21E-004	6.23E-004
hs021-2	0.01	12	0	2.21E-003	6.23E-003
hs021-3	0.0001	11	0	2.42E-005	7.99E-005
hs021-3	0.001	11	0	2.40E-004	7.99E-004
hs021-3	0.01	11	0	2.40E-003	7.99E-003
hs022-0		8			
hs022-1	0.0001	3	0	6.46E-005	4.50E-005
hs022-1	0.001	3	0	6.45E-004	4.50E-004
hs022-1	0.01	8	0	6.42E-003	4.51E-003
hs022-2	0.0001	4	0	3.15E-005	4.07E-005
hs022-2	0.001	5	0	3.15E-004	4.07E-004
hs022-2	0.01	6	0	3.14E-003	4.07E-003
hs022-3	0.0001	3	0	5.44E-005	5.82E-005
hs022-3	0.001	3	0	5.44E-004	5.82E-004
hs022-3	0.01	7	0	5.42E-003	5.82E-003
hs023-0		14			
hs023-1	0.0001	9	0	2.11E-005	8.35E-005
hs023-1	0.001	11	0	2.11E-004	8.34E-004
hs023-1	0.01	16	0	2.11E-003	8.29E-003
hs023-2	0.0001	9	0	6.30E-005	4.96E-005
hs023-2	0.001	10	0	6.30E-004	4.96E-004
hs023-2	0.01	15	0	6.31E-003	4.96E-003
hs023-3	0.0001	9	0	2.24E-005	4.76E-005
hs023-3	0.001	11	0	2.24E-004	4.76E-004
hs023-3	0.01	16	0	2.24E-003	4.78E-003
hs024-0		12			
hs024-1	0.0001	4	0	8.51E-005	4.13E-005
hs024-1	0.001	6	0	8.50E-004	4.13E-004
hs024-1	0.01	7	0	8.44E-003	4.14E-003
hs024-2	0.0001	4	0	7.47E-005	3.87E-005
hs024-2	0.001	5	0	7.47E-004	3.87E-004
hs024-2	0.01	7	0	7.49E-003	3.88E-003
hs024-3	0.0001	4	0	3.23E-005	4.93E-005
hs024-3	0.001	5	0	3.23E-004	4.93E-004
hs024-3	0.01	6	0	3.24E-003	4.92E-003
hs026-0		16			
hs026-1	0.0001	3	0	6.32E-004	5.01E-005
hs026-1	0.001	4	0	6.36E-004	5.03E-004
hs026-1	0.01	5	0	6.94E-003	5.03E-003
hs026-2	0.0001	3	0	1.76E-003	5.62E-005
hs026-2	0.001	11	0	3.15E-003	5.63E-004
hs026-2	0.01	11	0	4.51E-003	5.63E-003
hs026-3	0.0001	3	0	7.73E-004	6.98E-005
hs026-3	0.001	5	0	1.00E-003	6.99E-004
hs026-3	0.01	5	0	5.24E-003	6.99E-003
hs027-0		27			
hs027-1	0.0001	3	0	6.33E-005	8.18E-007
hs027-1	0.001	4	0	6.44E-004	1.89E-005
hs027-1	0.01	5	0	6.42E-003	2.00E-004
hs027-2	0.0001	3	0	3.11E-005	3.46E-006
hs027-2	0.001	3	1	3.12E-004	2.37E-005
hs027-2	0.01	4	0	3.14E-003	2.26E-004
hs027-3	0.0001	3	0	5.34E-005	1.60E-006
hs027-3	0.001	4	0	5.43E-004	2.67E-005
hs027-3	0.01	5	0	5.42E-003	2.78E-004

TABLE 4. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs028-0		6			
hs028-1	0.0001	2	0	5.43E-005	5.02E-005
hs028-1	0.001	4	0	5.45E-004	5.03E-004
hs028-1	0.01	5	0	5.44E-003	5.03E-003
hs028-2	0.0001	2	0	2.19E-005	5.61E-005
hs028-2	0.001	4	0	2.20E-004	5.62E-004
hs028-2	0.01	5	0	2.20E-003	5.63E-003
hs028-3	0.0001	2	0	3.97E-005	6.97E-005
hs028-3	0.001	4	0	3.98E-004	6.99E-004
hs028-3	0.01	5	0	3.97E-003	6.99E-003
hs029-0		17			
hs029-1	0.0001	4	0	8.32E-005	2.90E-005
hs029-1	0.001	6	1	8.33E-004	2.90E-004
hs029-1	0.01	12	0	8.33E-003	2.91E-003
hs029-2	0.0001	3	0	7.44E-005	3.22E-005
hs029-2	0.001	4	0	7.45E-004	3.22E-004
hs029-2	0.01	5	0	7.49E-003	3.21E-003
hs029-3	0.0001	3	0	6.54E-005	1.11E-005
hs029-3	0.001	4	0	6.54E-004	1.11E-004
hs029-3	0.01	5	0	6.56E-003	1.11E-003
hs031-0		14			
hs031-1	0.0001	5	0	5.92E-005	4.96E-005
hs031-1	0.001	6	0	5.92E-004	4.96E-004
hs031-1	0.01	8	0	5.91E-003	4.98E-003
hs031-2	0.0001	5	0	7.07E-005	5.03E-005
hs031-2	0.001	6	0	7.07E-004	5.03E-004
hs031-2	0.01	7	0	7.04E-003	5.01E-003
hs031-3	0.0001	6	0	2.81E-005	3.27E-005
hs031-3	0.001	7	0	2.81E-004	3.27E-004
hs031-3	0.01	9	0	2.81E-003	3.26E-003
hs032-0		20			
hs032-1	0.0001	32	0	4.95E-005	7.32E-005
hs032-1	0.001	39	0	4.58E-004	7.32E-004
hs032-1	0.01	40	0	4.60E-003	7.36E-003
hs032-2	0.0001	32	0	3.61E-005	9.28E-005
hs032-2	0.001	33	0	3.35E-004	9.27E-004
hs032-2	0.01	43	0	3.34E-003	9.21E-003
hs032-3	0.0001	34	0	9.16E-005	9.37E-005
hs032-3	0.001	42	0	6.99E-004	9.37E-004
hs032-3	0.01	34	0	6.96E-003	9.43E-003
hs033-0		28			
hs033-1	0.0001	9	0	1.03E-004	7.57E-005
hs033-1	0.001	15	0	6.58E-004	7.64E-004
hs033-1	0.01	20	0	6.58E-003	7.65E-003
hs033-2	0.0001	9	0	6.60E-005	9.63E-005
hs033-2	0.001	12	0	6.01E-004	9.63E-004
hs033-2	0.01	16	0	5.96E-003	9.63E-003
hs033-3	0.0001	9	0	9.59E-005	9.70E-005
hs033-3	0.001	15	0	6.19E-004	9.59E-004
hs033-3	0.01	18	0	6.03E-003	9.57E-003
hs034-0		14			
hs034-1	0.0001	8	0	2.83E-005	2.03E-005
hs034-1	0.001	9	0	2.83E-004	2.03E-004
hs034-1	0.01	11	0	2.83E-003	2.03E-003
hs034-2	0.0001	8	0	1.92E-005	1.25E-005
hs034-2	0.001	9	0	1.92E-004	1.25E-004
hs034-2	0.01	11	0	1.93E-003	1.25E-003
hs034-3	0.0001	8	0	4.20E-005	3.85E-005
hs034-3	0.001	9	0	4.20E-004	3.85E-004
hs034-3	0.01	10	0	4.21E-003	3.85E-003

