```
"E:\1 □□□□\3 □□□□□\1 □□□□□□\1 □□□□□□□□\1_□□□□□□_□□□□\1_LW _□□□□\4 □□□□\3 python_code\1 exzample\2 □□□□□□\9 Code for this paper\Scripts\python.exe" "D:\Python\Pycharm\setroute\PyCharm Community Edition 2021.2.3\plugins\python-ce\helpers\pydev\pydevconsole.py" --mode=client --port=23122

import sys; print('Python %s on %s' % (sys.version, sys.platform))
sys.path.extend(['E:\\1 □□□□\\3 □□□□□\\1 □□□□□□\\1 □□□□□□□□\\1_□□□□□□_□□□□\\1_LW _□□□□\\4 □□□□\\3 python_code\\9 Code for this paper', 'E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/4 □□□□/3 python_code/9 Code for this paper'])

PyDev console: starting.

Python 3.9.7 (tags/v3.9.7:1016ef3, Aug 30 2021, 20:19:38) [MSC v.1929 64 bit (AMD64)] on win32
>>> runfile('E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/4 □□□□/3 python_code/9 Code for this paper/main_RO_CCG.py', wdir='E:/1 □□□□/3 □□□□□/1 □□□□□□/1 □□□□□□□□/1_□□□□□□_□□□□/1_LW _□□□□/4 □□□□/3 python_code/9 Code for this paper')
Backend TkAgg is interactive backend. Turning interactive mode on.
Waiting 5s.....
Set parameter MIPGap to value 1e-10
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
Thread count: 4 physical cores, 8 logical processors, using up to 8 threads

Optimize a model with 599385 rows, 52642 columns and 1660437 nonzeros
Model fingerprint: 0xa7479769
Variable types: 1 continuous, 52641 integer (52605 binary)
Coefficient statistics:
  Matrix range     [1e+00, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 370756 rows and 24895 columns (presolve time = 5s) ...
Presolve removed 530972 rows and 37088 columns
Presolve time: 9.01s
Presolved: 68413 rows, 15554 columns, 230775 nonzeros
Variable types: 0 continuous, 15554 integer (15527 binary)

Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
Showing first log only...

Root relaxation presolved: 15554 rows, 83967 columns, 246329 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    6.4700000e+02   0.000000e+00   9.240000e+02      9s
Concurrent spin time: 0.00s

Solved with dual simplex (primal model)

Root relaxation: objective 6.470000e+02, 2678 iterations, 0.30 seconds (0.31 work units)
Total elapsed time = 10.05s

     Nodes    |    Current Node    |     Objective Bounds      |     Work
  Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0  647.00000    0   12          -  647.00000      -     -   10s
H    0     0                1527.0000000  647.00000  57.6%     -   10s
H    0     0                 947.0000000  647.00000  31.7%     -   10s
H    0     0                 787.0000000  647.00000  17.8%     -   11s
     0     0  647.00000    0   68  787.00000  647.00000  17.8%     -   11s
H    0     0                 747.0000000  647.00000  13.4%     -   11s
H    0     0                 727.0000000  647.00000  11.0%     -   11s
     0     0  647.00000    0   67  727.00000  647.00000  11.0%     -   11s
H    0     0                 707.0000000  647.00000  8.49%     -   12s
H    0     0                 647.0000000  647.00000  0.00%     -   12s

Cutting planes:
  Gomory: 3
  Cover: 136
  Implied bound: 504
  Clique: 3
  MIR: 18
  StrongCG: 25
  GUB cover: 6
  RLT: 14
  Relax-and-lift: 2

Explored 1 nodes (9739 simplex iterations) in 12.79 seconds (20.47 work units)
Thread count was 8 (of 8 available processors)
```

```
 80
 81  Solution count 7: 647 707 727 ... 1527
 82
 83  Optimal solution found (tolerance 1.00e-10)
 84  Best objective 6.470000000000e+02, best bound 6.470000000000e+02, gap 0.0000%
 85  Set parameter MIPGap to value 1e-08
 86  Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
 87
 88  CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
 89  Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
 90
 91  Optimize a model with 2481684 rows, 1955335 columns and 17236273 nonzeros
 92  Model fingerprint: 0xdd2ae776
 93  Variable types: 963295 continuous, 992040 integer (985965 binary)
 94  Coefficient statistics:
 95    Matrix range     [1e-01, 1e+10]
 96    Objective range  [6e-05, 5e+01]
 97    Bounds range     [1e+00, 8e+01]
 98    RHS range        [8e-01, 1e+10]
 99  Warning: Model contains large matrix coefficients
100  Warning: Model contains large rhs
101           Consider reformulating model or setting NumericFocus parameter
102           to avoid numerical issues.
