

# Supplementary file of “Seeking Multiple Solutions of Combinatorial Optimization Problems: A Proof of Principle Study”

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The supplementary file describes details of 25 Multiple solution Traveling Salesman Problem (MSTSP) instances, including the name, the category, the number of cities, the number of optima, and the length of optima. In addition, we plot the tours of overall optima. But for some instances with many optima, we only drawn the representative ones. For composite MSTPS instances, the city clusters are first outlined, and then city cluster(s) with multiple optimal sub-tours is (are) zoomed in.

## 1) MSTSP1

Name: simple1\_9

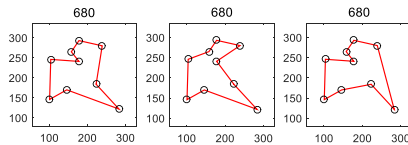
Category: simple MSTSP

Number of cities: 9

Number of optima: 3

Length of optima: 680

Figure of overall optima:



## 2) MSTSP2

Name: simple2\_10

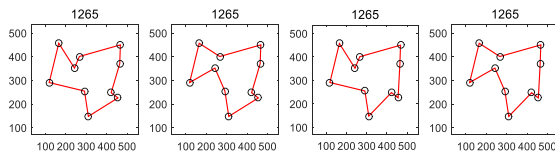
Category: simple MSTSP

Number of cities: 10

Number of optima: 4

Length of optima: 1265

Figure of overall optima:



## 3) MSTSP3

Name: simple3\_10

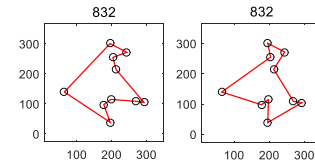
Category: simple MSTSP

Number of cities: 10

Number of optima: 13

Length of optima: 832

Figure of the representative optima:



## 4) MSTSP4

Name: simple4\_11

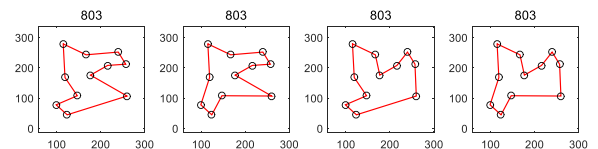
Category: simple MSTSP

Number of cities: 11

Number of optima: 4

Length of optima: 803

Figure of overall optima:



## 5) MSTSP5

Name: simple5\_12

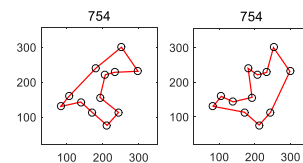
Category: simple MSTSP

Number of cities: 12

Number of optima: 2

Length of optima: 754

Figure of overall optima:

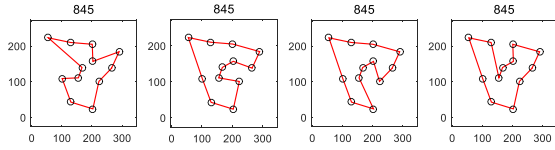


## 6) MSTSP6

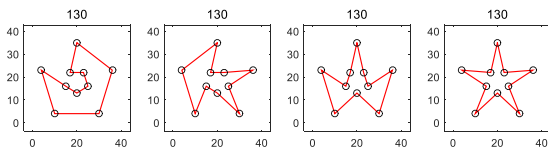
Name: simple6\_12

Category: simple MSTSP

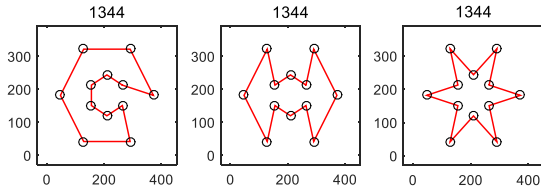
Number of cities: 12  
 Number of optima: 4  
 Length of optima: 845  
 Figure of overall optima:



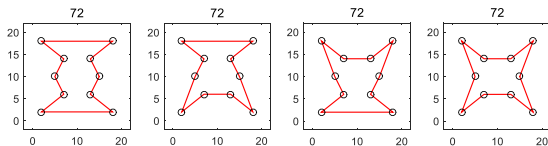
7) MSTSP7  
 Name: geometry1\_10  
 Category: geometry MSTSP  
 Number of cities: 10  
 Number of optima: 56  
 Length of optima: 130  
 Figure of the representative optima:



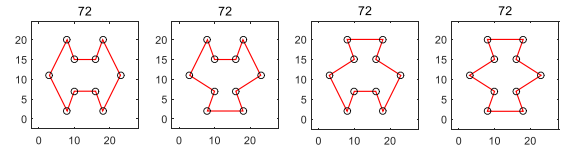
8) MSTSP8  
 Name: geometry2\_12  
 Category: geometry MSTSP  
 Number of cities: 12  
 Number of optima: 110  
 Length of optima: 1344  
 Figure of the representative optima:



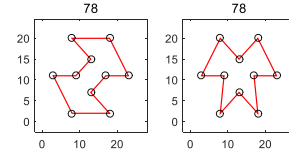
9) MSTSP9  
 Name: geometry3\_10  
 Category: geometry MSTSP  
 Number of cities: 10  
 Number of optima: 4  
 Length of optima: 72  
 Figure of optima:



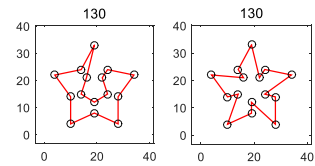
10) MSTSP10  
 Name: geometry4\_10  
 Category: geometry MSTSP  
 Number of cities: 10  
 Number of optima: 4  
 Length of optima: 72  
 Figure of the representative optima:



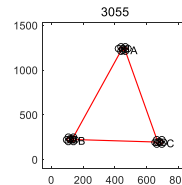
11) MSTSP11  
 Name: geometry5\_10  
 Category: geometry MSTSP  
 Number of cities: 10  
 Number of optima: 14  
 Length of optima: 78  
 Figure of the representative optima:



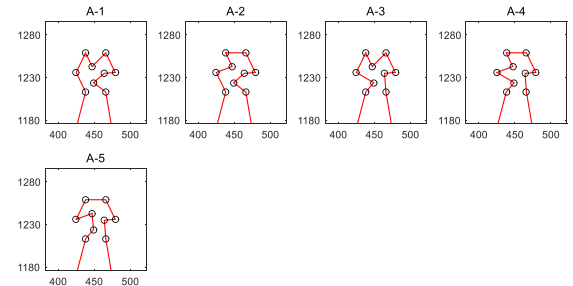
12) MSTSP12  
 Name: geometry6\_15  
 Category: geometry MSTSP  
 Number of cities: 15  
 Number of optima: 196  
 Length of optima: 130  
 Figure of the representative optima:

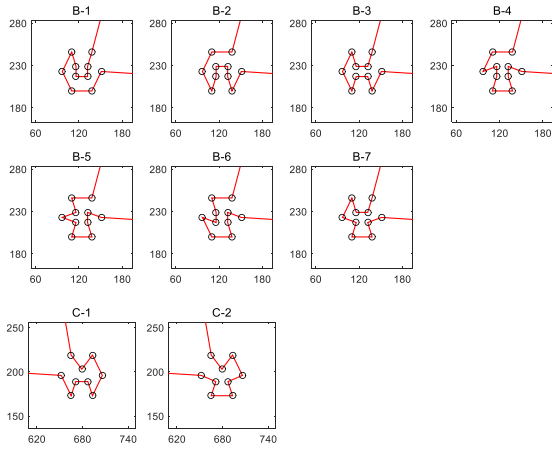


13) MSTSP13  
 Name: composite1\_28  
 Category: composite MSTSP  
 Number of cities: 28  
 Number of optima: 70  
 Length of optima: 3055  
 Number of optimal inter-cluster topology: 1  
 Figure of optima:



Figures of subtours:





#### 14) MSTSP14

Name: composite2\_34

Category: composite MSTSP

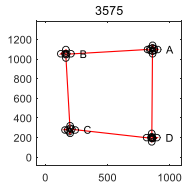
Number of cities: 34

Number of optima: 16

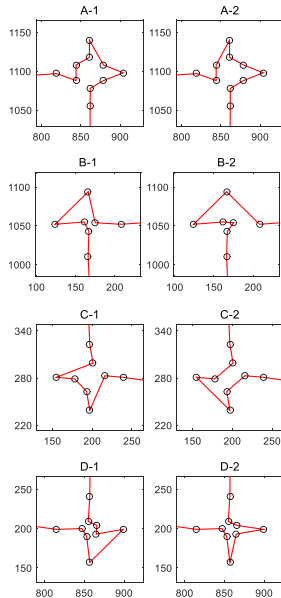
Length of optima: 3575

Number of optimal inter-cluster topologies: 1

Figure of optima:



Figures of subtours:



#### 15) MSTSP15

Name: composite3\_22

Category: composite MSTSP

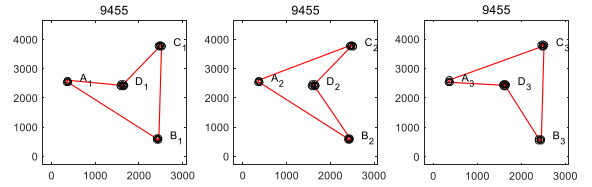
Number of cities: 22

Number of optima: 72

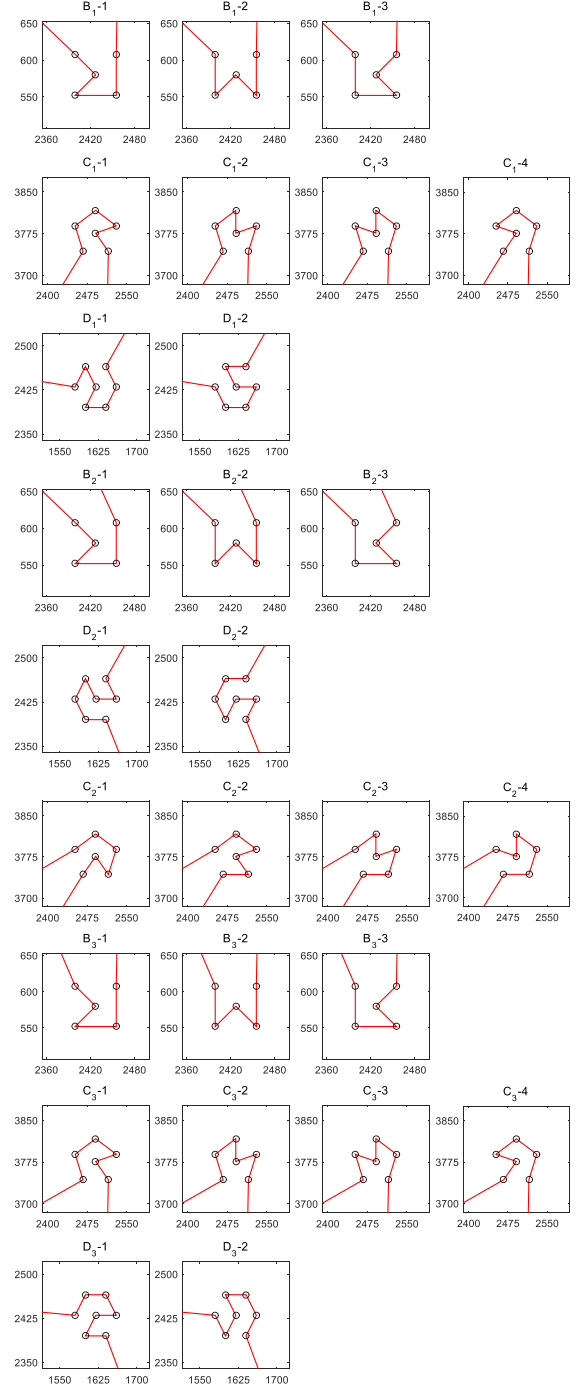
Length of optima: 9455

Number of optimal inter-cluster topologies: 3

Figure of optima:



Figures of subtours:



#### 16) MSTSP16

Name: composite4\_33

Category: composite MSTSP

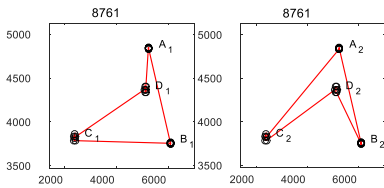
Number of cities: 33

Number of optima: 64

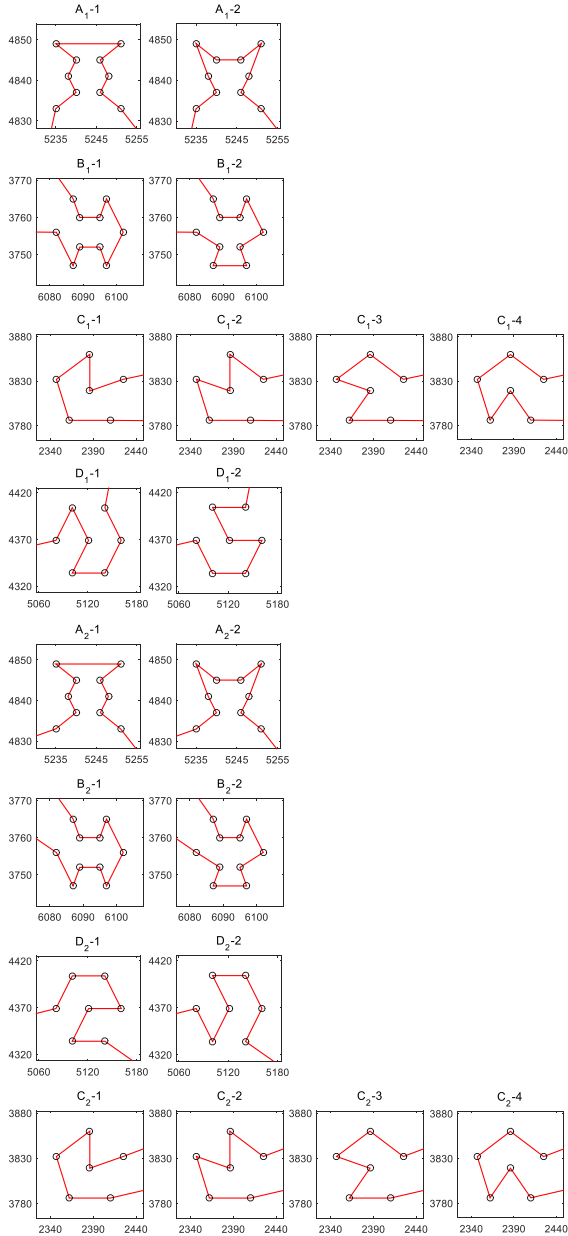
Length of optima: 8761

Number of optimal intra-cluster topologies: 2

Figure of optima:



Figures of subtours:



17) MSTSP17

Name: composite5\_35

Category: composite MSTSP

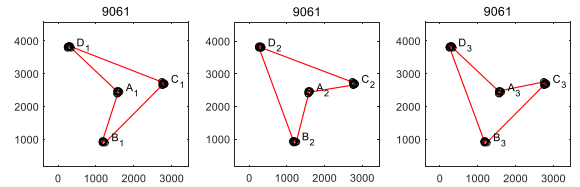
Number of cities: 35

Number of optima: 10

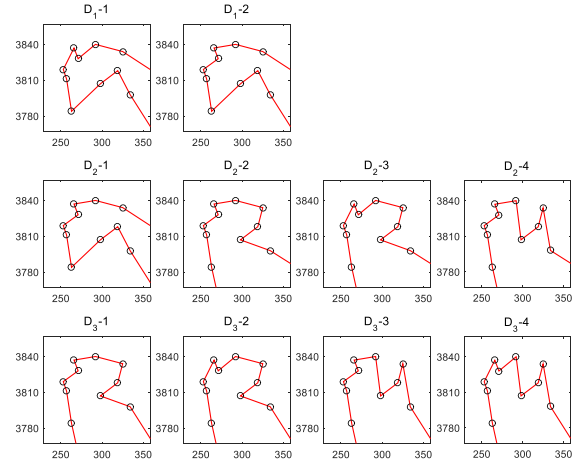
Length of optima: 9061

Number of optimal inter-cluster topologies: 3

Figure of optima:



Figures of subtours:



18) MSTSP18

Name: composite6\_39

Category: composite MSTSP

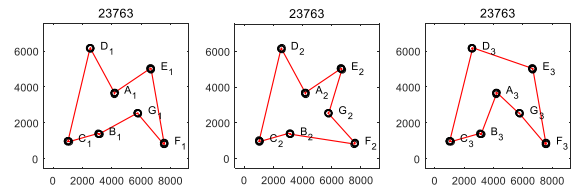
Number of cities: 39

Number of optima: 20

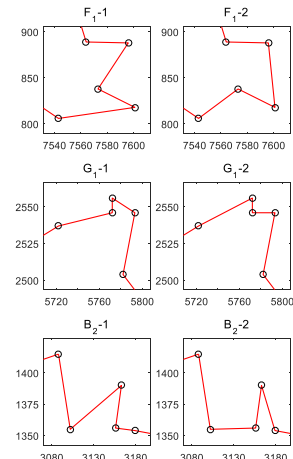
Length of optima: 23763

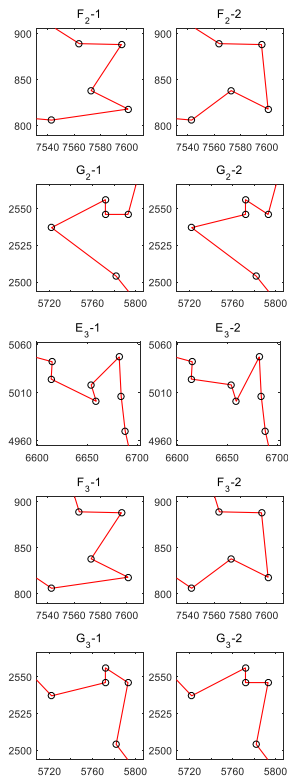
Number of optimal inter-cluster topologies: 3

Figure of optima:



Figures of subtours:





## 19) MSTSP19

Name: composite7\_42

Category: composite MSTSP

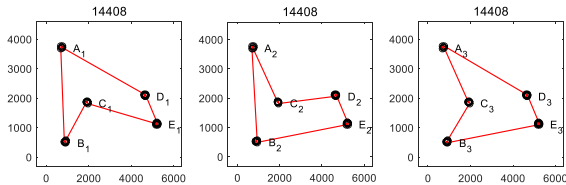
Number of cities: 42

Number of optima: 20

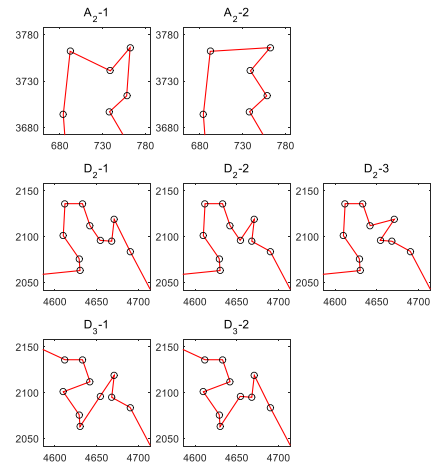
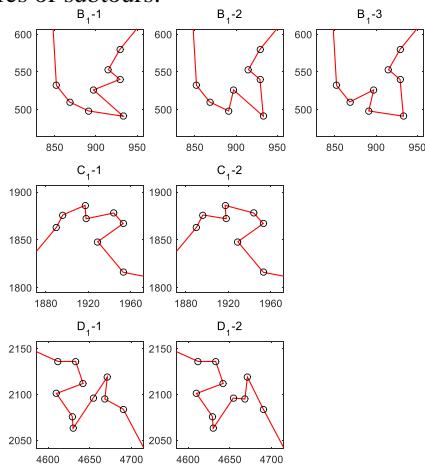
Length of optima: 14408