TABLE 5. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs035-0		9			
hs035-1	0.0001	5	0	6.90E-005	1.09E-005
hs035-1	0.001	6	0	6.90E-004	1.09E-004
hs035-1	0.01	9	0	6.92E-003	1.09E-003
hs035-2	0.0001	5	0	3.92E-005	1.35E-005
hs035-2	0.001	6	0	3.92E-004	1.35E-004
hs035-2	0.01	9	0	3.92E-003	1.35E-003
hs035-3	0.0001	5	0	2.01E-005	1.73E-005
hs035-3	0.001	5	0	2.01E-004	1.73E-004
hs035-3	0.01	6	0	2.01E-003	1.73E-003
hs036-0		15			
hs036-1	0.0001	4	0	7.01E-005	5.03E-005
hs036-1	0.001	4	0	7.01E-004	5.03E-004
hs036-1	0.01	6	0	7.04E-003	5.05E-003
hs036-2	0.0001	4	0	4.71E-005	5.10E-005
hs036-2	0.001	4	0	4.71E-004	5.10E-004
hs036-2	0.01	7	0	4.72E-003	5.07E-003
hs036-3	0.0001	4	0	6.13E-005	3.32E-005
hs036-3	0.001	5	0	6.13E-004	3.32E-004
hs036-3	0.01	9	0	6.10E-003	3.31E-003
hs037-0		10			
hs037-1	0.0001	4	0	7.20E-005	5.03E-005
hs037-1	0.001	6	0	7.21E-004	5.03E-004
hs037-1	0.01	8	0	7.24E-003	5.05E-003
hs037-2	0.0001	4	0	4.55E-005	5.10E-005
hs037-2	0.001	6	0	4.56E-004	5.10E-004
hs037-2	0.01	8	0	4.56E-003	5.07E-003
hs037-3	0.0001	3	0	6.69E-005	3.32E-005
hs037-3	0.001	4	1	6.69E-004	3.32E-004
hs037-3	0.01	8	0	6.65E-003	3.31E-003
hs038-0		38			
hs038-1	0.0001	7	0	5.38E-005	0.00E+000
hs038-1	0.001	8	0	5.37E-004	0.00E+000
hs038-1	0.01	16	0	5.36E-003	0.00E+000
hs038-2	0.0001	5	0	4.25E-005	0.00E+000
hs038-2	0.001	7	0	4.25E-004	0.00E+000
hs038-2	0.01	11	0	4.27E-003	0.00E+000
hs038-3	0.0001	7	0	5.50E-005	0.00E+000
hs038-3	0.001	9	0	5.50E-004	0.00E+000
hs038-3	0.01	13	0	5.50E-003	0.00E+000
hs040-0		10			
hs040-1	0.0001	5	0	3.43E-005	4.24E-005
hs040-1	0.001	6	0	3.43E-004	4.25E-004
hs040-1	0.01	7	0	3.42E-003	4.24E-003
hs040-2	0.0001	5	0	4.88E-005	3.49E-005
hs040-2	0.001	6	0	4.88E-004	3.48E-004
hs040-2	0.01	6	0	4.87E-003	3.48E-003
hs040-3	0.0001	5	0	5.53E-005	4.73E-005
hs040-3	0.001	6	0	5.53E-004	4.72E-004
hs040-3	0.01	7	0	5.52E-003	4.72E-003
hs041-0		8			
hs041-1	0.0001	5	0	6.40E-005	5.79E-006
hs041-1	0.001	5	0	6.46E-004	5.57E-005
hs041-1	0.01	7	0	6.48E-003	5.56E-004
hs041-2	0.0001	5	0	1.70E-005	5.40E-006
hs041-2	0.001	5	0	1.65E-004	5.19E-005
hs041-2	0.01	6	0	1.64E-003	5.17E-004
hs041-3	0.0001	5	0	4.25E-005	3.10E-006
hs041-3	0.001	5	0	4.16E-004	3.30E-005
hs041-3	0.01	6	0	4.14E-003	3.32E-004

TABLE 6. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs042-0		8			
hs042-1	0.0001	6	0	7.74E-005	4.68E-005
hs042-1	0.001	6	0	7.74E-004	4.68E-004
hs042-1	0.01	7	0	7.76E-003	4.70E-003
hs042-2	0.0001	6	0	7.68E-005	1.92E-005
hs042-2	0.001	7	0	7.67E-004	1.92E-004
hs042-2	0.01	8	0	7.64E-003	1.92E-003
hs042-3	0.0001	4	0	6.57E-005	1.63E-005
hs042-3	0.001	6	0	6.57E-004	1.62E-004
hs042-3	0.01	7	0	6.55E-003	1.62E-003
hs043-0		15			
hs043-1	0.0001	3	0	6.22E-005	8.79E-005
hs043-1	0.001	3	0	6.22E-004	8.77E-004
hs043-1	0.01	4	0	6.25E-003	8.72E-003
hs043-2	0.0001	2	0	4.18E-005	8.49E-005
hs043-2	0.001	3	0	4.19E-004	8.50E-004
hs043-2	0.01	5	0	4.20E-003	8.45E-003
hs043-3	0.0001	3	0	4.45E-005	6.81E-005
hs043-3	0.001	5	0	4.44E-004	6.83E-004
hs043-3	0.01	8	0	4.43E-003	6.81E-003
hs044-0		15			
hs044-1	0.0001	4	0	6.26E-005	8.59E-005
hs044-1	0.001	6	0	6.26E-004	8.59E-004
hs044-1	0.01	7	0	6.25E-003	8.59E-003
hs044-2	0.0001	4	0	5.05E-005	7.00E-005
hs044-2	0.001	5	0	5.05E-004	7.00E-004
hs044-2	0.01	7	0	5.07E-003	6.98E-003
hs044-3	0.0001	4	0	3.65E-005	5.44E-005
hs044-3	0.001	5	0	3.65E-004	5.44E-004
hs044-3	0.01	6	0	3.65E-003	5.44E-003
hs046-0		16			
hs046-1	0.0001	3	0	7.60E-003	1.04E-004
hs046-1	0.001	11	0	1.45E-003	1.04E-003
hs046-1	0.01	8	0	1.78E-002	1.04E-002
hs046-2	0.0001	2	0	1.00E-002	1.10E-004
hs046-2	0.001	4	2	1.10E-002	1.10E-003
hs046-2	0.01	6	0	3.70E-003	1.10E-002
hs046-3	0.0001	2	0	6.59E-003	8.99E-005
hs046-3	0.001	4	0	5.91E-003	9.09E-004
hs046-3	0.01	8	0	5.51E-003	9.09E-003
hs047-0		20			
hs047-1	0.0001	2	0	2.09E-004	1.18E-004
hs047-1	0.001	4	0	7.11E-004	1.18E-003
hs047-1	0.01	10	0	4.15E-001	7.06E-001
hs047-2	0.0001	2	0	2.06E-004	1.14E-004
hs047-2	0.001	8	0	6.32E-004	1.15E-003
hs047-2	0.01	6	0	6.25E-003	1.15E-002
hs047-3	0.0001	2	0	1.95E-004	9.61E-005
hs047-3	0.001	4	0	5.43E-004	9.63E-004
hs047-3	0.01	15	0	4.09E-001	7.18E-001
hs048-0		6			
hs048-1	0.0001	2	0	5.11E-005	1.04E-004
hs048-1	0.001	4	0	5.13E-004	1.04E-003
hs048-1	0.01	5	0	5.14E-003	1.04E-002
hs048-2	0.0001	2	0	3.59E-005	1.10E-004
hs048-2	0.001	4	0	3.61E-004	1.10E-003
hs048-2	0.01	5	0	3.62E-003	1.10E-002
hs048-3	0.0001	2	1	4.69E-005	9.03E-005
hs048-3	0.001	4	2	4.72E-004	9.08E-004
hs048-3	0.01	5	1	4.74E-003	9.09E-003