103  Presolve removed 2478686 rows and 1954269 columns (presolve time = 5s) ...
104  Presolve removed 2478686 rows and 1954269 columns
105  Presolve time: 5.07s
106  Presolved: 2998 rows, 1066 columns, 7940 nonzeros
107  Variable types: 8 continuous, 1058 integer (626 binary)
108  Found heuristic solution: objective 3251.8528892
109  Found heuristic solution: objective 3465.7100450
110
111  Root simplex log...
112
113  Iteration    Objective       Primal Inf.    Dual Inf.      Time
114         0    7.7662796e+03   5.820592e+03   0.000000e+00      6s
115      1040    4.3839422e+03   0.000000e+00   0.000000e+00      6s
116
117  Root relaxation: objective 4.383942e+03, 1040 iterations, 0.02 seconds (0.01 work units)
118
119      Nodes    |    Current Node    |     Objective Bounds      |     Work
120   Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time
121
122      0     0 4383.94217    0   22 3465.71005 4383.94217  26.5%     -    6s
123  H   0     0                4358.0671749 4383.94217  0.59%     -    6s
124  H   0     0                4378.0671749 4383.94217  0.13%     -    6s
125      0     0 4383.17520    0   18 4378.06717 4383.17520  0.12%     -    6s
126      0     0 4383.17520    0   14 4378.06717 4383.17520  0.12%     -    6s
127      0     0 4383.17520    0    9 4378.06717 4383.17520  0.12%     -    6s
128  H   0     0                4381.8528892 4383.17520  0.03%     -    6s
129
130  Cutting planes:
131    Learned: 2
132    MIR: 2
133
134  Explored 1 nodes (1936 simplex iterations) in 6.75 seconds (7.57 work units)
135  Thread count was 8 (of 8 available processors)
136
137  Solution count 5: 4381.85 4378.07 4358.07 ... 3251.85
138
139  Optimal solution found (tolerance 1.00e-08)
140  Best objective 4.381852889165e+03, best bound 4.381852889165e+03, gap 0.0000%
141  SP is solved
142  SP's optimal solution is'□4381
143
144    Itr = 0
145  Collect_LB =   [647.0]
146  Collect_UB =   [9410.70577833071]
147  Collect_Hua =   [0.0]
148  Collect_SPObjVal =   [4381.852889165355]
149  Collect_MPObjValNHua =   [647.0]
150
151
152  Set parameter MIPGap to value 0.05
153  Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)
154
155  CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
156  Thread count: 4 physical cores, 8 logical processors, using up to 8 threads
157
158  Optimize a model with 1140514 rows, 303661 columns and 3363968 nonzeros
159  Model fingerprint: 0x4fad03a4
160  Variable types: 1 continuous, 303660 integer (292257 binary)
161  Coefficient statistics:
162    Matrix range     [1e-01, 1e+10]
163    Objective range  [1e+00, 2e+01]
```

```
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 887295 rows and 275736 columns (presolve time = 5s) ...
Presolve removed 909924 rows and 277610 columns (presolve time = 10s) ...
Presolve removed 909924 rows and 277610 columns (presolve time = 15s) ...
