RS-HL-4: Data Transmission by MDP algorithm

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Scope

Create Data Transmission Dataset from given contact matrix

I. Load the Data

```
clc; clear;
addpath('~/Desktop/Redstone_Project/RS_HL/RS_HL_3_Network_Graph_Generation/')
load("RS_HL_3_Network_Graph_Generation.mat")

sat_to_sat_contact_3d_matrix(:,:,1);
gs_to_sat_contact_3d_matrix(:,:,1);
```

II. Specify the start GS and end GS and get the contact schedule

```
start_gs = 26;

end_gs = 3;


start_gs_contact_schedule = zeros(48,5761);
end_gs_contact_schedule = zeros(48,5761);

for i = 1:48
start_gs_contact_schedule(i,:) = gs_to_sat_contact_3d_matrix(start_gs,i,:);
end_gs_contact_schedule(i,:) = gs_to_sat_contact_3d_matrix(end_gs,i,:);
end

start_gs_contact_schedule;
end_gs_contact_schedule;
```

III. Contact Availability For GS

```
[row1,col1] = find(start_gs_contact_schedule == 1);
```

```
[row2,col2] = find(end_gs_contact_schedule == 1);

start_info = [row1,col1]
```

```
start_info = 2063×2
     7   821
     7   822
     7   823
     7   824
     7   825
     6   834
     6   835
     6   836
     6   837
     6   838
     ⋮
```

```
end_info = [row2,col2]
```

```
end_info = 2162×2
    16   179
    16   180
    16   181
    16   182
    16   183
    16   184
    16   185
    15   193
    15   194
    15   195
     ⋮
```

```
end_info = end_info(end_info(:,2) > start_info(1,2),:);

start_sat = start_info(1,1)
```

```
start_sat = 7
```

```

end_sat = end_info(1,1)
```

```
end_sat = 47
```

```

start_time = start_info(1,2)
```

```
start_time = 821
```

```

end_time = end_info(1,2)
```

```
end_time = 822
```

IV. MDP formulation

```
A = 1:48;
B = string(A');

MDP = createMDP(48,B);



time_stamp  = start_time;

gs_to_sat_matrix = gs_to_sat_contact_3d_matrix(:,:,time_stamp);
sat_to_sat_matrix = sat_to_sat_contact_3d_matrix(:,:,time_stamp);

MDP.TerminalStates = "s" + end_sat;

for i = 1:48
    for j = 1:48
        if sat_to_sat_matrix(i,j) == 1
        MDP.T(i,j,j) = sat_to_sat_matrix(i,j);


        if i < 25
            if j < 25
                MDP.R(i,j,j) = -1;
            end
            if j > 24
                MDP.R(i,j,j) = -25;
            end
        end

        if i > 24
            if j > 24
                MDP.R(i,j,j) = -1;
            end
            if j < 25
                MDP.R(i,j,j) = -25;
            end
        end

        if j == end_sat
            if j < 25
                if i > 24
                 MDP.R(i,end_sat,end_sat) = 70;
                end
                else
                MDP.R(i,end_sat,end_sat) = 100;
            end
```

```
            if j > 24
                if i < 25
                MDP.R(i,end_sat,end_sat) = 70;
                end
                else
                MDP.R(i,end_sat,end_sat) = 100;
            end
        end

        end

        if sat_to_sat_matrix(i,j) == 0
        MDP.T(i,i,j) = 1;
        MDP.R(i,i,j) = -50;
        end
    end
end



env = rlMDPEnv(MDP);

env.ResetFcn = @() start_sat;

rng(0)

obsInfo = getObservationInfo(env);
actInfo = getActionInfo(env);
qTable = rlTable(obsInfo, actInfo);
qFunction = rlQValueFunction(qTable, obsInfo, actInfo);
qOptions = rlOptimizerOptions(LearnRate=1);

agentOpts = rlQAgentOptions;
agentOpts.DiscountFactor = 1;
agentOpts.EpsilonGreedyExploration.Epsilon = 0.9;
agentOpts.EpsilonGreedyExploration.EpsilonDecay = 0.01;
agentOpts.CriticOptimizerOptions = qOptions;
qAgent = rlQAgent(qFunction,agentOpts); % #ok<NASGU>

trainOpts = rlTrainingOptions;
trainOpts.MaxStepsPerEpisode = 100;
trainOpts.MaxEpisodes = 500;
trainOpts.StopTrainingCriteria = "AverageReward";
trainOpts.StopTrainingValue = 13;
trainOpts.ScoreAveragingWindowLength = 30;

trainingStats = train(qAgent,env,trainOpts);
```

```
Data = sim(qAgent,env);

reshape(Data.Observation.MDPObservations.Data, [],1)
```

```
ans = 7×1
     7
     6
     5
     4
     3
     2
    47
```

```
size(Data.Observation.MDPObservations.Data)
```

```
ans = 1×3
     1     1     7
```

```
Data.Reward.Data
```

```
ans = 6×1
    -1
    -1
    -1
    -1
    -1
    70
```

```
sum(Data.Reward.Data)
```

```
ans = 65
```