TABLE 7. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs049-0		16			
hs049-1	0.0001	2	0	5.91E-003	1.04E-004
hs049-1	0.001	4	0	8.72E-003	1.24E-004
hs049-1	0.01	5	0	1.46E-002	1.24E-003
hs049-2	0.0001	2	0	5.88E-003	1.10E-004
hs049-2	0.001	3	1	7.56E-003	3.35E-005
hs049-2	0.01	8	1	1.23E-002	3.35E-004
hs049-3	0.0001	2	0	5.87E-003	9.07E-005
hs049-3	0.001	3	2	6.88E-003	5.33E-004
hs049-3	0.01	5	0	8.56E-003	5.34E-003
hs050-0		14			
hs050-1	0.0001	3	0	3.93E-005	1.18E-004
hs050-1	0.001	3	0	3.93E-004	1.18E-003
hs050-1	0.01	5	0	3.93E-003	1.18E-002
hs050-2	0.0001	2	0	6.23E-005	1.15E-004
hs050-2	0.001	3	0	6.24E-004	1.15E-003
hs050-2	0.01	5	1	6.24E-003	1.15E-002
hs050-3	0.0001	3	0	5.99E-005	9.63E-005
hs050-3	0.001	3	0	5.99E-004	9.63E-004
hs050-3	0.01	5	0	5.97E-003	9.63E-003
hs051-0		5			
hs051-1	0.0001	2	0	3.94E-005	1.18E-004
hs051-1	0.001	4	0	3.93E-004	1.18E-003
hs051-1	0.01	5	0	3.93E-003	1.18E-002
hs051-2	0.0001	2	0	6.23E-005	1.14E-004
hs051-2	0.001	4	2	6.24E-004	1.14E-003
hs051-2	0.01	5	0	6.24E-003	1.15E-002
hs051-3	0.0001	2	0	5.98E-005	9.55E-005
hs051-3	0.001	4	0	5.98E-004	9.61E-004
hs051-3	0.01	5	1	5.97E-003	9.63E-003
hs052-0		9			
hs052-1	0.0001	6	0	3.38E-005	5.99E-005
hs052-1	0.001	6	0	3.38E-004	5.98E-004
hs052-1	0.01	5	0	3.39E-003	5.96E-003
hs052-2	0.0001	6	0	5.08E-005	4.89E-005
hs052-2	0.001	6	0	5.08E-004	4.89E-004
hs052-2	0.01	6	0	5.08E-003	4.90E-003
hs052-3	0.0001	6	0	3.23E-005	6.20E-005
hs052-3	0.001	6	0	3.23E-004	6.21E-004
hs052-3	0.01	5	0	3.23E-003	6.24E-003
hs053-0		10			
hs053-1	0.0001	6	0	2.70E-005	6.00E-005
hs053-1	0.001	4	0	2.70E-004	6.00E-004
hs053-1	0.01	7	0	2.70E-003	5.97E-003
hs053-2	0.0001	6	0	5.64E-005	3.62E-005
hs053-2	0.001	5	0	5.64E-004	3.62E-004
hs053-2	0.01	7	0	5.65E-003	3.61E-003
hs053-3	0.0001	6	0	5.23E-005	6.15E-005
hs053-3	0.001	5	0	5.24E-004	6.15E-004
hs053-3	0.01	7	0	5.25E-003	6.18E-003
hs054-0		9			
hs054-1	0.0001	6	0	8.82E-005	3.27E-005
hs054-1	0.001	7	0	8.83E-004	3.27E-004
hs054-1	0.01	8	0	8.82E-003	3.28E-003
hs054-2	0.0001	6	0	1.19E-004	2.66E-005
hs054-2	0.001	7	0	1.19E-003	2.66E-004
hs054-2	0.01	8	0	1.19E-002	2.66E-003
hs054-3	0.0001	6	0	1.20E-004	2.43E-005
hs054-3	0.001	6	0	1.20E-003	2.43E-004
hs054-3	0.01	7	0	1.20E-002	2.43E-003

TABLE 8. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs055-0		9			
hs055-1	0.0001	12	0	7.47E-005	2.11E-001
hs055-1	0.001	10	0	7.47E-004	4.20E+000
hs055-1	0.01	11	0	7.49E-003	6.14E-001
hs055-2	0.0001	12	0	4.66E-005	1.04E-001
hs055-2	0.001	12	0	4.66E-004	1.40E-001
hs055-2	0.01	12	0	4.65E-003	2.32E+000
hs055-3	0.0001	12	0	6.97E-005	9.89E-002
hs055-3	0.001	11	0	6.96E-004	1.43E-001
hs055-3	0.01	10	0	6.93E-003	3.23E+000
hs056-0		9			
hs056-1	0.0001	6	0	4.47E-005	6.96E-005
hs056-1	0.001	6	0	4.47E-004	6.96E-004
hs056-1	0.01	7	0	4.47E-003	6.95E-003
hs056-2	0.0001	6	0	4.90E-005	8.65E-005
hs056-2	0.001	7	0	4.90E-004	8.65E-004
hs056-2	0.01	8	0	4.90E-003	8.62E-003
hs056-3	0.0001	6	0	6.40E-005	7.78E-005
hs056-3	0.001	6	0	6.40E-004	7.77E-004
hs056-3	0.01	7	0	6.40E-003	7.73E-003
hs059-0		18			
hs059-1	0.0001	7	0	2.46E-005	1.24E-004
hs059-1	0.001	7	0	2.46E-004	1.24E-003
hs059-1	0.01	7	0	2.45E-003	1.24E-002
hs059-2	0.0001	7	0	3.98E-005	1.26E-004
hs059-2	0.001	7	0	3.98E-004	1.26E-003
hs059-2	0.01	8	0	3.99E-003	1.26E-002
hs059-3	0.0001	7	0	8.48E-005	9.89E-005
hs059-3	0.001	7	0	8.49E-004	9.89E-004
hs059-3	0.01	7	0	8.55E-003	9.89E-003
hs060-0		9			
hs060-1	0.0001	6	0	5.11E-005	5.40E-007
hs060-1	0.001	7	0	5.11E-004	5.39E-006
hs060-1	0.01	7	0	5.09E-003	5.39E-005
hs060-2	0.0001	7	0	3.42E-005	7.50E-007
hs060-2	0.001	6	0	3.42E-004	7.50E-006
hs060-2	0.01	7	0	3.43E-003	7.50E-005
hs060-3	0.0001	7	0	5.69E-005	8.63E-007
hs060-3	0.001	6	0	5.69E-004	8.63E-006
hs060-3	0.01	7	0	5.70E-003	8.63E-005
hs061-0		10			
hs061-1	0.0001	4	0	6.84E-005	7.51E-005
hs061-1	0.001	5	0	6.84E-004	7.51E-004
hs061-1	0.01	6	0	6.88E-003	7.48E-003
hs061-2	0.0001	4	0	5.76E-005	5.60E-005
hs061-2	0.001	5	0	5.76E-004	5.60E-004
hs061-2	0.01	5	1	5.73E-003	5.62E-003
hs061-3	0.0001	5	0	9.13E-005	3.31E-005
hs061-3	0.001	5	1	9.13E-004	3.31E-004
hs061-3	0.01	6	0	9.16E-003	3.32E-003
hs062-0		12			
hs062-1	0.0001	16	0	4.86E-005	5.03E-005
hs062-1	0.001	16	0	4.86E-004	5.03E-004
hs062-1	0.01	14	0	4.84E-003	5.05E-003
hs062-2	0.0001	15	0	2.42E-005	6.99E-005
hs062-2	0.001	15	0	2.42E-004	6.99E-004
hs062-2	0.01	15	0	2.42E-003	7.04E-003
hs062-3	0.0001	15	0	1.05E-005	8.04E-005
hs062-3	0.001	15	0	1.05E-004	8.04E-004
hs062-3	0.01	14	0	1.05E-003	7.98E-003

TABLE 9. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs063-0		8			
hs063-1	0.0001	5	1	4.11E-005	4.00E-005
hs063-1	0.001	5	2	4.11E-004	4.11E-004
hs063-1	0.01	6	1	4.09E-003	4.15E-003
hs063-2	0.0001	5	1	2.58E-005	5.28E-005
hs063-2	0.001	4	2	2.57E-004	5.25E-004
hs063-2	0.01	5	1	2.61E-003	5.41E-003
hs063-3	0.0001	5	1	5.20E-005	6.94E-005
hs063-3	0.001	6	0	5.10E-004	6.15E-004
hs063-3	0.01	7	1	5.11E-003	6.12E-003
hs064-0		26			
hs064-1	0.0001	8	0	6.69E-005	5.03E-005
hs064-1	0.001	8	0	6.68E-004	5.03E-004
hs064-1	0.01	8	0	6.66E-003	5.05E-003
hs064-2	0.0001	8	0	8.49E-005	6.23E-005
hs064-2	0.001	8	0	8.48E-004	6.23E-004
hs064-2	0.01	9	0	8.44E-003	6.27E-003
hs064-3	0.0001	8	0	3.08E-005	7.99E-005
hs064-3	0.001	8	0	3.08E-004	7.99E-004
hs064-3	0.01	8	0	3.08E-003	7.93E-003
hs065-0		17			
hs065-1	0.0001	6	0	6.47E-005	4.13E-006
hs065-1	0.001	7	0	6.47E-004	4.12E-005
hs065-1	0.01	9	0	6.49E-003	4.12E-004
hs065-2	0.0001	6	0	5.44E-005	4.17E-006
hs065-2	0.001	7	0	5.44E-004	4.18E-005
hs065-2	0.01	9	0	5.45E-003	4.18E-004
hs065-3	0.0001	6	0	4.68E-005	2.71E-006
hs065-3	0.001	8	0	4.67E-004	2.72E-005
hs065-3	0.01	10	0	4.66E-003	2.72E-004
hs066-0		13			
hs066-1	0.0001	7	0	3.43E-005	3.03E-005
hs066-1	0.001	9	0	3.43E-004	3.03E-004
hs066-1	0.01	16	0	3.43E-003	3.04E-003
hs066-2	0.0001	7	0	1.97E-005	1.87E-005
hs066-2	0.001	9	0	1.97E-004	1.87E-004
hs066-2	0.01	10	0	1.97E-003	1.87E-003
hs066-3	0.0001	8	0	4.49E-005	5.29E-005
hs066-3	0.001	9	0	4.50E-004	5.29E-004
hs066-3	0.01	17	0	4.51E-003	5.31E-003
hs070-0		23			
hs070-1	0.0001	12	0	6.06E-005	5.03E-005
hs070-1	0.001	32	0	6.06E-004	5.03E-004
hs070-1	0.01	42	0	6.08E-003	5.03E-003
hs070-2	0.0001	12	0	4.39E-005	9.77E-005
hs070-2	0.001	30	0	4.39E-004	9.77E-004
hs070-2	0.01	24	0	2.27E+000	9.77E-003
hs070-3	0.0001	12	0	4.64E-005	2.11E-005
hs070-3	0.001	24	0	8.41E-001	2.11E-004
hs070-3	0.01	14	0	4.65E-003	2.11E-003
hs071-0		11			
hs071-1	0.0001	12	0	5.98E-005	2.66E-005
hs071-1	0.001	9	0	5.98E-004	2.64E-004
hs071-1	0.01	9	0	5.98E-003	2.65E-003
hs071-2	0.0001	9	0	6.58E-005	2.48E-005
hs071-2	0.001	11	0	6.57E-004	2.48E-004
hs071-2	0.01	10	0	6.54E-003	2.48E-003
hs071-3	0.0001	11	0	3.07E-005	3.24E-005
hs071-3	0.001	11	0	3.06E-004	3.24E-004
hs071-3	0.01	10	0	3.06E-003	3.24E-003