Presolve removed 1010309 rows and 287903 columns
Presolve time: 17.29s
Presolved: 130205 rows, 15758 columns, 395077 nonzeros
Variable types: 1 continuous, 15757 integer (13150 binary)

Deterministic concurrent LP optimizer: primal and dual simplex (primal and dual model)
Showing first log only...

Root relaxation presolved: 15758 rows, 145963 columns, 410835 nonzeros


Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    5.0288529e+03   0.000000e+00   8.172938e+03     18s
Concurrent spin time: 0.28s

Solved with dual simplex (primal model)

Root relaxation: objective 5.028853e+03, 8662 iterations, 1.97 seconds (3.15 work units)
Total elapsed time = 23.23s
Total elapsed time = 25.36s

     Nodes    |    Current Node    |     Objective Bounds      |     Work
  Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0 5028.85289    0  258          - 5028.85289      -     -   26s
     0     0 5028.85289    0  746          - 5028.85289      -     -   31s
     0     0 5028.85289    0  720          - 5028.85289      -     -   31s
     0     0 5028.85289    0  727          - 5028.85289      -     -   32s
     0     0 5028.85289    0  723          - 5028.85289      -     -   33s
     0     0 5028.85289    0  698          - 5028.85289      -     -   33s
     0     0 5028.85289    0  217          - 5028.85289      -     -   45s
     0     0 5028.85289    0  237          - 5028.85289      -     -   45s
     0     0 5028.85289    0  276          - 5028.85289      -     -   46s
     0     0 5028.85289    0  275          - 5028.85289      -     -   46s
     0     0 5028.85289    0  190          - 5028.85289      -     -   53s
     0     0 5028.85289    0  218          - 5028.85289      -     -   54s
     0     0 5028.85289    0  184          - 5028.85289      -     -   58s
     0     0 5028.85289    0  186          - 5028.85289      -     -   59s
     0     0 5028.85289    0  304          - 5028.85289      -     -   68s
     0     0 5028.85289    0  327          - 5028.85289      -     -   68s
     0     0 5028.85289    0  316          - 5028.85289      -     -   69s
     0     0 5028.85289    0  317          - 5028.85289      -     -   69s
     0     0 5028.85289    0  318          - 5028.85289      -     -   77s
     0     0 5028.85289    0  316          - 5028.85289      -     -   78s
     0     0 5028.85289    0  316          - 5028.85289      -     -   78s
     0     0 5028.85289    0  292          - 5028.85289      -     -   81s
H    0     0                    5028.8528892 5028.85289  0.00%     -   91s
     0     0 5028.85289    0  292 5028.85289 5028.85289  0.00%     -   91s

Cutting planes:
  Gomory: 1
  Cover: 210
  Implied bound: 57
  Clique: 1050
  MIR: 475
  StrongCG: 81
  Flow cover: 11
  GUB cover: 26
  Zero half: 27
  RLT: 60
  Relax-and-lift: 357
  BQP: 47

Explored 1 nodes (186645 simplex iterations) in 91.36 seconds (267.10 work units)
Thread count was 8 (of 8 available processors)

Solution count 1: 5028.85

Optimal solution found (tolerance 5.00e-02)
Best objective 5.028852889165e+03, best bound 5.028852889165e+03, gap 0.0000%
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

```

```
CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
Thread count: 4 physical cores, 8 logical processors, using up to 8 threads

Optimize a model with 2481684 rows, 1955335 columns and 17236273 nonzeros
Model fingerprint: 0xb66ebb75
Variable types: 963295 continuous, 992040 integer (985965 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 2477274 rows and 1953860 columns
Presolve time: 4.77s
Presolved: 4410 rows, 1475 columns, 11768 nonzeros
Variable types: 8 continuous, 1467 integer (850 binary)
Found heuristic solution: objective 3227.8528892

Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    9.0534085e+03   3.964725e+03   0.000000e+00      6s
    1268    4.7955672e+03   0.000000e+00   0.000000e+00      6s

Root relaxation: objective 4.795567e+03, 1268 iterations, 0.01 seconds (0.01 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

H    0     0                    4795.5671749 13146.7410   174%     -    6s
     0     0          -    0     4795.56717 4795.56717  0.00%     -    6s

Explored 1 nodes (1906 simplex iterations) in 6.35 seconds (6.97 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 4795.57 3227.85

Optimal solution found (tolerance 1.00e-08)
Best objective 4.795567174880e+03, best bound 4.795567174880e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□4795

  Itr = 1
Collect_LB =   [647.0, 5028.852889165355]
Collect_UB =   [9410.70577833071, 5442.567174879641]
Collect_Hua =   [0.0, 4381.852889165355]
Collect_SPObjVal =   [4381.852889165355, 4795.567174879641]
Collect_MPObjValNHua =   [647.0, 647.0]


Set parameter MIPGap to value 0.05
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
Thread count: 4 physical cores, 8 logical processors, using up to 8 threads

Optimize a model with 1676770 rows, 323344 columns and 5062590 nonzeros
Model fingerprint: 0xd1f3e031
Variable types: 1 continuous, 323343 integer (300573 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [1e+00, 2e+01]
  Bounds range     [1e+00, 1e+00]
  RHS range        [1e+00, 2e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 1346036 rows and 288770 columns (presolve time = 5s) ...
Presolve removed 1380501 rows and 291938 columns (presolve time = 10s) ...
Presolve removed 1394517 rows and 292727 columns (presolve time = 18s) ...
Presolve removed 1456034 rows and 301032 columns (presolve time = 20s) ...
Presolve removed 1474511 rows and 301032 columns
Presolve time: 20.62s
Presolved: 202259 rows, 22312 columns, 647473 nonzeros
Variable types: 1 continuous, 22311 integer (17164 binary)

Deterministic concurrent LP optimizer: primal simplex, dual simplex, and barrier
Showing barrier log only...

Root relaxation presolved: 22312 rows, 224571 columns, 669785 nonzeros
```

```
Root barrier log...

Ordering time: 2.56s

Barrier statistics:
 Dense cols : 29
 Free vars  : 748
 AA' NZ     : 7.020e+05
 Factor NZ  : 2.218e+07 (roughly 300 MB of memory)
 Factor Ops : 5.538e+10 (roughly 2 seconds per iteration)
 Threads    : 1

                 Objective                Residual
Iter       Primal          Dual         Primal    Dual     Compl     Time
   0  -5.64830474e+07  3.34809857e+04  2.69e+04 1.97e+03  9.11e+04    26s

Barrier performed 0 iterations in 26.07 seconds (49.16 work units)
Barrier solve interrupted - model solved by another algorithm

Concurrent spin time: 0.97s (can be avoided by choosing Method=3)

Solved with primal simplex

Root relaxation: objective 5.456853e+03, 22745 iterations, 4.53 seconds (6.36 work units)
Total elapsed time = 30.08s
Total elapsed time = 35.88s

     Nodes    |    Current Node    |     Objective Bounds      |     Work
  Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

     0     0 5456.85289    0  548          - 5456.85289      -     -   38s
     0     0 5456.85289    0  690          - 5456.85289      -     -   38s
     0     0 5456.85289    0  914          - 5456.85289      -     -   49s
     0     0 5456.85289    0  923          - 5456.85289      -     -   49s
     0     0 5456.85289    0  911          - 5456.85289      -     -   55s
     0     0 5456.85289    0  912          - 5456.85289      -     -   55s
     0     0 5456.85289    0  673          - 5456.85289      -     -   72s
     0     0 5456.85289    0  666          - 5456.85289      -     -   72s
     0     0 5456.85289    0  783          - 5456.85289      -     -   76s
     0     0 5456.85289    0  785          - 5456.85289      -     -   76s
     0     0 5456.85289    0  450          - 5456.85289      -     -   95s
     0     0 5456.85289    0  462          - 5456.85289      -     -   96s
     0     0 5456.85289    0  462          - 5456.85289      -     -   96s
     0     0 5456.85289    0  423          - 5456.85289      -     -   97s
     0     0 5456.85289    0  405          - 5456.85289      -     -   98s
     0     0 5456.85289    0  377          - 5456.85289      -     -  113s
     0     0 5456.85289    0  487          - 5456.85289      -     -  114s
     0     0 5456.85289    0  484          - 5456.85289      -     -  114s
     0     0 5456.85289    0  459          - 5456.85289      -     -  116s
     0     0 5456.85289    0  491          - 5456.85289      -     -  116s
     0     0 5456.85289    0  489          - 5456.85289      -     -  117s
     0     0 5456.85289    0  316          - 5456.85289      -     -  128s
     0     0 5456.85289    0  323          - 5456.85289      -     -  128s
     0     0 5456.85289    0  307          - 5456.85289      -     -  129s
     0     0 5456.85289    0  377          - 5456.85289      -     -  130s
     0     0 5456.85289    0  379          - 5456.85289      -     -  130s
     0     0 5456.85289    0  374          - 5456.85289      -     -  141s
     0     0 5456.85289    0  388          - 5456.85289      -     -  142s
     0     0 5456.85289    0  388          - 5456.85289      -     -  142s
     0     0 5456.85289    0  274          - 5456.85289      -     -  145s
H    0     0                5456.8528892 5456.85289  0.00%     -  167s
     0     0 5456.85289    0  274 5456.85289 5456.85289  0.00%     -  167s

Cutting planes:
  Learned: 15
  Gomory: 3
  Cover: 330
  Implied bound: 102
  Clique: 3890
  MIR: 462
  StrongCG: 260
  Flow cover: 26
  GUB cover: 69
  Zero half: 24
  Network: 3
  RLT: 141
  Relax-and-lift: 463
  BQP: 51
  PSD: 3

Explored 1 nodes (266619 simplex iterations) in 167.41 seconds (527.99 work units)
Thread count was 8 (of 8 available processors)
```

```
Solution count 1: 5456.85

Optimal solution found (tolerance 5.00e-02)
Best objective 5.456852889165e+03, best bound 5.456852889165e+03, gap 0.0000%
Warning: linear constraint 604259 and linear constraint 1140515 have the same name "ConSP25_1[0,0]"
Set parameter MIPGap to value 1e-08
Gurobi Optimizer version 10.0.2 build v10.0.2rc0 (win64)

CPU model: 11th Gen Intel(R) Core(TM) i7-11370H @ 3.30GHz, instruction set [SSE2|AVX|AVX2|AVX512]
Thread count: 4 physical cores, 8 logical processors, using up to 8 threads

Optimize a model with 2481684 rows, 1955335 columns and 17236273 nonzeros
Model fingerprint: 0x622fa79d
Variable types: 963295 continuous, 992040 integer (985965 binary)
Coefficient statistics:
  Matrix range     [1e-01, 1e+10]
  Objective range  [6e-05, 5e+01]
  Bounds range     [1e+00, 8e+01]
  RHS range        [8e-01, 1e+10]
Warning: Model contains large matrix coefficients
Warning: Model contains large rhs
         Consider reformulating model or setting NumericFocus parameter
         to avoid numerical issues.
Presolve removed 2477413 rows and 1953880 columns
Presolve time: 4.80s
Presolved: 4271 rows, 1455 columns, 11395 nonzeros
Variable types: 8 continuous, 1447 integer (841 binary)
Found heuristic solution: objective 3253.5671749

Root simplex log...

Iteration    Objective       Primal Inf.    Dual Inf.      Time
       0    9.2334085e+03   4.138363e+03   0.000000e+00      6s
    1264    4.8105672e+03   0.000000e+00   0.000000e+00      6s

Root relaxation: objective 4.810567e+03, 1264 iterations, 0.02 seconds (0.01 work units)

    Nodes    |    Current Node    |     Objective Bounds      |     Work
 Expl Unexpl |  Obj  Depth IntInf | Incumbent    BestBd   Gap | It/Node Time

H    0     0                    4810.5671749 12966.7410   170%     -    6s
     0     0        -    0      4810.56717 4810.56717  0.00%     -    6s

Explored 1 nodes (1895 simplex iterations) in 6.35 seconds (6.95 work units)
Thread count was 8 (of 8 available processors)

Solution count 2: 4810.57 3253.57

Optimal solution found (tolerance 1.00e-08)
Best objective 4.810567174880e+03, best bound 4.810567174880e+03, gap 0.0000%
SP is solved
SP's optimal solution is'□4810

  Itr = 2
Collect_LB =   [647.0, 5028.852889165355, 5456.852889165355]
Collect_UB =   [9410.70577833071, 5442.567174879641, 5442.567174879641]
Collect_Hua =   [0.0, 4381.852889165355, 4795.567174879641]
Collect_SPObjVal =   [4381.852889165355, 4795.567174879641, 4810.567174879641]
Collect_MPObjValNHua =   [647.0, 647.0, 661.2857142857138]


  Reach the termination conditions, stop iteration
  Values adopted from the judgeCount's th iteration, and Itr = {2}, judgeCount = {1}

~~~~~~~~~~judgeCount = 1, SPObj_SPF = 4795.567174879641
Vessel i: 0:     pi: 0-5,     ai-di: 8-25,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 8-25,     taoi-deltai: 8-17,     taoPi_SP-deltaPi_SP: 8-17,     betaNi: 9,     bi: 9
Vessel i: 1:     pi: 5-10,     ai-di: 3-21,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 3-21,     taoi-deltai: 3-15,     taoPi_SP-deltaPi_SP: 3-15,     betaNi: 12,     bi: 12
Vessel i: 2:     pi: 18-23,     ai-di: 13-36,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 13-36,     taoi-deltai: 13-28,     taoPi_SP-deltaPi_SP: 13-28,     betaNi: 15,     bi: 15
Vessel i: 3:     pi: 9-15,     ai-di: 22-49,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 22-49,     taoi-deltai: 22-39,     taoPi_SP-deltaPi_SP: 22-39,     betaNi: 17,     bi: 17
Vessel i: 4:     pi: 22-28,     ai-di: 35-57,     gi_SP-gpi_SP: 0.000000-0.000000,     ai_SP-di: 35-57,     taoi-deltai: 35-48,     taoPi_SP-deltaPi_SP: 35-48,     betaNi: 13,     bi: 13
Vessel i: 5:     pi: 11-18,     ai-di: 3-35,     gi_SP-gpi_SP: 0.257143-0.800000,     ai_SP-di: 4-35,     taoi-deltai: 6-21,     taoPi_SP-deltaPi_SP: 6-21,     betaNi: 15,     bi: 15
Vessel i: 6:     pi: 29-34,     ai-di: 2-29,     gi_SP-gpi_SP: 1.000000-0.000000,     ai_SP-di: 10-29,     taoi-deltai: 7-15,     taoPi_SP-deltaPi_SP: 10-15,     betaNi: 8,     bi: 8
Vessel i: 7:     pi: 15-22,     ai-di: 27-68,     gi_SP-gpi_SP: 1.000000-0.600000,     ai_SP-di: 37-68,     taoi-deltai: 37-53,     taoPi_SP-deltaPi_SP: 37-53,     betaNi: 16,     bi: 16
Vessel i: 8:     pi: 28-34,     ai-di: 29-59,     gi_SP-gpi_SP: 0.142857-1.000000,     ai_SP-di: 30-59,     taoi-deltai: 30-35,     taoPi_SP-deltaPi_SP: 30-35,     betaNi: 5,     bi: 5

```

```
491   round LB =   [647, 5029, 5457]
492   round UB =   [9411, 5443, 5443]
493   round Hua =   [0, 4382, 4796]
494   round SPObjVal =   [4382, 4796, 4811]
495   round MPObjValNHua =   [647, 647, 661]
496
497   Time: 739.000000
498
499
500
501
```