Number of optimal inter-cluster topologies: 3

Figure of optima:



Figures of subtours:



## 20) MSTSP20

Name: composite8\_45

Category: composite MSTSP

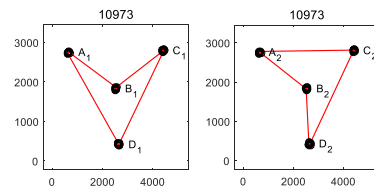
Number of cities: 45

Number of optima: 20

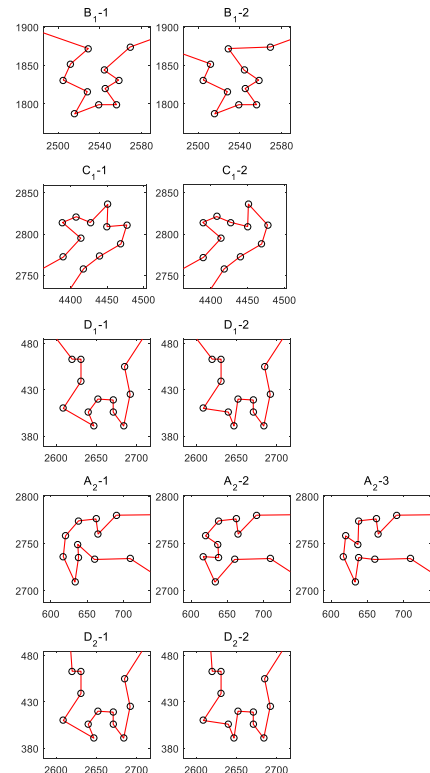
Length of optima: 10973

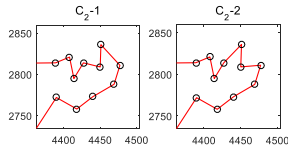
Number of optimal inter-cluster topologies: 3

Figure of optima:



Figures of subtours:





### 21) MSTSP21

Name: composite9\_48

Category: composite MSTSP

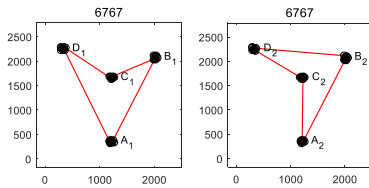
Number of cities: 48

Number of optima: 4

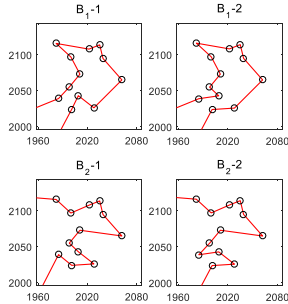
Length of optima: 6767

Number of optimal inter-cluster topologies: 2

Figure of optima:



Figures of subtours:



### 22) MSTSP22

Name: composite10\_55

Category: composite MSTSP

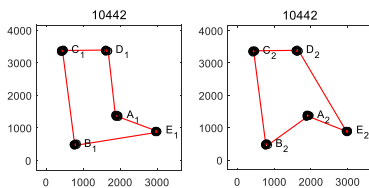
Number of cities: 55

Number of optima: 9

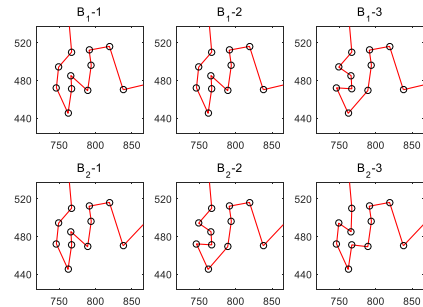
Length of optima: 10442

Number of optimal inter-cluster topologies: 2

Figure of optima:



Figures of subtours:



### 23) MSTSP23

Name: composite11\_59

Category: composite MSTSP

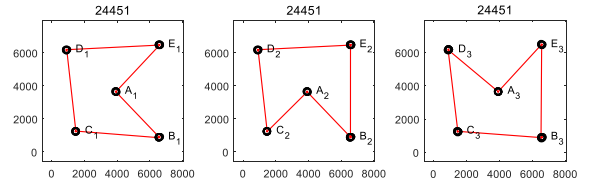
Number of cities: 59

Number of optima: 10

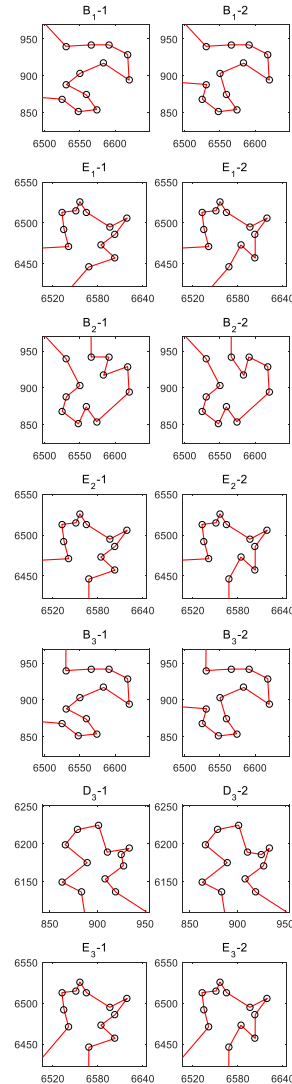
Length of optima: 24451

Number of optimal inter-cluster topologies: 3

Figure of optima:



Figures of subtours:



### 24) MSTSP24

Name: composite12\_60

Category: composite MSTSP

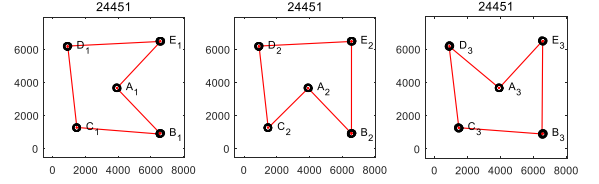
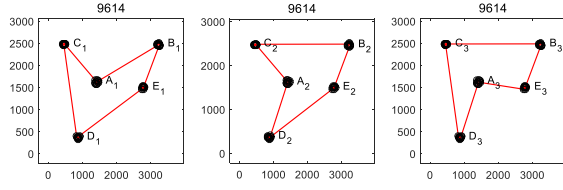
Number of cities: 60