TABLE 10. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs072-0		41			
hs072-1	0.0001	20	0	7.00E-005	7.70E-005
hs072-1	0.001	24	0	7.00E-004	7.71E-004
hs072-1	0.01	39	0	7.00E-003	7.76E-003
hs072-2	0.0001	20	0	5.80E-005	2.25E-005
hs072-2	0.001	21	0	5.81E-004	2.25E-004
hs072-2	0.01	21	0	5.82E-003	2.25E-003
hs072-3	0.0001	18	0	4.62E-005	6.66E-005
hs072-3	0.001	18	0	4.62E-004	6.69E-004
hs072-3	0.01	18	0	4.61E-003	6.73E-003
hs073-0		17			
hs073-1	0.0001	13	0	5.10E-005	9.68E-005
hs073-1	0.001	11	2	5.10E-004	9.66E-004
hs073-1	0.01	14	0	5.11E-003	9.58E-003
hs073-2	0.0001	13	0	7.20E-005	4.68E-005
hs073-2	0.001	11	0	7.21E-004	4.69E-004
hs073-2	0.01	14	0	7.21E-003	4.71E-003
hs073-3	0.0001	11	2	8.05E-005	6.68E-005
hs073-3	0.001	14	0	8.07E-004	6.66E-004
hs073-3	0.01	14	0	8.05E-003	6.70E-003
hs074-0		15			
hs074-1	0.0001	11	0	3.54E-005	6.63E-005
hs074-1	0.001	12	0	3.54E-004	6.51E-004
hs074-1	0.01	10	1	3.55E-003	6.49E-003
hs074-2	0.0001	11	0	2.24E-005	4.80E-005
hs074-2	0.001	10	1	2.24E-004	5.46E-004
hs074-2	0.01	14	0	2.24E-003	4.77E-003
hs074-3	0.0001	11	0	1.91E-006	6.18E-005
hs074-3	0.001	14	0	1.90E-005	6.08E-004
hs074-3	0.01	14	0	1.90E-004	6.11E-003
hs075-0		16			
hs075-1	0.0001	16	1	3.32E-005	1.92E-005
hs075-1	0.001	9	2	3.33E-004	2.05E-004
hs075-1	0.01	9	1	3.33E-003	2.06E-003
hs075-2	0.0001	14	2	2.53E-005	8.75E-005
hs075-2	0.001	12	1	2.53E-004	8.76E-004
hs075-2	0.01	14	1	2.53E-003	8.82E-003
hs075-3	0.0001	14	2	2.12E-006	6.50E-005
hs075-3	0.001	12	1	2.16E-005	6.49E-004
hs075-3	0.01	15	1	2.17E-004	6.52E-003
hs076-0		10			
hs076-1	0.0001	4	0	5.74E-005	1.15E-004
hs076-1	0.001	5	0	5.76E-004	1.15E-003
hs076-1	0.01	6	0	5.78E-003	1.15E-002
hs076-2	0.0001	4	0	4.97E-005	8.46E-005
hs076-2	0.001	6	0	4.96E-004	8.47E-004
hs076-2	0.01	8	0	4.95E-003	8.46E-003
hs076-3	0.0001	4	0	3.73E-005	7.15E-005
hs076-3	0.001	5	0	3.73E-004	7.14E-004
hs076-3	0.01	7	0	3.74E-003	7.14E-003
hs077-0		10			
hs077-1	0.0001	4	0	5.89E-005	5.35E-006
hs077-1	0.001	6	0	5.91E-004	5.19E-005
hs077-1	0.01	7	0	5.92E-003	5.17E-004
hs077-2	0.0001	4	0	3.78E-005	5.18E-006
hs077-2	0.001	6	0	3.76E-004	5.32E-005
hs077-2	0.01	7	0	3.77E-003	5.34E-004
hs077-3	0.0001	5	0	4.48E-005	3.76E-006
hs077-3	0.001	6	0	4.45E-004	3.89E-005
hs077-3	0.01	7	0	4.44E-003	3.90E-004

TABLE 11. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs078-0		7			
hs078-1	0.0001	4	0	3.60E-005	5.19E-005
hs078-1	0.001	6	0	3.60E-004	5.19E-004
hs078-1	0.01	6	0	3.60E-003	5.19E-003
hs078-2	0.0001	5	0	6.53E-005	5.63E-005
hs078-2	0.001	5	0	6.52E-004	5.63E-004
hs078-2	0.01	6	0	6.50E-003	5.61E-003
hs078-3	0.0001	5	0	6.89E-005	3.46E-005
hs078-3	0.001	6	0	6.89E-004	3.46E-004
hs078-3	0.01	7	0	6.86E-003	3.46E-003
hs079-0		6			
hs079-1	0.0001	3	1	4.40E-005	2.47E-006
hs079-1	0.001	5	0	4.42E-004	2.47E-005
hs079-1	0.01	6	0	4.42E-003	2.48E-004
hs079-2	0.0001	4	0	6.76E-005	3.94E-006
hs079-2	0.001	5	0	6.77E-004	3.88E-005
hs079-2	0.01	6	0	6.76E-003	3.88E-004
hs079-3	0.0001	4	0	5.94E-005	1.41E-006
hs079-3	0.001	5	0	5.93E-004	1.38E-005
hs079-3	0.01	6	0	5.91E-003	1.38E-004
hs080-0		8			
hs080-1	0.0001	6	0	4.49E-005	4.01E-006
hs080-1	0.001	7	0	4.49E-004	4.01E-005
hs080-1	0.01	8	0	4.50E-003	4.01E-004
hs080-2	0.0001	6	0	6.42E-005	3.25E-006
hs080-2	0.001	7	0	6.42E-004	3.26E-005
hs080-2	0.01	8	0	6.43E-003	3.26E-004
hs080-3	0.0001	6	0	6.21E-005	3.42E-006
hs080-3	0.001	7	0	6.22E-004	3.42E-005
hs080-3	0.01	9	0	6.24E-003	3.42E-004
hs081-0		10			
hs081-1	0.0001	7	0	4.49E-005	4.01E-006
hs081-1	0.001	8	0	4.49E-004	4.01E-005
hs081-1	0.01	10	0	4.50E-003	4.01E-004
hs081-2	0.0001	5	0	6.41E-005	3.28E-006
hs081-2	0.001	7	0	6.42E-004	3.26E-005
hs081-2	0.01	9	0	6.43E-003	3.26E-004
hs081-3	0.0001	6	0	6.21E-005	3.42E-006
hs081-3	0.001	7	0	6.22E-004	3.42E-005
hs081-3	0.01	9	0	6.24E-003	3.42E-004
hs083-0		13			
hs083-1	0.0001	11	0	3.45E-005	5.51E-005
hs083-1	0.001	11	0	3.45E-004	5.51E-004
hs083-1	0.01	11	0	3.46E-003	5.49E-003
hs083-2	0.0001	11	0	7.05E-005	4.48E-005
hs083-2	0.001	11	0	7.05E-004	4.48E-004
hs083-2	0.01	11	0	7.07E-003	4.47E-003
hs083-3	0.0001	12	0	5.73E-005	5.47E-005
hs083-3	0.001	11	0	5.73E-004	5.47E-004
hs083-3	0.01	12	0	5.76E-003	5.50E-003
hs084-0		131			
hs084-1	0.0001	73	0	4.62E-005	5.64E-005
hs084-1	0.001	102	0	4.62E-004	5.64E-004
hs084-1	0.01	56	0	4.64E-003	5.61E-003
hs084-2	0.0001	102	0	7.29E-005	3.03E-005
hs084-2	0.001	101	0	7.28E-004	3.03E-004
hs084-2	0.01	64	0	7.24E-003	3.02E-003
hs084-3	0.0001	37	0	8.97E-005	6.12E-005
hs084-3	0.001	91	0	8.98E-004	6.12E-004
hs084-3	0.01	89	0	9.05E-003	6.16E-003

TABLE 12. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs086-0		13			
hs086-1	0.0001	7	0	4.11E-005	5.76E-005
hs086-1	0.001	10	0	4.06E-004	5.86E-004
hs086-1	0.01	12	0	4.07E-003	5.81E-003
hs086-2	0.0001	7	0	2.36E-005	3.39E-005
hs086-2	0.001	7	0	2.29E-004	3.29E-004
hs086-2	0.01	7	0	2.28E-003	3.27E-003
hs086-3	0.0001	7	0	2.43E-005	8.19E-005
hs086-3	0.001	8	0	2.34E-004	8.08E-004
hs086-3	0.01	11	0	2.39E-003	8.09E-003
hs087-0		26			
hs087-1	0.0001	23	0	5.92E-005	7.30E-005
hs087-1	0.001	23	0	5.93E-004	7.30E-004
hs087-1	0.01	23	0	5.96E-003	7.28E-003
hs087-2	0.0001	23	0	7.46E-005	5.91E-005
hs087-2	0.001	22	0	7.40E-004	5.91E-004
hs087-2	0.01	23	0	7.45E-003	5.88E-003
hs087-3	0.0001	22	0	7.34E-005	7.91E-005
hs087-3	0.001	22	0	7.33E-004	7.91E-004
hs087-3	0.01	22	0	7.32E-003	7.90E-003
hs088-0		24			
hs088-1	0.0001	9	0	6.08E-005	5.07E-005
hs088-1	0.001	10	0	6.08E-004	5.03E-004
hs088-1	0.01	13	0	6.09E-003	5.05E-003
hs088-2	0.0001	10	0	4.74E-005	9.67E-005
hs088-2	0.001	10	0	4.74E-004	9.68E-004
hs088-2	0.01	11	0	4.74E-003	9.60E-003
hs088-3	0.0001	10	0	2.02E-005	6.25E-005
hs088-3	0.001	10	0	2.02E-004	6.23E-004
hs088-3	0.01	10	0	2.02E-003	6.27E-003
hs089-0		40			
hs089-1	0.0001	9	0	8.76E-005	5.09E-005
hs089-1	0.001	10	0	8.76E-004	5.04E-004
hs089-1	0.01	13	0	8.78E-003	5.05E-003
hs089-2	0.0001	9	0	6.66E-005	5.51E-005
hs089-2	0.001	10	0	6.66E-004	5.57E-004
hs089-2	0.01	12	0	6.69E-003	5.54E-003
hs089-3	0.0001	9	0	8.07E-005	1.86E-005
hs089-3	0.001	10	0	8.07E-004	1.92E-004
hs089-3	0.01	12	0	8.10E-003	1.92E-003
hs090-0		67			
hs090-1	0.0001	10	0	6.58E-005	5.10E-005
hs090-1	0.001	10	0	6.92E-004	5.04E-004
hs090-1	0.01	10	0	6.46E-003	5.06E-003
hs090-2	0.0001	10	0	2.23E-005	5.55E-005
hs090-2	0.001	9	0	2.25E-004	5.61E-004
hs090-2	0.01	10	0	4.20E-003	5.59E-003
hs090-3	0.0001	9	0	6.96E-005	7.08E-005
hs090-3	0.001	10	0	6.96E-004	7.00E-004
hs090-3	0.01	10	0	3.43E-002	7.04E-003
hs091-0		25			
hs091-1	0.0001	9	0	7.48E-005	5.06E-005
hs091-1	0.001	10	0	7.48E-004	5.03E-004
hs091-1	0.01	10	0	7.60E-003	5.05E-003
hs091-2	0.0001	10	0	4.19E-005	8.95E-005
hs091-2	0.001	9	0	4.19E-004	8.95E-004
hs091-2	0.01	10	0	4.72E-003	9.02E-003
hs091-3	0.0001	10	0	4.39E-005	9.76E-005
hs091-3	0.001	9	0	4.39E-004	9.76E-004
hs091-3	0.01	10	0	5.24E-002	9.67E-003

TABLE 13. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs092-0		24			
hs092-1	0.0001	10	0	8.09E-005	5.07E-005
hs092-1	0.001	9	0	8.09E-004	5.04E-004
hs092-1	0.01	10	0	8.17E-003	5.05E-003
hs092-2	0.0001	10	0	4.50E-005	6.27E-005
hs092-2	0.001	9	0	4.50E-004	6.24E-004
hs092-2	0.01	10	0	5.69E-003	6.27E-003
hs092-3	0.0001	10	0	4.09E-005	7.95E-005
hs092-3	0.001	10	0	4.09E-004	7.98E-004
hs092-3	0.01	10	0	4.09E-003	7.93E-003
hs093-0		11			
hs093-1	0.0001	5	0	5.17E-005	6.41E-005
hs093-1	0.001	6	0	5.17E-004	6.37E-004
hs093-1	0.01	9	0	5.17E-003	6.40E-003
hs093-2	0.0001	5	0	8.29E-005	7.99E-005
hs093-2	0.001	5	0	8.29E-004	7.98E-004
hs093-2	0.01	6	0	8.30E-003	7.93E-003
hs093-3	0.0001	5	0	2.99E-005	7.03E-005
hs093-3	0.001	7	0	3.00E-004	6.97E-004
hs093-3	0.01	9	0	2.99E-003	7.01E-003
hs095-0		14			
hs095-1	0.0001	33	0	1.22E-004	1.39E-004
hs095-1	0.001	22	1	1.22E-003	1.39E-003
hs095-1	0.01	20	0	1.22E-002	1.39E-002
hs095-2	0.0001	22	0	1.34E-004	1.22E-004
hs095-2	0.001	35	0	1.34E-003	1.22E-003
hs095-2	0.01	27	0	1.34E-002	1.22E-002
hs095-3	0.0001	27	0	1.24E-004	1.32E-004
hs095-3	0.001	24	1	1.24E-003	1.32E-003
hs095-3	0.01	23	0	1.24E-002	1.32E-002
hs096-0		17			
hs096-1	0.0001	34	1	1.22E-004	1.39E-004
hs096-1	0.001	22	0	1.22E-003	1.39E-003
hs096-1	0.01	22	1	1.22E-002	1.39E-002
hs096-2	0.0001	16	0	1.34E-004	1.22E-004
hs096-2	0.001	20	0	1.34E-003	1.22E-003
hs096-2	0.01	23	0	1.34E-002	1.22E-002
hs096-3	0.0001	74	0	1.24E-004	1.32E-004
hs096-3	0.001	18	0	1.24E-003	1.32E-003
hs096-3	0.01	17	0	1.24E-002	1.32E-002
hs097-0		16			
hs097-1	0.0001	30	0	1.13E-004	1.31E-004
hs097-1	0.001	64	0	1.13E-003	1.31E-003
hs097-1	0.01	35	0	1.13E-002	1.31E-002
hs097-2	0.0001	105	4	2.77E-001	5.59E-002
hs097-2	0.001	33	0	1.11E-003	1.15E-003
hs097-2	0.01	24	0	1.11E-002	1.15E-002
hs097-3	0.0001	25	0	1.06E-004	4.18E-005
hs097-3	0.001	17	0	1.06E-003	4.19E-004
hs097-3	0.01	21	0	1.06E-002	4.20E-003
hs098-0		43			
hs098-1	0.0001	18	4	2.68E-001	5.68E-002
hs098-1	0.001	23	4	2.67E-001	5.69E-002
hs098-1	0.01	26	0	1.09E-002	1.33E-002
hs098-2	0.0001	30	4	2.68E-001	5.68E-002
hs098-2	0.001	26	4	2.67E-001	5.70E-002
hs098-2	0.01	34	0	1.07E-002	8.17E-003
hs098-3	0.0001	29	4	2.68E-001	5.68E-002
hs098-3	0.001	20	4	2.68E-001	5.67E-002
hs098-3	0.01	42	0	8.88E-003	6.50E-003

TABLE 14. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs099-0		22			
hs099-1	0.0001	17	5	3.75E-005	5.66E-005
hs099-1	0.001	15	6	3.75E-004	5.66E-004
hs099-1	0.01	17	5	3.76E-003	5.66E-003
hs099-2	0.0001	17	6	5.86E-005	6.24E-005
hs099-2	0.001	18	5	5.86E-004	6.24E-004
hs099-2	0.01	20	5	5.84E-003	6.25E-003
hs099-3	0.0001	17	5	6.37E-005	5.47E-005
hs099-3	0.001	20	5	6.37E-004	5.48E-004
hs099-3	0.01	23	5	6.36E-003	5.50E-003
hs100-0		24			
hs100-1	0.0001	7	1	5.54E-005	8.91E-005
hs100-1	0.001	7	0	5.51E-004	8.87E-004
hs100-1	0.01	7	0	5.51E-003	8.89E-003
hs100-2	0.0001	6	0	7.95E-005	5.68E-005
hs100-2	0.001	7	0	7.97E-004	5.66E-004
hs100-2	0.01	7	0	8.00E-003	5.67E-003
hs100-3	0.0001	7	1	6.38E-005	6.68E-005
hs100-3	0.001	7	0	6.36E-004	6.71E-004
hs100-3	0.01	7	1	6.33E-003	6.70E-003
hs101-0		37			
hs101-1	0.0001	13	0	4.68E-005	8.97E-005
hs101-1	0.001	12	0	4.68E-004	8.96E-004
hs101-1	0.01	17	0	4.70E-003	8.94E-003
hs101-2	0.0001	12	0	5.69E-005	8.22E-005
hs101-2	0.001	13	0	5.69E-004	8.21E-004
hs101-2	0.01	14	0	5.71E-003	8.16E-003
hs101-3	0.0001	14	0	4.65E-005	7.64E-005
hs101-3	0.001	12	0	4.64E-004	7.64E-004
hs101-3	0.01	14	0	4.63E-003	7.69E-003
hs102-0		54			
hs102-1	0.0001	14	1	5.03E-005	9.01E-005
hs102-1	0.001	11	0	5.06E-004	9.01E-004
hs102-1	0.01	16	0	5.08E-003	8.99E-003
hs102-2	0.0001	12	0	5.44E-005	8.32E-005
hs102-2	0.001	11	0	5.46E-004	8.32E-004
hs102-2	0.01	18	0	5.47E-003	8.26E-003
hs102-3	0.0001	13	0	5.35E-005	7.80E-005
hs102-3	0.001	12	0	5.34E-004	7.80E-004
hs102-3	0.01	17	0	5.33E-003	7.85E-003
hs103-0		71			
hs103-1	0.0001	13	0	5.37E-005	9.16E-005
hs103-1	0.001	11	0	5.37E-004	9.15E-004
hs103-1	0.01	11	0	5.40E-003	9.12E-003
hs103-2	0.0001	10	0	5.19E-005	8.62E-005
hs103-2	0.001	10	0	5.20E-004	8.63E-004
hs103-2	0.01	12	0	5.21E-003	8.57E-003
hs103-3	0.0001	10	0	5.93E-005	8.28E-005
hs103-3	0.001	10	0	5.92E-004	8.28E-004
hs103-3	0.01	14	0	5.91E-003	8.34E-003
hs104-0		12			
hs104-1	0.0001	5	0	6.47E-005	7.51E-005
hs104-1	0.001	6	0	6.47E-004	7.50E-004
hs104-1	0.01	7	0	6.50E-003	7.54E-003
hs104-2	0.0001	5	0	2.06E-005	3.62E-005
hs104-2	0.001	7	0	2.05E-004	3.60E-004
hs104-2	0.01	8	0	2.05E-003	3.61E-003
hs104-3	0.0001	5	0	7.19E-005	5.38E-005
hs104-3	0.001	7	0	7.20E-004	5.35E-004
hs104-3	0.01	8	0	7.21E-003	5.36E-003

TABLE 15. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowski test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs105-0		18			
hs105-1	0.0001	11	0	4.87E-005	0.00E+000
hs105-1	0.001	11	0	4.87E-004	0.00E+000
hs105-1	0.01	11	0	4.87E-003	0.00E+000
hs105-2	0.0001	11	0	6.57E-005	0.00E+000
hs105-2	0.001	10	0	6.58E-004	0.00E+000
hs105-2	0.01	11	0	6.60E-003	0.00E+000
hs105-3	0.0001	11	0	5.50E-005	0.00E+000
hs105-3	0.001	11	0	5.50E-004	0.00E+000
hs105-3	0.01	11	0	5.52E-003	0.00E+000
hs106-0		23			
hs106-1	0.0001	14	0	3.73E-005	5.20E-005
hs106-1	0.001	14	0	3.71E-004	5.17E-004
hs106-1	0.01	14	0	3.72E-003	5.18E-003
hs106-2	0.0001	14	0	8.32E-006	6.23E-005
hs106-2	0.001	11	0	8.34E-005	6.25E-004
hs106-2	0.01	15	0	8.33E-004	6.23E-003
hs106-3	0.0001	14	0	4.21E-005	6.22E-005
hs106-3	0.001	14	0	4.23E-004	6.25E-004
hs106-3	0.01	15	0	4.22E-003	6.27E-003
hs107-0		12			
hs107-1	0.0001	14	0	5.08E-005	6.59E-005
hs107-1	0.001	14	0	5.08E-004	6.59E-004
hs107-1	0.01	12	0	5.08E-003	6.58E-003
hs107-2	0.0001	14	0	3.93E-005	5.95E-005
hs107-2	0.001	14	0	3.93E-004	5.95E-004
hs107-2	0.01	17	0	3.92E-003	5.93E-003
hs107-3	0.0001	15	0	3.65E-005	8.61E-005
hs107-3	0.001	14	0	3.65E-004	8.61E-004
hs107-3	0.01	14	0	3.65E-003	8.60E-003
hs108-0		15			
hs108-1	0.0001	5	2	5.67E-005	1.62E-004
hs108-1	0.001	6	2	5.69E-004	1.62E-003
hs108-1	0.01	9	6	3.41E-001	1.48E-001
hs108-2	0.0001	5	2	5.96E-005	1.17E-004
hs108-2	0.001	6	0	5.97E-004	1.17E-003
hs108-2	0.01	15	2	1.85E-001	9.77E-002
hs108-3	0.0001	5	2	4.71E-005	1.66E-004
hs108-3	0.001	6	2	4.68E-004	1.66E-003
hs108-3	0.01	9	6	3.44E-001	1.60E-001
hs109-0		23			
hs109-1	0.0001	26	0	4.94E-005	1.48E-004
hs109-1	0.001	26	0	4.94E-004	1.48E-003
hs109-1	0.01	28	0	4.95E-003	1.48E-002
hs109-2	0.0001	26	0	4.30E-005	1.32E-004
hs109-2	0.001	26	0	4.29E-004	1.32E-003
hs109-2	0.01	35	0	4.28E-003	1.32E-002
hs109-3	0.0001	25	0	7.57E-005	1.33E-004
hs109-3	0.001	27	0	7.58E-004	1.33E-003
hs109-3	0.01	31	0	7.62E-003	1.33E-002
hs111-0		19			
hs111-1	0.0001	8	0	5.72E-005	6.92E-005
hs111-1	0.001	9	0	5.63E-004	6.91E-004
hs111-1	0.01	22	0	5.55E-003	6.88E-003
hs111-2	0.0001	8	0	6.39E-005	3.97E-005
hs111-2	0.001	10	0	6.53E-004	3.97E-004
hs111-2	0.01	16	0	6.58E-003	3.96E-003
hs111-3	0.0001	8	0	6.66E-005	6.42E-005
hs111-3	0.001	9	0	6.78E-004	6.42E-004
hs111-3	0.01	13	0	6.80E-003	6.44E-003

TABLE 16. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.

Problem	δ	Iteration	Δ	Primal Dist	Dual Dist
hs112-0		15			
hs112-1	0.0001	8	0	2.36E-005	6.96E-005
hs112-1	0.001	7	0	2.00E-004	6.91E-004
hs112-1	0.01	8	0	2.00E-003	6.88E-003
hs112-2	0.0001	8	0	2.55E-005	8.24E-005
hs112-2	0.001	8	0	2.69E-004	8.21E-004
hs112-2	0.01	10	0	2.71E-003	8.20E-003
hs112-3	0.0001	8	0	1.62E-005	4.52E-005
hs112-3	0.001	8	0	1.54E-004	4.54E-004
hs112-3	0.01	8	0	1.53E-003	4.55E-003
hs113-0		19			
hs113-1	0.0001	8	0	6.11E-005	7.42E-005
hs113-1	0.001	7	0	6.11E-004	7.42E-004
hs113-1	0.01	7	0	6.09E-003	7.39E-003
hs113-2	0.0001	7	2	6.83E-005	4.10E-005
hs113-2	0.001	7	0	6.83E-004	4.09E-004
hs113-2	0.01	8	0	6.82E-003	4.10E-003
hs113-3	0.0001	8	0	7.40E-005	4.35E-005
hs113-3	0.001	7	0	7.40E-004	4.35E-004
hs113-3	0.01	7	0	7.38E-003	4.34E-003
hs114-0		24			
hs114-1	0.0001	23	0	6.69E-005	5.03E-005
hs114-1	0.001	55	9	4.27E-002	4.55E-001
hs114-1	0.01	48	9	4.45E-002	4.54E-001
hs114-2	0.0001	25	1	8.41E-005	5.03E-005
hs114-2	0.001	29	0	8.55E-004	4.95E-004
hs114-2	0.01	44	9	4.43E-002	4.45E-001
hs114-3	0.0001	24	0	7.08E-005	7.99E-005
hs114-3	0.001	25	0	7.06E-004	7.99E-004
hs114-3	0.01	26	0	7.02E-003	8.03E-003
hs117-0		19			
hs117-1	0.0001	7	0	4.03E-005	4.46E-005
hs117-1	0.001	9	0	4.33E-004	4.47E-004
hs117-1	0.01	10	0	4.28E-003	4.46E-003
hs117-2	0.0001	7	0	9.42E-005	2.59E-005
hs117-2	0.001	9	0	8.99E-004	2.32E-004
hs117-2	0.01	10	0	9.09E-003	2.34E-003
hs117-3	0.0001	7	0	5.37E-005	3.56E-005
hs117-3	0.001	9	0	4.99E-004	3.38E-004
hs117-3	0.01	10	0	5.04E-003	3.40E-003
hs118-0		17			
hs118-1	0.0001	19	0	6.68E-005	4.44E-005
hs118-1	0.001	19	0	6.68E-004	4.44E-004
hs118-1	0.01	18	0	6.64E-003	4.44E-003
hs118-2	0.0001	19	0	5.46E-005	5.23E-005
hs118-2	0.001	18	0	5.46E-004	5.24E-004
hs118-2	0.01	18	0	5.48E-003	5.25E-003
hs118-3	0.0001	19	0	5.69E-005	7.88E-005
hs118-3	0.001	19	0	5.69E-004	7.88E-004
hs118-3	0.01	21	0	5.67E-003	7.88E-003
hs119-0		21			
hs119-1	0.0001	20	0	6.12E-005	4.85E-005
hs119-1	0.001	20	0	6.12E-004	4.85E-004
hs119-1	0.01	19	0	6.11E-003	4.87E-003
hs119-2	0.0001	20	0	6.79E-005	5.40E-005
hs119-2	0.001	20	0	6.79E-004	5.40E-004
hs119-2	0.01	20	0	6.80E-003	5.40E-003
hs119-3	0.0001	20	0	6.17E-005	4.71E-005
hs119-3	0.001	20	0	6.17E-004	4.72E-004
hs119-3	0.01	20	0	6.18E-003	4.73E-003

TABLE 17. Performance of the primal-dual penalty approach when warmstarting problems from the Hock and Schittkowsky test set. Problem 0 corresponds to the coldstart results. δ is the perturbation factor, Δ is the number of changes to the active set, and Primal Dist and Dual Dist are the scaled Euclidean distances between the warmstart and the optimal solutions for the primal and the dual variables, respectively.