**Set**

V= {1, 2, …v, …|V|} Vehicles set

P= {1, 2,…p, …|*P|*} Passengers set

G={1,2,…g,…|G|} Group set

Vehicles decomposition.

Passengers sub set for each group g

**Variables**

**Model P1**

P1 can divided into |G| group, for a given Vg and Pg:

**Model P-Sub**

)

st. Flow balance constraints

Step 1: Initial Vg and Pg

Step 2: Subgradient algorithm

Low Bound Generation

Up Bound Generation

End

**Model P1**

(1)

(2)

(3)

Note that, similar to GAP based heuristics by Fisher, is treated as a nonlinear function to be obtained through the iterative process. In generate, we assume subsets V are mutually exclusive throughout the process.

As the vehicle group has been determined in the preprocessing, we can simplified Model P1 into P1’:

(4)

(5)

(6)

**Step 1: Initiation.** For an approximate value of , generate initial clustering solution for , that is we form mutually exclusive set Vg, and Pg

To avoid symmetry, we try to put vehicles, and passengers with the similar characteristics (e.g. same OD, same O, or same D) into the same group, if the size of vehicles or passenger for a group does not exceed the allowable size by the m-VRP program.

**Step 1.1: Initiation**

For each v in V

Find shortest path: ;

End

**Step 1.1: Initiation Vg**

Rule 1: If the vehicle has the same OD and time window, associated in the same group;

Check the group number |G|, if |G|<required group number

Rule 2: If the vehicle has the same OD, associated in the same group;

Check the group number |G|, if |G|<required group number

Rule 3: If the vehicle has the same O or same D, associated in the same group;

Check the group number |G|, if |G|<required group number

Rule 3: If vehicles service the number of same passengers accumulated to a certain number, saying N, associated in the same group.

**Step 1.2: Initiation Pg**

Passenger seeds select rule:

For each v in V

For each p in P

If Then

Find g number to which the vehicle v belong;

End If

End

End

**Step 1.3:** Initialize LR multiplers ) = 0.

**Step 2:** for given vehicle and passenger set in each group g

Step2.1: Calling m-VRP Algorithm, find nonlinear cost

Step2.2: Solve sub-problem SP 2

**Model SP2 for given group g with** Vg

Step2.3: Update Pg ?

Step 3: Subgradient algorithm to enable different vehicle teams to compete for profitable p

Gather unserved or unsatisfactory passengers p from each group, form a shared list , in which a passenger *p* can belong to different group. That is, for , it can be in two and more than two Pg

And in this case Pg.

Update d using subgradient by checking equation Go back to step 2.

**Set**

V= {1, 2, …v, …|V|} Vehicles set

P= {1, 2,…p, …|*P|*} Passengers set

G={1,2,…g,…|G|} Group set

Vehicles decomposition.

Passengers sub set for each group g

S= {1, 2,…s, …|*S|*} States pattern set

**Parameter**

**Variables**

**Model P1**

(1)

(2)

(3)

**Model P2**

(4)

(2)