Number of optima: 36

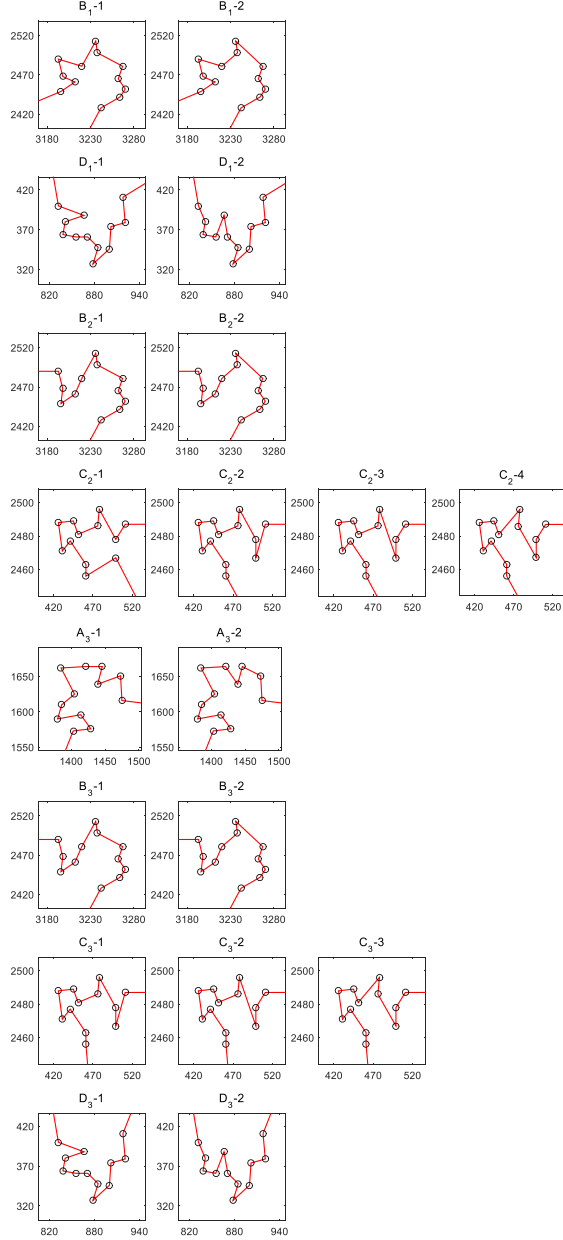
Length of optima: 9614

Number of optimal inter-cluster topologies: 2

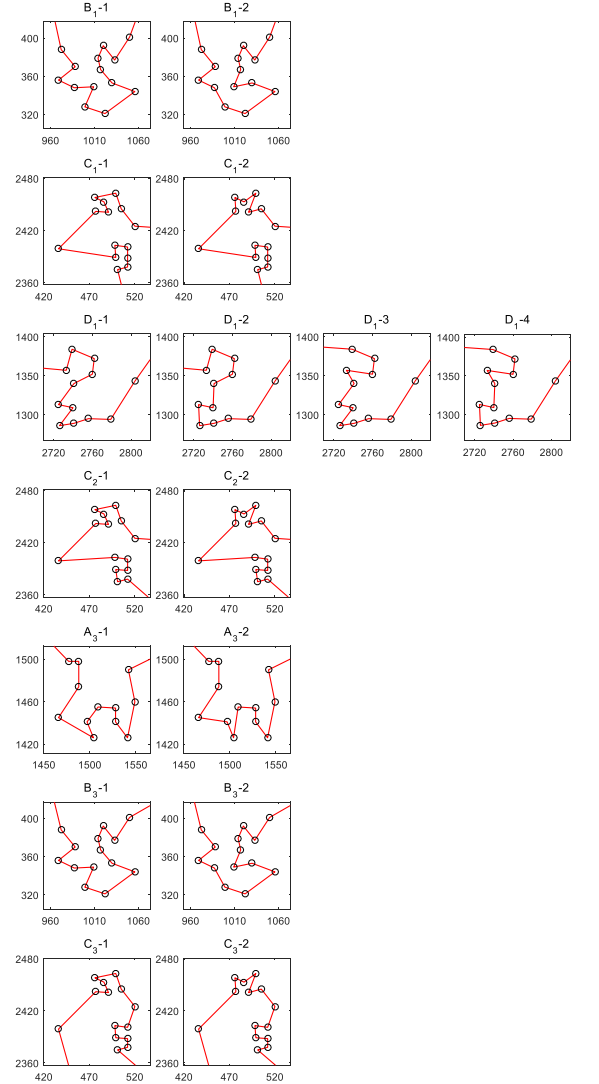
Figure of optima:



Figures of subtours:



Figures of subtours:



## 25) MSTSP25

Name: composite13\_66

Category: composite MSTSP

Number of cities: 66

Number of optima: 26

Length of optima: 9521

Number of optimal inter-cluster topologies: 3

Figure of optima: