
Simulation Loop

Start here!

load main workspace

```
end_sim = 0;
fail_count = 0;
addpath(genpath(pwd));
load_db_params;
conn = database(datasource_name, user_name, password);

% load UAV airframe
uav_sern = 'X001';
octomodel = get_airframe(conn, uav_sern);

% load battery
battery_sern = 'B001';
battery = get_battery(conn, battery_sern);
batterytwin = get_battery(conn, battery_sern);

% load motors
[Motor1, Motor2, Motor3, Motor4, Motor5, Motor6, Motor7, Motor8] = get_motors(conn, octomodel.i
[Motortwin1, Motortwin2, Motortwin3, Motortwin4, Motortwin5, Motortwin6, Motortwin7, Motortwin8

% initial rul estimate, used as baseline in rul updates where the minimum
% value is taken to ensure rul_hat never exceeds this value
rul_init = 18.0;
rul_hat = rul_init;

% minimum rul
rul_threshold = 10.0;

% load base directory
load_base_workspace;

%load_trajectory; % load individually
```

Initialize some variables

```
% for poly fitting
lookback = 6;

% how far into the future to look
horizon = 2;

% number of missions (can be oversized)
```

```

n_missions = 250;

% keep track of delta over time
% number of missions, 3 degradation parameters, 2 coefficients to save
% (slope & intercept)
polys = zeros(n_missions, 3, 2);

% keep track of degradation parameter values for poly fitting
q_deg = zeros(n_missions, 1);
r_deg = zeros(n_missions, 1);
m_deg = zeros(n_missions, 1);

% variance gets tighter over time, a pseudo-hack...
r_var_vals = [.001:-.00001:.0001];
q_var_vals = [.9:-.01:.2];
m_var_vals = [.025:-.00025:.005];

% keep track of rul
ruls = zeros(n_missions, 1);

```

Main Loop

```

% loop
% accelerated is 80
% normal is 300
for i = 1:n_missions
    if i > 11
        lookback = 8;
        horizon = 3;
    end
    ruls(i) = rul_hat;
    load_trajectory;
    if end_sim == 1
        disp("[INFO] no more valid trajectories. ending simulation.")
        break;
    end
    fprintf("[INFO] selecting trajectory: <%d> with path_time: %.2f that meets constraint: path
    sys = "TrueSystem";
    octomodel.sampletime = true_sample_rate;
    fprintf('[INFO] simulating true system on i: %d\n', i)
    tic
    sim('truesystem.slx');
    toc

```

update degradation parameters for saving

- assign values from the current run to the arrays for saving

```

q_deg(i) = battery.Q;
r_deg(i) = battery.R0;
m_deg(i) = Motor2.Req;

```

update variance

```
fprintf('[INFO] updating degradation parameter variance on i: %d\n', i)
if i <= length(r_var_vals)
    r_var = r_var_vals(i);
else
    r_var = .0001;
end
if i <= length(q_var_vals)
    q_var = q_var_vals(i);
else
    q_var = .25;
end
if i <= length(m_var_vals)
    m_var = m_var_vals(i);
else
    m_var = .005;
end
```

sample the degradation parameters and update

```
fprintf('[INFO] updating degradation parameter values via random sampling on i: %d\n', i)
battery.R0 = max(abs(normrnd(rdeg(i), r_var)), .0001);
battery.Q = min(abs(normrnd(qdeg(i), q_var)), 15.5);
Motor2.Req = max(abs(normrnd(mdeg(i), m_var)), .001);
```

write telemetry data to database

```
distance = calculatedistance([pos_actual.Data(:,1) pos_actual.Data(:,2)]);
mission_id = table2array(select(conn, 'select id from mission_tb mt order by id desc limit 1'));
if isempty(mission_id)
    mission_id = 1;
else
    mission_id = mission_id + 1;
end
start = table2array(select(conn, 'select mt.dt_stop from mission_tb mt order by dt_stop desc limit 1'));
if isempty(start)
    start = datetime(now, 'ConvertFrom', 'datetime');
end
start = datetime(start, 'InputFormat', 'yyyy-MM-dd HH:mm:ss');
start = dateshift(start, 'start', 'second');
start = start + hours(1);
stop = start + seconds(flight_time.Data(end, 1)*60);

fprintf("[INFO] i: %d\tmission_id: %d\ttrul_hat: %.2f\tflight_time: %.2f\tdistance: %.2f\tR0: %.2f\tQ: %.2f\tReq: %.2f\n", i, mission_id, trul_hat, flight_time, distance, R0, Q, Req);

write_mission_data;
write_battery_data;
write_flight_data;

if any(stop_code.Data(:,1)) == 1 && ~any(stop_code.Data(:,3)) == 1
    fprintf('[INFO] true system low soc threshold exceeded on i: %d\tmission_id: %d\n', i, mission_id);
    %break;
```



```
write_degradation_data;
```

now simulate digital twin

```
load_trajectory;
sys = "DigitalTwin";
octomodel.sampletime = twin_sample_rate;
for twin_ctr=1:twin_count
    fprintf('[INFO] simulating digital twin on i: %d\n', i)
    out = sim('digitaltwin1c.slx');
    % get the output from each parallel worker
    times(twin_ctr) = flight_time.Data(end);
    vs(twin_ctr) = battery_actual.Data(end, 1);
    socs(twin_ctr) = battery_actual.Data(end, 2);
    r0s(twin_ctr) = battery_actual.Data(end, 3);
    qs(twin_ctr) = battery_actual.Data(end, 6);
    ms(twin_ctr) = motors.Data(end, 1);
    errs(twin_ctr) = mean(euclidean_pos_err);
    dist(twin_ctr) = calculatedistance([pos_actual.Data(:,1) pos_actual.Data(:,2)]);
    degs(:, twin_ctr) = [batterytwin.R0 batterytwin.Q Motortwin2.Req]';

    % resample the degradation parameters if more than one digital twin
    % simulation
    if twin_count > 1 && twin_ctr < twin_count
        fprintf('[INFO] resampling for twin run # %d', twin_ctr + 1);
        if i > lookback
            batterytwin.R0 = normrnd(r_mu, r_var);
            batterytwin.Q = normrnd(q_mu, q_var);
            Motortwin2.Req = normrnd(m_mu, m_var);
        else
            batterytwin.R0 = max(abs(normrnd(rdeg(i), r_var)), .00075);
            batterytwin.Q = min(abs(normrnd(qdeg(i), q_var)), 15.5);
            Motortwin2.Req = max(abs(normrnd(mdeg(i), m_var)), .001);
        end
    end
end
```

do some checks on when to stop the simulation

```
if any(stop_code.Data(:,1)) == 1
    fprintf('[INFO] digital twin low soc threshold exceeded on i: %d\mission_id: %d\n', i, mission_id);
    fprintf('[INFO] updating RUL from %.2f to %.2f', rul_hat, min(mean(times(:)) - 1, rul_init));
    rul_hat = min(mean(times(:)) - 1, rul_init); % rul is now 1 minute less than the digital twin
end

if any(stop_code.Data(:,2)) == 1
    fprintf('[INFO] digital twin position error threshold exceeded on i: %d\mission_id: %d\n', i, mission_id);
    fprintf('[INFO] updating RUL from %.2f to %.2f', rul_hat, min(mean(times(:)) - 1, rul_init));
    rul_hat = min(mean(times(:)) - 1, rul_init); % rul is now 1 minute less than the digital twin
end

if any(stop_code.Data(:,3)) == 1 && ~any(stop_code.Data(:,1)) == 1 && ~any(stop_code.Data(:,2)) == 1
    fprintf('[INFO] digital twin mission success on i: %d\mission_id: %d\n', i, mission_id);
end
```



```

[INFO] digital twin mission success on i: 4 mission_id: 191
[INFO] selecting trajectory: <15> with path_time: 17.63 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 5
Elapsed time is 238.838327 seconds.
[INFO] updating degradation parameter variance on i: 5
[INFO] updating degradation parameter values via random sampling on i: 5
[INFO] i: 5 mission_id: 192 rul_hat: 18.00 flight_time: 17.45 distance: 1272.08 R0: 0.00046 Q: 13.86 Req: 0.23543
[INFO] true system low soc threshold exceeded on i: 5 mission_id: 192
[INFO] digital twin degradation parameters: 0.0006 14.2372 0.2277
[INFO] simulating digital twin on i: 5
[INFO] digital twin mission success on i: 5 mission_id: 192
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 6
Elapsed time is 224.927220 seconds.
[INFO] updating degradation parameter variance on i: 6
[INFO] updating degradation parameter values via random sampling on i: 6
[INFO] i: 6 mission_id: 193 rul_hat: 18.00 flight_time: 16.36 distance: 1218.66 R0: 0.00140 Q: 13.72 Req: 0.23452
[INFO] success on i: 6 mission_id: 193
[INFO] digital twin degradation parameters: 0.0019 14.5659 0.2372
[INFO] simulating digital twin on i: 6
[INFO] digital twin mission success on i: 6 mission_id: 193
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 7
Elapsed time is 189.201044 seconds.
[INFO] updating degradation parameter variance on i: 7
[INFO] updating degradation parameter values via random sampling on i: 7
[INFO] i: 7 mission_id: 194 rul_hat: 18.00 flight_time: 13.94 distance: 1047.85 R0: 0.00052 Q: 14.72 Req: 0.24989
[INFO] success on i: 7 mission_id: 194
[INFO] forecasting degradation values: r_mu: 0.001026 q_mu: 12.947793 m_mu: 0.237719
[INFO] digital twin degradation parameters: 0.0010 12.8227 0.2459
[INFO] simulating digital twin on i: 7
[INFO] digital twin mission success on i: 7 mission_id: 194
[INFO] selecting trajectory: <3> with path_time: 17.83 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 8
Elapsed time is 219.289745 seconds.
[INFO] updating degradation parameter variance on i: 8
[INFO] updating degradation parameter values via random sampling on i: 8
[INFO] i: 8 mission_id: 195 rul_hat: 18.00 flight_time: 17.84 distance: 1302.17 R0: 0.00149 Q: 13.91 Req: 0.26701
[INFO] success on i: 8 mission_id: 195
[INFO] forecasting degradation values: r_mu: 0.000494 q_mu: 13.754388 m_mu: 0.257300
[INFO] digital twin degradation parameters: 0.0008 14.0562 0.2836
[INFO] simulating digital twin on i: 8
[INFO] digital twin mission success on i: 8 mission_id: 195
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 9
Elapsed time is 187.738313 seconds.
[INFO] updating degradation parameter variance on i: 9
[INFO] updating degradation parameter values via random sampling on i: 9
[INFO] i: 9 mission_id: 196 rul_hat: 18.00 flight_time: 13.94 distance: 1047.71 R0: 0.00010 Q: 15.50 Req: 0.23042
[INFO] success on i: 9 mission_id: 196
[INFO] forecasting degradation values: r_mu: -0.000155 q_mu: 13.812827 m_mu: 0.284958
[INFO] digital twin degradation parameters: 0.0013 13.9512 0.2730
[INFO] simulating digital twin on i: 9
[INFO] digital twin mission success on i: 9 mission_id: 196
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 10
Elapsed time is 224.334450 seconds.
[INFO] updating degradation parameter variance on i: 10
[INFO] updating degradation parameter values via random sampling on i: 10
[INFO] i: 10 mission_id: 197 rul_hat: 18.00 flight_time: 16.36 distance: 1218.62 R0: 0.00160 Q: 14.04 Req: 0.23433
[INFO] success on i: 10 mission_id: 197
[INFO] forecasting degradation values: r_mu: -0.000591 q_mu: 15.802029 m_mu: 0.245896
[INFO] digital twin degradation parameters: 0.0004 15.5000 0.2348
[INFO] simulating digital twin on i: 10
[INFO] digital twin mission success on i: 10 mission_id: 197

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```

[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 11
Elapsed time is 205.311364 seconds.
[INFO] updating degradation parameter variance on i: 11
[INFO] updating degradation parameter values via random sampling on i: 11
[INFO] i: 11 mission_id: 198 rul_hat: 18.00 flight_time: 14.83 distance: 1083.12 R0: 0.00020 Q: 14.49 Req: 0.22829
[INFO] success on i: 11 mission_id: 198
[INFO] forecasting degradation values: r_mu: 0.001341 q_mu: 14.854568 m_mu: 0.234408
[INFO] digital twin degradation parameters: 0.0008 15.5000 0.2528
[INFO] simulating digital twin on i: 11
[INFO] digital twin mission success on i: 11 mission_id: 198
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 12
Elapsed time is 191.472932 seconds.
[INFO] updating degradation parameter variance on i: 12
[INFO] updating degradation parameter values via random sampling on i: 12
[INFO] i: 12 mission_id: 199 rul_hat: 18.00 flight_time: 13.94 distance: 1047.86 R0: 0.00181 Q: 15.36 Req: 0.26933
[INFO] success on i: 12 mission_id: 199
[INFO] forecasting degradation values: r_mu: -0.000377 q_mu: 15.060105 m_mu: 0.235993
[INFO] digital twin degradation parameters: 0.0025 13.7418 0.2626
[INFO] simulating digital twin on i: 12
[INFO] digital twin mission success on i: 12 mission_id: 199
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 13
Elapsed time is 220.236639 seconds.
[INFO] updating degradation parameter variance on i: 13
[INFO] updating degradation parameter values via random sampling on i: 13
[INFO] i: 13 mission_id: 200 rul_hat: 18.00 flight_time: 16.36 distance: 1218.56 R0: 0.00067 Q: 15.14 Req: 0.25199
[INFO] success on i: 13 mission_id: 200
[INFO] forecasting degradation values: r_mu: 0.001427 q_mu: 15.547246 m_mu: 0.258412
[INFO] digital twin degradation parameters: 0.0006 15.5000 0.2682
[INFO] simulating digital twin on i: 13
[INFO] digital twin mission success on i: 13 mission_id: 200
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 14
Elapsed time is 202.223760 seconds.
[INFO] updating degradation parameter variance on i: 14
[INFO] updating degradation parameter values via random sampling on i: 14
[INFO] i: 14 mission_id: 201 rul_hat: 18.00 flight_time: 14.83 distance: 1083.40 R0: 0.00062 Q: 14.47 Req: 0.20141
[INFO] success on i: 14 mission_id: 201
[INFO] forecasting degradation values: r_mu: 0.000877 q_mu: 15.680345 m_mu: 0.254474
[INFO] digital twin degradation parameters: 0.0017 15.5000 0.2424
[INFO] simulating digital twin on i: 14
[INFO] digital twin mission success on i: 14 mission_id: 201
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 15
Elapsed time is 188.786038 seconds.
[INFO] updating degradation parameter variance on i: 15
[INFO] updating degradation parameter values via random sampling on i: 15
[INFO] i: 15 mission_id: 202 rul_hat: 18.00 flight_time: 13.94 distance: 1048.05 R0: 0.00062 Q: 14.47 Req: 0.27919
[INFO] success on i: 15 mission_id: 202
[INFO] forecasting degradation values: r_mu: 0.000850 q_mu: 15.078658 m_mu: 0.214698
[INFO] digital twin degradation parameters: 0.0005 15.4978 0.2277
[INFO] simulating digital twin on i: 15
[INFO] digital twin mission success on i: 15 mission_id: 202
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 16
Elapsed time is 185.141137 seconds.
[INFO] updating degradation parameter variance on i: 16
[INFO] updating degradation parameter values via random sampling on i: 16
[INFO] i: 16 mission_id: 203 rul_hat: 18.00 flight_time: 13.94 distance: 1047.87 R0: 0.00239 Q: 14.92 Req: 0.26137
[INFO] success on i: 16 mission_id: 203
[INFO] forecasting degradation values: r_mu: 0.000485 q_mu: 15.247590 m_mu: 0.277703
[INFO] digital twin degradation parameters: 0.0004 15.4388 0.2542
[INFO] simulating digital twin on i: 16

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[INFO] digital twin mission success on i: 16 mission_id: 203
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 17
Elapsed time is 190.573582 seconds.
[INFO] updating degradation parameter variance on i: 17
[INFO] updating degradation parameter values via random sampling on i: 17
[INFO] i: 17 mission_id: 204 rul_hat: 18.00 flight_time: 13.94 distance: 1047.78 R0: 0.00207 Q: 13.53 Req: 0.22519
[INFO] success on i: 17 mission_id: 204
[INFO] forecasting degradation values: r_mu: 0.001992 q_mu: 14.407192 m_mu: 0.290811
[INFO] digital twin degradation parameters: 0.0020 14.8113 0.3171
[INFO] simulating digital twin on i: 17
[INFO] digital twin mission success on i: 17 mission_id: 204
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 18
Elapsed time is 207.196080 seconds.
[INFO] updating degradation parameter variance on i: 18
[INFO] updating degradation parameter values via random sampling on i: 18
[INFO] i: 18 mission_id: 205 rul_hat: 18.00 flight_time: 14.83 distance: 1082.98 R0: 0.00269 Q: 14.73 Req: 0.20795
[INFO] success on i: 18 mission_id: 205
[INFO] forecasting degradation values: r_mu: 0.002064 q_mu: 13.845845 m_mu: 0.254049
[INFO] digital twin degradation parameters: 0.0018 14.5523 0.2872
[INFO] simulating digital twin on i: 18
[INFO] digital twin mission success on i: 18 mission_id: 205
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 19
Elapsed time is 189.352555 seconds.
[INFO] updating degradation parameter variance on i: 19
[INFO] updating degradation parameter values via random sampling on i: 19
[INFO] i: 19 mission_id: 206 rul_hat: 18.00 flight_time: 13.94 distance: 1048.10 R0: 0.00217 Q: 15.36 Req: 0.22601
[INFO] success on i: 19 mission_id: 206
[INFO] forecasting degradation values: r_mu: 0.003402 q_mu: 14.507422 m_mu: 0.230485
[INFO] digital twin degradation parameters: 0.0031 14.4319 0.2355
[INFO] simulating digital twin on i: 19
[INFO] digital twin mission success on i: 19 mission_id: 206
[INFO] selecting trajectory: <3> with path_time: 17.83 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 20
Elapsed time is 222.101086 seconds.
[INFO] updating degradation parameter variance on i: 20
[INFO] updating degradation parameter values via random sampling on i: 20
[INFO] i: 20 mission_id: 207 rul_hat: 18.00 flight_time: 17.83 distance: 1302.07 R0: 0.00015 Q: 14.05 Req: 0.23112
[INFO] success on i: 20 mission_id: 207
[INFO] forecasting degradation values: r_mu: 0.002969 q_mu: 14.920806 m_mu: 0.199032
[INFO] digital twin degradation parameters: 0.0039 15.3883 0.1901
[INFO] simulating digital twin on i: 20
[INFO] digital twin mission success on i: 20 mission_id: 207
[INFO] selecting trajectory: <3> with path_time: 17.83 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 21
Elapsed time is 221.369718 seconds.
[INFO] updating degradation parameter variance on i: 21
[INFO] updating degradation parameter values via random sampling on i: 21
[INFO] i: 21 mission_id: 208 rul_hat: 18.00 flight_time: 17.83 distance: 1302.07 R0: 0.00140 Q: 13.85 Req: 0.22073
[INFO] success on i: 21 mission_id: 208
[INFO] forecasting degradation values: r_mu: 0.002027 q_mu: 14.226147 m_mu: 0.203741
[INFO] digital twin degradation parameters: 0.0022 14.4042 0.1992
[INFO] simulating digital twin on i: 21
[INFO] digital twin mission success on i: 21 mission_id: 208
[INFO] selecting trajectory: <3> with path_time: 17.83 that meets constraint: path_time < 18.00
[INFO] simulating true system on i: 22
Elapsed time is 218.436016 seconds.
[INFO] updating degradation parameter variance on i: 22
[INFO] updating degradation parameter values via random sampling on i: 22
[INFO] i: 22 mission_id: 209 rul_hat: 18.00 flight_time: 17.83 distance: 1302.04 R0: 0.00075 Q: 14.99 Req: 0.23750
[INFO] success on i: 22 mission_id: 209
[INFO] forecasting degradation values: r_mu: 0.002026 q_mu: 13.820179 m_mu: 0.227285
[INFO] digital twin degradation parameters: 0.0019 12.7779 0.2276

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[INFO] simulating digital twin on i: 22
[INFO] digital twin low soc threshold exceeded on i: 22 mission_id: 209
[INFO] updating RUL from 18.00 to 15.65
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 23
Elapsed time is 191.001382 seconds.
[INFO] updating degradation parameter variance on i: 23
[INFO] updating degradation parameter values via random sampling on i: 23
[INFO] i: 23 mission_id: 210 rul_hat: 15.65 flight_time: 13.94 distance: 1047.83 R0: 0.00128 Q: 14.24 Req: 0.24179
[INFO] success on i: 23 mission_id: 210
[INFO] forecasting degradation values: r_mu: 0.000994 q_mu: 14.526822 m_mu: 0.201170
[INFO] digital twin degradation parameters: 0.0009 13.9163 0.1858
[INFO] simulating digital twin on i: 23
[INFO] digital twin mission success on i: 23 mission_id: 210
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 24
Elapsed time is 179.597154 seconds.
[INFO] updating degradation parameter variance on i: 24
[INFO] updating degradation parameter values via random sampling on i: 24
[INFO] i: 24 mission_id: 211 rul_hat: 15.65 flight_time: 13.26 distance: 989.31 R0: 0.00207 Q: 14.22 Req: 0.26176
[INFO] success on i: 24 mission_id: 211
[INFO] forecasting degradation values: r_mu: 0.000238 q_mu: 14.311857 m_mu: 0.228995
[INFO] digital twin degradation parameters: 0.0013 14.3779 0.2060
[INFO] simulating digital twin on i: 24
[INFO] digital twin mission success on i: 24 mission_id: 211
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 25
Elapsed time is 187.703258 seconds.
[INFO] updating degradation parameter variance on i: 25
[INFO] updating degradation parameter values via random sampling on i: 25
[INFO] i: 25 mission_id: 212 rul_hat: 15.65 flight_time: 13.94 distance: 1047.90 R0: 0.00264 Q: 14.71 Req: 0.25186
[INFO] success on i: 25 mission_id: 212
[INFO] forecasting degradation values: r_mu: 0.000900 q_mu: 14.440209 m_mu: 0.266036
[INFO] digital twin degradation parameters: 0.0006 14.2542 0.2457
[INFO] simulating digital twin on i: 25
[INFO] digital twin mission success on i: 25 mission_id: 212
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 26
Elapsed time is 201.020006 seconds.
[INFO] updating degradation parameter variance on i: 26
[INFO] updating degradation parameter values via random sampling on i: 26
[INFO] i: 26 mission_id: 213 rul_hat: 15.65 flight_time: 14.83 distance: 1083.43 R0: 0.00051 Q: 14.17 Req: 0.25229
[INFO] success on i: 26 mission_id: 213
[INFO] forecasting degradation values: r_mu: 0.001718 q_mu: 14.227169 m_mu: 0.274680
[INFO] digital twin degradation parameters: 0.0021 14.5879 0.2833
[INFO] simulating digital twin on i: 26
[INFO] digital twin mission success on i: 26 mission_id: 213
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 27
Elapsed time is 201.923378 seconds.
[INFO] updating degradation parameter variance on i: 27
[INFO] updating degradation parameter values via random sampling on i: 27
[INFO] i: 27 mission_id: 214 rul_hat: 15.65 flight_time: 14.83 distance: 1083.49 R0: 0.00066 Q: 13.97 Req: 0.26272
[INFO] success on i: 27 mission_id: 214
[INFO] forecasting degradation values: r_mu: 0.001373 q_mu: 14.064146 m_mu: 0.269424
[INFO] digital twin degradation parameters: 0.0004 14.6030 0.2803
[INFO] simulating digital twin on i: 27
[INFO] digital twin mission success on i: 27 mission_id: 214
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 28
Elapsed time is 189.206024 seconds.
[INFO] updating degradation parameter variance on i: 28
[INFO] updating degradation parameter values via random sampling on i: 28
[INFO] i: 28 mission_id: 215 rul_hat: 15.65 flight_time: 13.94 distance: 1047.88 R0: 0.00177 Q: 15.37 Req: 0.24013
[INFO] success on i: 28 mission_id: 215

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[INFO] forecasting degradation values: r_mu: 0.001487 q_mu: 14.295998 m_mu: 0.278035
[INFO] digital twin degradation parameters: 0.0026 14.5232 0.2468
[INFO] simulating digital twin on i: 28
[INFO] digital twin mission success on i: 28 mission_id: 215
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 29
Elapsed time is 183.698050 seconds.
[INFO] updating degradation parameter variance on i: 29
[INFO] updating degradation parameter values via random sampling on i: 29
[INFO] i: 29 mission_id: 216 rul_hat: 15.65 flight_time: 13.26 distance: 989.22 R0: 0.00190 Q: 15.08 Req: 0.23382
[INFO] success on i: 29 mission_id: 216
[INFO] forecasting degradation values: r_mu: 0.001469 q_mu: 15.017585 m_mu: 0.262956
[INFO] digital twin degradation parameters: 0.0016 15.2685 0.2271
[INFO] simulating digital twin on i: 29
[INFO] digital twin mission success on i: 29 mission_id: 216
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 30
Elapsed time is 186.887184 seconds.
[INFO] updating degradation parameter variance on i: 30
[INFO] updating degradation parameter values via random sampling on i: 30
[INFO] i: 30 mission_id: 217 rul_hat: 15.65 flight_time: 13.47 distance: 994.75 R0: 0.00252 Q: 14.92 Req: 0.22721
[INFO] success on i: 30 mission_id: 217
[INFO] forecasting degradation values: r_mu: 0.001628 q_mu: 14.991439 m_mu: 0.241021
[INFO] digital twin degradation parameters: 0.0022 14.3429 0.2742
[INFO] simulating digital twin on i: 30
[INFO] digital twin mission success on i: 30 mission_id: 217
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 31
Elapsed time is 190.800994 seconds.
[INFO] updating degradation parameter variance on i: 31
[INFO] updating degradation parameter values via random sampling on i: 31
[INFO] i: 31 mission_id: 218 rul_hat: 15.65 flight_time: 13.47 distance: 994.86 R0: 0.00187 Q: 15.50 Req: 0.26508
[INFO] success on i: 31 mission_id: 218
[INFO] forecasting degradation values: r_mu: 0.002184 q_mu: 15.053756 m_mu: 0.226379
[INFO] digital twin degradation parameters: 0.0005 15.1744 0.2227
[INFO] simulating digital twin on i: 31
[INFO] digital twin mission success on i: 31 mission_id: 218
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 32
Elapsed time is 187.504960 seconds.
[INFO] updating degradation parameter variance on i: 32
[INFO] updating degradation parameter values via random sampling on i: 32
[INFO] i: 32 mission_id: 219 rul_hat: 15.65 flight_time: 13.58 distance: 1020.80 R0: 0.00096 Q: 14.30 Req: 0.26622
[INFO] success on i: 32 mission_id: 219
[INFO] forecasting degradation values: r_mu: 0.002051 q_mu: 15.819629 m_mu: 0.247145
[INFO] digital twin degradation parameters: 0.0016 15.5000 0.2553
[INFO] simulating digital twin on i: 32
[INFO] digital twin mission success on i: 32 mission_id: 219
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 33
Elapsed time is 202.320309 seconds.
[INFO] updating degradation parameter variance on i: 33
[INFO] updating degradation parameter values via random sampling on i: 33
[INFO] i: 33 mission_id: 220 rul_hat: 15.65 flight_time: 14.83 distance: 1083.43 R0: 0.00193 Q: 14.66 Req: 0.27070
[INFO] success on i: 33 mission_id: 220
[INFO] forecasting degradation values: r_mu: 0.001248 q_mu: 15.063579 m_mu: 0.262142
[INFO] digital twin degradation parameters: 0.0014 13.9610 0.2918
[INFO] simulating digital twin on i: 33
[INFO] digital twin mission success on i: 33 mission_id: 220
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 34
Elapsed time is 202.618639 seconds.
[INFO] updating degradation parameter variance on i: 34
[INFO] updating degradation parameter values via random sampling on i: 34
[INFO] i: 34 mission_id: 221 rul_hat: 15.65 flight_time: 14.83 distance: 1083.72 R0: 0.00241 Q: 14.52 Req: 0.25925

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[INFO] success on i: 34 mission_id: 221
[INFO] forecasting degradation values: r_mu: 0.002554 q_mu: 15.135531 m_mu: 0.270787
[INFO] digital twin degradation parameters: 0.0027 14.9491 0.2601
[INFO] simulating digital twin on i: 34
[INFO] digital twin mission success on i: 34 mission_id: 221
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 35
Elapsed time is 191.453202 seconds.
[INFO] updating degradation parameter variance on i: 35
[INFO] updating degradation parameter values via random sampling on i: 35
[INFO] i: 35 mission_id: 222 rul_hat: 15.65 flight_time: 13.58 distance: 1020.82 R0: 0.00198 Q: 13.60 Req: 0.24851
[INFO] success on i: 35 mission_id: 222
[INFO] forecasting degradation values: r_mu: 0.002857 q_mu: 14.747312 m_mu: 0.271691
[INFO] digital twin degradation parameters: 0.0029 14.7076 0.2801
[INFO] simulating digital twin on i: 35
[INFO] digital twin mission success on i: 35 mission_id: 222
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 36
Elapsed time is 202.544244 seconds.
[INFO] updating degradation parameter variance on i: 36
[INFO] updating degradation parameter values via random sampling on i: 36
[INFO] i: 36 mission_id: 223 rul_hat: 15.65 flight_time: 14.83 distance: 1083.45 R0: 0.00233 Q: 14.72 Req: 0.27324
[INFO] success on i: 36 mission_id: 223
[INFO] forecasting degradation values: r_mu: 0.002043 q_mu: 13.379195 m_mu: 0.272780
[INFO] digital twin degradation parameters: 0.0004 14.1195 0.3099
[INFO] simulating digital twin on i: 36
[INFO] digital twin mission success on i: 36 mission_id: 223
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 37
Elapsed time is 184.655301 seconds.
[INFO] updating degradation parameter variance on i: 37
[INFO] updating degradation parameter values via random sampling on i: 37
[INFO] i: 37 mission_id: 224 rul_hat: 15.65 flight_time: 13.58 distance: 1021.11 R0: 0.00229 Q: 14.79 Req: 0.28054
[INFO] success on i: 37 mission_id: 224
[INFO] forecasting degradation values: r_mu: 0.002213 q_mu: 14.191500 m_mu: 0.285168
[INFO] digital twin degradation parameters: 0.0024 14.3946 0.2851
[INFO] simulating digital twin on i: 37
[INFO] digital twin mission success on i: 37 mission_id: 224
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 38
Elapsed time is 184.406779 seconds.
[INFO] updating degradation parameter variance on i: 38
[INFO] updating degradation parameter values via random sampling on i: 38
[INFO] i: 38 mission_id: 225 rul_hat: 15.65 flight_time: 14.83 distance: 1083.73 R0: 0.00191 Q: 13.62 Req: 0.27531
[INFO] success on i: 38 mission_id: 225
[INFO] forecasting degradation values: r_mu: 0.002260 q_mu: 14.644910 m_mu: 0.299249
[INFO] digital twin degradation parameters: 0.0022 14.1183 0.3420
[INFO] simulating digital twin on i: 38
[INFO] digital twin mission success on i: 38 mission_id: 225
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 39
Elapsed time is 182.173687 seconds.
[INFO] updating degradation parameter variance on i: 39
[INFO] updating degradation parameter values via random sampling on i: 39
[INFO] i: 39 mission_id: 226 rul_hat: 15.65 flight_time: 13.58 distance: 1020.99 R0: 0.00313 Q: 14.36 Req: 0.25805
[INFO] success on i: 39 mission_id: 226
[INFO] forecasting degradation values: r_mu: 0.002291 q_mu: 13.524120 m_mu: 0.278970
[INFO] digital twin degradation parameters: 0.0007 13.3237 0.2682
[INFO] simulating digital twin on i: 39
[INFO] digital twin mission success on i: 39 mission_id: 226
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 40
Elapsed time is 176.876481 seconds.
[INFO] updating degradation parameter variance on i: 40
[INFO] updating degradation parameter values via random sampling on i: 40

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[INFO] i: 40 mission_id: 227 rul_hat: 15.65 flight_time: 13.27 distance: 989.36 R0: 0.00193 Q: 14.66 Req: 0.25255
[INFO] success on i: 40 mission_id: 227
[INFO] forecasting degradation values: r_mu: 0.003411 q_mu: 14.179948 m_mu: 0.269146
[INFO] digital twin degradation parameters: 0.0028 13.9800 0.2720
[INFO] simulating digital twin on i: 40
[INFO] digital twin mission success on i: 40 mission_id: 227
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 41
Elapsed time is 193.370959 seconds.
[INFO] updating degradation parameter variance on i: 41
[INFO] updating degradation parameter values via random sampling on i: 41
[INFO] i: 41 mission_id: 228 rul_hat: 15.65 flight_time: 13.94 distance: 1047.83 R0: 0.00202 Q: 14.91 Req: 0.24926
[INFO] success on i: 41 mission_id: 228
[INFO] forecasting degradation values: r_mu: 0.001870 q_mu: 14.575913 m_mu: 0.258799
[INFO] digital twin degradation parameters: 0.0008 14.2283 0.2562
[INFO] simulating digital twin on i: 41
[INFO] digital twin mission success on i: 41 mission_id: 228
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 42
Elapsed time is 206.247884 seconds.
[INFO] updating degradation parameter variance on i: 42
[INFO] updating degradation parameter values via random sampling on i: 42
[INFO] i: 42 mission_id: 229 rul_hat: 15.65 flight_time: 14.83 distance: 1083.39 R0: 0.00266 Q: 15.02 Req: 0.24208
[INFO] success on i: 42 mission_id: 229
[INFO] forecasting degradation values: r_mu: 0.001714 q_mu: 14.841859 m_mu: 0.249839
[INFO] digital twin degradation parameters: 0.0013 14.9969 0.2425
[INFO] simulating digital twin on i: 42
[INFO] digital twin mission success on i: 42 mission_id: 229
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 43
Elapsed time is 185.334997 seconds.
[INFO] updating degradation parameter variance on i: 43
[INFO] updating degradation parameter values via random sampling on i: 43
[INFO] i: 43 mission_id: 230 rul_hat: 15.65 flight_time: 13.47 distance: 994.81 R0: 0.00190 Q: 14.89 Req: 0.26033
[INFO] success on i: 43 mission_id: 230
[INFO] forecasting degradation values: r_mu: 0.002342 q_mu: 15.417702 m_mu: 0.240355
[INFO] digital twin degradation parameters: 0.0014 15.5000 0.2328
[INFO] simulating digital twin on i: 43
[INFO] digital twin mission success on i: 43 mission_id: 230
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 44
Elapsed time is 188.732496 seconds.
[INFO] updating degradation parameter variance on i: 44
[INFO] updating degradation parameter values via random sampling on i: 44
[INFO] i: 44 mission_id: 231 rul_hat: 15.65 flight_time: 13.94 distance: 1047.72 R0: 0.00299 Q: 14.27 Req: 0.27820
[INFO] success on i: 44 mission_id: 231
[INFO] forecasting degradation values: r_mu: 0.002076 q_mu: 15.005893 m_mu: 0.235938
[INFO] digital twin degradation parameters: 0.0018 15.0131 0.2620
[INFO] simulating digital twin on i: 44
[INFO] digital twin mission success on i: 44 mission_id: 231
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 45
Elapsed time is 185.690569 seconds.
[INFO] updating degradation parameter variance on i: 45
[INFO] updating degradation parameter values via random sampling on i: 45
[INFO] i: 45 mission_id: 232 rul_hat: 15.65 flight_time: 13.94 distance: 1047.96 R0: 0.00281 Q: 14.24 Req: 0.26133
[INFO] success on i: 45 mission_id: 232
[INFO] forecasting degradation values: r_mu: 0.002696 q_mu: 14.556772 m_mu: 0.254198
[INFO] digital twin degradation parameters: 0.0014 14.7466 0.2531
[INFO] simulating digital twin on i: 45
[INFO] digital twin mission success on i: 45 mission_id: 232
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 46
Elapsed time is 184.483639 seconds.
[INFO] updating degradation parameter variance on i: 46

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[INFO] updating degradation parameter values via random sampling on i: 46
[INFO] i: 46 mission_id: 233 rul_hat: 15.65 flight_time: 13.47 distance: 994.74 R0: 0.00228 Q: 14.02 Req: 0.25216
[INFO] success on i: 46 mission_id: 233
[INFO] forecasting degradation values: r_mu: 0.002984 q_mu: 14.864313 m_mu: 0.254412
[INFO] digital twin degradation parameters: 0.0037 14.7583 0.2501
[INFO] simulating digital twin on i: 46
[INFO] digital twin mission success on i: 46 mission_id: 233
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 47
Elapsed time is 200.183914 seconds.
[INFO] updating degradation parameter variance on i: 47
[INFO] updating degradation parameter values via random sampling on i: 47
[INFO] i: 47 mission_id: 234 rul_hat: 15.65 flight_time: 14.83 distance: 1083.29 R0: 0.00264 Q: 14.27 Req: 0.25368
[INFO] success on i: 47 mission_id: 234
[INFO] forecasting degradation values: r_mu: 0.002465 q_mu: 14.153100 m_mu: 0.257127
[INFO] digital twin degradation parameters: 0.0018 14.0164 0.2453
[INFO] simulating digital twin on i: 47
[INFO] digital twin mission success on i: 47 mission_id: 234
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 48
Elapsed time is 178.827159 seconds.
[INFO] updating degradation parameter variance on i: 48
[INFO] updating degradation parameter values via random sampling on i: 48
[INFO] i: 48 mission_id: 235 rul_hat: 15.65 flight_time: 13.27 distance: 989.45 R0: 0.00275 Q: 13.75 Req: 0.27213
[INFO] success on i: 48 mission_id: 235
[INFO] forecasting degradation values: r_mu: 0.003000 q_mu: 13.827793 m_mu: 0.259802
[INFO] digital twin degradation parameters: 0.0025 14.4036 0.2622
[INFO] simulating digital twin on i: 48
[INFO] digital twin mission success on i: 48 mission_id: 235
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 49
Elapsed time is 196.304171 seconds.
[INFO] updating degradation parameter variance on i: 49
[INFO] updating degradation parameter values via random sampling on i: 49
[INFO] i: 49 mission_id: 236 rul_hat: 15.65 flight_time: 14.83 distance: 1083.67 R0: 0.00289 Q: 14.07 Req: 0.28082
[INFO] success on i: 49 mission_id: 236
[INFO] forecasting degradation values: r_mu: 0.002962 q_mu: 13.284394 m_mu: 0.273226
[INFO] digital twin degradation parameters: 0.0034 12.6783 0.2500
[INFO] simulating digital twin on i: 49
[INFO] digital twin mission success on i: 49 mission_id: 236
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 50
Elapsed time is 183.956127 seconds.
[INFO] updating degradation parameter variance on i: 50
[INFO] updating degradation parameter values via random sampling on i: 50
[INFO] i: 50 mission_id: 237 rul_hat: 15.65 flight_time: 13.94 distance: 1047.85 R0: 0.00249 Q: 14.28 Req: 0.28418
[INFO] success on i: 50 mission_id: 237
[INFO] forecasting degradation values: r_mu: 0.002787 q_mu: 13.357850 m_mu: 0.284916
[INFO] digital twin degradation parameters: 0.0039 13.7244 0.2763
[INFO] simulating digital twin on i: 50
[INFO] digital twin mission success on i: 50 mission_id: 237
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 51
Elapsed time is 165.353479 seconds.
[INFO] updating degradation parameter variance on i: 51
[INFO] updating degradation parameter values via random sampling on i: 51
[INFO] i: 51 mission_id: 238 rul_hat: 15.65 flight_time: 13.27 distance: 989.59 R0: 0.00354 Q: 14.46 Req: 0.27132
[INFO] success on i: 51 mission_id: 238
[INFO] forecasting degradation values: r_mu: 0.002979 q_mu: 13.750587 m_mu: 0.289171
[INFO] digital twin degradation parameters: 0.0037 13.6420 0.2896
[INFO] simulating digital twin on i: 51
[INFO] digital twin mission success on i: 51 mission_id: 238
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 52
Elapsed time is 165.970017 seconds.

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[INFO] updating degradation parameter variance on i: 52
[INFO] updating degradation parameter values via random sampling on i: 52
[INFO] i: 52 mission_id: 239 rul_hat: 15.65 flight_time: 13.27 distance: 989.50 R0: 0.00315 Q: 14.57 Req: 0.26968
[INFO] success on i: 52 mission_id: 239
[INFO] forecasting degradation values: r_mu: 0.003445 q_mu: 14.335394 m_mu: 0.280499
[INFO] digital twin degradation parameters: 0.0033 14.9377 0.2719
[INFO] simulating digital twin on i: 52
[INFO] digital twin mission success on i: 52 mission_id: 239
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 53
Elapsed time is 182.426805 seconds.
[INFO] updating degradation parameter variance on i: 53
[INFO] updating degradation parameter values via random sampling on i: 53
[INFO] i: 53 mission_id: 240 rul_hat: 15.65 flight_time: 13.58 distance: 1020.91 R0: 0.00324 Q: 14.04 Req: 0.26971
[INFO] success on i: 53 mission_id: 240
[INFO] forecasting degradation values: r_mu: 0.003415 q_mu: 14.618689 m_mu: 0.286307
[INFO] digital twin degradation parameters: 0.0031 14.8843 0.2872
[INFO] simulating digital twin on i: 53
[INFO] digital twin mission success on i: 53 mission_id: 240
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 54
Elapsed time is 186.151185 seconds.
[INFO] updating degradation parameter variance on i: 54
[INFO] updating degradation parameter values via random sampling on i: 54
[INFO] i: 54 mission_id: 241 rul_hat: 15.65 flight_time: 13.94 distance: 1047.77 R0: 0.00286 Q: 13.69 Req: 0.27615
[INFO] success on i: 54 mission_id: 241
[INFO] forecasting degradation values: r_mu: 0.003720 q_mu: 14.425758 m_mu: 0.284469
[INFO] digital twin degradation parameters: 0.0035 14.8010 0.2809
[INFO] simulating digital twin on i: 54
[INFO] digital twin mission success on i: 54 mission_id: 241
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 55
Elapsed time is 182.006838 seconds.
[INFO] updating degradation parameter variance on i: 55
[INFO] updating degradation parameter values via random sampling on i: 55
[INFO] i: 55 mission_id: 242 rul_hat: 15.65 flight_time: 13.58 distance: 1021.07 R0: 0.00330 Q: 14.53 Req: 0.27997
[INFO] success on i: 55 mission_id: 242
[INFO] forecasting degradation values: r_mu: 0.003292 q_mu: 14.278173 m_mu: 0.280902
[INFO] digital twin degradation parameters: 0.0027 14.2367 0.2764
[INFO] simulating digital twin on i: 55
[INFO] digital twin mission success on i: 55 mission_id: 242
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 56
Elapsed time is 183.162064 seconds.
[INFO] updating degradation parameter variance on i: 56
[INFO] updating degradation parameter values via random sampling on i: 56
[INFO] i: 56 mission_id: 243 rul_hat: 15.65 flight_time: 14.83 distance: 1083.58 R0: 0.00334 Q: 13.86 Req: 0.27074
[INFO] success on i: 56 mission_id: 243
[INFO] forecasting degradation values: r_mu: 0.003446 q_mu: 13.547119 m_mu: 0.275405
[INFO] digital twin degradation parameters: 0.0036 13.7023 0.3022
[INFO] simulating digital twin on i: 56
[INFO] digital twin mission success on i: 56 mission_id: 243
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 57
Elapsed time is 166.216710 seconds.
[INFO] updating degradation parameter variance on i: 57
[INFO] updating degradation parameter values via random sampling on i: 57
[INFO] i: 57 mission_id: 244 rul_hat: 15.65 flight_time: 13.27 distance: 989.54 R0: 0.00348 Q: 13.82 Req: 0.26879
[INFO] success on i: 57 mission_id: 244
[INFO] forecasting degradation values: r_mu: 0.003488 q_mu: 13.524619 m_mu: 0.268961
[INFO] digital twin degradation parameters: 0.0038 13.4145 0.2573
[INFO] simulating digital twin on i: 57
[INFO] digital twin mission success on i: 57 mission_id: 244
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 58

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Elapsed time is 183.302377 seconds.

[INFO] updating degradation parameter variance on i: 58

[INFO] updating degradation parameter values via random sampling on i: 58

[INFO] i: 58 mission_id: 245 rul_hat: 15.65 flight_time: 13.58 distance: 1021.02 R0: 0.00412 Q: 14.10 Req: 0.29247

[INFO] success on i: 58 mission_id: 245

[INFO] forecasting degradation values: r_mu: 0.003919 q_mu: 13.388840 m_mu: 0.266729

[INFO] digital twin degradation parameters: 0.0047 13.3441 0.2752

[INFO] simulating digital twin on i: 58

[INFO] digital twin mission success on i: 58 mission_id: 245

[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65

[INFO] simulating true system on i: 59

Elapsed time is 174.432164 seconds.

[INFO] updating degradation parameter variance on i: 59

[INFO] updating degradation parameter values via random sampling on i: 59

[INFO] i: 59 mission_id: 246 rul_hat: 15.65 flight_time: 13.47 distance: 994.78 R0: 0.00417 Q: 13.67 Req: 0.27670

[INFO] success on i: 59 mission_id: 246

[INFO] forecasting degradation values: r_mu: 0.003900 q_mu: 13.634099 m_mu: 0.291637

[INFO] digital twin degradation parameters: 0.0038 13.6803 0.2898

[INFO] simulating digital twin on i: 59

[INFO] digital twin mission success on i: 59 mission_id: 246

[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65

[INFO] simulating true system on i: 60

Elapsed time is 186.234447 seconds.

[INFO] updating degradation parameter variance on i: 60

[INFO] updating degradation parameter values via random sampling on i: 60

[INFO] i: 60 mission_id: 247 rul_hat: 15.65 flight_time: 13.94 distance: 1047.87 R0: 0.00381 Q: 14.34 Req: 0.25867

[INFO] success on i: 60 mission_id: 247

[INFO] forecasting degradation values: r_mu: 0.004488 q_mu: 13.480026 m_mu: 0.275764

[INFO] digital twin degradation parameters: 0.0052 13.8388 0.2889

[INFO] simulating digital twin on i: 60

[INFO] digital twin mission success on i: 60 mission_id: 247

[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65

[INFO] simulating true system on i: 61

Elapsed time is 189.778733 seconds.

[INFO] updating degradation parameter variance on i: 61

[INFO] updating degradation parameter values via random sampling on i: 61

[INFO] i: 61 mission_id: 248 rul_hat: 15.65 flight_time: 13.94 distance: 1047.83 R0: 0.00415 Q: 14.08 Req: 0.27108

[INFO] success on i: 61 mission_id: 248

[INFO] forecasting degradation values: r_mu: 0.004507 q_mu: 14.116577 m_mu: 0.267100

[INFO] digital twin degradation parameters: 0.0049 13.9995 0.2735

[INFO] simulating digital twin on i: 61

[INFO] digital twin mission success on i: 61 mission_id: 248

[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65

[INFO] simulating true system on i: 62

Elapsed time is 197.288296 seconds.

[INFO] updating degradation parameter variance on i: 62

[INFO] updating degradation parameter values via random sampling on i: 62

[INFO] i: 62 mission_id: 249 rul_hat: 15.65 flight_time: 14.83 distance: 1083.74 R0: 0.00427 Q: 13.63 Req: 0.27329

[INFO] success on i: 62 mission_id: 249

[INFO] forecasting degradation values: r_mu: 0.004783 q_mu: 14.178466 m_mu: 0.266839

[INFO] digital twin degradation parameters: 0.0048 14.2280 0.2614

[INFO] simulating digital twin on i: 62

[INFO] digital twin mission success on i: 62 mission_id: 249

[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65

[INFO] simulating true system on i: 63

Elapsed time is 165.814449 seconds.

[INFO] updating degradation parameter variance on i: 63

[INFO] updating degradation parameter values via random sampling on i: 63

[INFO] i: 63 mission_id: 250 rul_hat: 15.65 flight_time: 13.27 distance: 989.49 R0: 0.00495 Q: 14.05 Req: 0.26191

[INFO] success on i: 63 mission_id: 250

[INFO] forecasting degradation values: r_mu: 0.004775 q_mu: 13.651844 m_mu: 0.271304

[INFO] digital twin degradation parameters: 0.0052 13.6357 0.2842

[INFO] simulating digital twin on i: 63

[INFO] digital twin mission success on i: 63 mission_id: 250

[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65


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[INFO] simulating true system on i: 64
Elapsed time is 185.763247 seconds.
[INFO] updating degradation parameter variance on i: 64
[INFO] updating degradation parameter values via random sampling on i: 64
[INFO] i: 64 mission_id: 251 rul_hat: 15.65 flight_time: 13.47 distance: 994.70 R0: 0.00475 Q: 13.50 Req: 0.26770
[INFO] success on i: 64 mission_id: 251
[INFO] forecasting degradation values: r_mu: 0.005256 q_mu: 14.029339 m_mu: 0.263471
[INFO] digital twin degradation parameters: 0.0052 14.2232 0.2450
[INFO] simulating digital twin on i: 64
[INFO] digital twin mission success on i: 64 mission_id: 251
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 65
Elapsed time is 183.122039 seconds.
[INFO] updating degradation parameter variance on i: 65
[INFO] updating degradation parameter values via random sampling on i: 65
[INFO] i: 65 mission_id: 252 rul_hat: 15.65 flight_time: 13.47 distance: 994.81 R0: 0.00509 Q: 13.63 Req: 0.27626
[INFO] success on i: 65 mission_id: 252
[INFO] forecasting degradation values: r_mu: 0.005272 q_mu: 13.658782 m_mu: 0.262834
[INFO] digital twin degradation parameters: 0.0052 13.5613 0.2532
[INFO] simulating digital twin on i: 65
[INFO] digital twin mission success on i: 65 mission_id: 252
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 66
Elapsed time is 180.587598 seconds.
[INFO] updating degradation parameter variance on i: 66
[INFO] updating degradation parameter values via random sampling on i: 66
[INFO] i: 66 mission_id: 253 rul_hat: 15.65 flight_time: 13.58 distance: 1021.07 R0: 0.00569 Q: 13.39 Req: 0.30140
[INFO] success on i: 66 mission_id: 253
[INFO] forecasting degradation values: r_mu: 0.005401 q_mu: 13.450727 m_mu: 0.260431
[INFO] digital twin degradation parameters: 0.0053 13.5339 0.2526
[INFO] simulating digital twin on i: 66
[INFO] digital twin mission success on i: 66 mission_id: 253
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 67
Elapsed time is 181.566990 seconds.
[INFO] updating degradation parameter variance on i: 67
[INFO] updating degradation parameter values via random sampling on i: 67
[INFO] i: 67 mission_id: 254 rul_hat: 15.65 flight_time: 13.58 distance: 1021.09 R0: 0.00533 Q: 13.69 Req: 0.27129
[INFO] success on i: 67 mission_id: 254
[INFO] forecasting degradation values: r_mu: 0.006123 q_mu: 13.265077 m_mu: 0.292727
[INFO] digital twin degradation parameters: 0.0063 12.9958 0.2886
[INFO] simulating digital twin on i: 67
[INFO] digital twin mission success on i: 67 mission_id: 254
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 68
Elapsed time is 186.331097 seconds.
[INFO] updating degradation parameter variance on i: 68
[INFO] updating degradation parameter values via random sampling on i: 68
[INFO] i: 68 mission_id: 255 rul_hat: 15.65 flight_time: 13.94 distance: 1047.82 R0: 0.00581 Q: 13.69 Req: 0.26953
[INFO] success on i: 68 mission_id: 255
[INFO] forecasting degradation values: r_mu: 0.006309 q_mu: 13.143293 m_mu: 0.278765
[INFO] digital twin degradation parameters: 0.0058 12.8231 0.2953
[INFO] simulating digital twin on i: 68
[INFO] digital twin mission success on i: 68 mission_id: 255
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 69
Elapsed time is 182.051428 seconds.
[INFO] updating degradation parameter variance on i: 69
[INFO] updating degradation parameter values via random sampling on i: 69
[INFO] i: 69 mission_id: 256 rul_hat: 15.65 flight_time: 13.47 distance: 994.66 R0: 0.00533 Q: 13.39 Req: 0.28323
[INFO] success on i: 69 mission_id: 256
[INFO] forecasting degradation values: r_mu: 0.006505 q_mu: 13.395123 m_mu: 0.272700
[INFO] digital twin degradation parameters: 0.0066 13.3387 0.2673
[INFO] simulating digital twin on i: 69
[INFO] digital twin mission success on i: 69 mission_id: 256

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[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 70
Elapsed time is 179.926552 seconds.
[INFO] updating degradation parameter variance on i: 70
[INFO] updating degradation parameter values via random sampling on i: 70
[INFO] i: 70 mission_id: 257 rul_hat: 15.65 flight_time: 13.58 distance: 1020.99 R0: 0.00638 Q: 13.83 Req: 0.26396
[INFO] success on i: 70 mission_id: 257
[INFO] forecasting degradation values: r_mu: 0.006198 q_mu: 13.404083 m_mu: 0.284741
[INFO] digital twin degradation parameters: 0.0059 13.6616 0.2851
[INFO] simulating digital twin on i: 70
[INFO] digital twin mission success on i: 70 mission_id: 257
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 71
Elapsed time is 187.925715 seconds.
[INFO] updating degradation parameter variance on i: 71
[INFO] updating degradation parameter values via random sampling on i: 71
[INFO] i: 71 mission_id: 258 rul_hat: 15.65 flight_time: 13.94 distance: 1047.81 R0: 0.00680 Q: 13.46 Req: 0.28115
[INFO] success on i: 71 mission_id: 258
[INFO] forecasting degradation values: r_mu: 0.006627 q_mu: 13.543340 m_mu: 0.267804
[INFO] digital twin degradation parameters: 0.0061 13.4804 0.2829
[INFO] simulating digital twin on i: 71
[INFO] digital twin mission success on i: 71 mission_id: 258
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 72
Elapsed time is 184.577365 seconds.
[INFO] updating degradation parameter variance on i: 72
[INFO] updating degradation parameter values via random sampling on i: 72
[INFO] i: 72 mission_id: 259 rul_hat: 15.65 flight_time: 14.83 distance: 1083.74 R0: 0.00658 Q: 13.46 Req: 0.27872
[INFO] success on i: 72 mission_id: 259
[INFO] forecasting degradation values: r_mu: 0.007395 q_mu: 13.584705 m_mu: 0.277843
[INFO] digital twin degradation parameters: 0.0069 13.8964 0.2863
[INFO] simulating digital twin on i: 72
[INFO] digital twin mission success on i: 72 mission_id: 259
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 73
Elapsed time is 184.022324 seconds.
[INFO] updating degradation parameter variance on i: 73
[INFO] updating degradation parameter values via random sampling on i: 73
[INFO] i: 73 mission_id: 260 rul_hat: 15.65 flight_time: 14.83 distance: 1083.75 R0: 0.00696 Q: 13.65 Req: 0.27551
[INFO] success on i: 73 mission_id: 260
[INFO] forecasting degradation values: r_mu: 0.007318 q_mu: 13.451908 m_mu: 0.273291
[INFO] digital twin degradation parameters: 0.0073 13.3329 0.2617
[INFO] simulating digital twin on i: 73
[INFO] digital twin mission success on i: 73 mission_id: 260
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 74
Elapsed time is 186.616617 seconds.
[INFO] updating degradation parameter variance on i: 74
[INFO] updating degradation parameter values via random sampling on i: 74
[INFO] i: 74 mission_id: 261 rul_hat: 15.65 flight_time: 13.94 distance: 1047.88 R0: 0.00747 Q: 13.03 Req: 0.27868
[INFO] success on i: 74 mission_id: 261
[INFO] forecasting degradation values: r_mu: 0.007558 q_mu: 13.605071 m_mu: 0.267720
[INFO] digital twin degradation parameters: 0.0075 13.6551 0.2667
[INFO] simulating digital twin on i: 74
[INFO] digital twin mission success on i: 74 mission_id: 261
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 75
Elapsed time is 174.323358 seconds.
[INFO] updating degradation parameter variance on i: 75
[INFO] updating degradation parameter values via random sampling on i: 75
[INFO] i: 75 mission_id: 262 rul_hat: 15.65 flight_time: 13.27 distance: 989.62 R0: 0.00783 Q: 13.43 Req: 0.28135
[INFO] success on i: 75 mission_id: 262
[INFO] forecasting degradation values: r_mu: 0.008230 q_mu: 13.071072 m_mu: 0.281966
[INFO] digital twin degradation parameters: 0.0083 13.2851 0.2687
[INFO] simulating digital twin on i: 75

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[INFO] digital twin mission success on i: 75 mission_id: 262
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 76
Elapsed time is 186.578132 seconds.
[INFO] updating degradation parameter variance on i: 76
[INFO] updating degradation parameter values via random sampling on i: 76
[INFO] i: 76 mission_id: 263 rul_hat: 15.65 flight_time: 13.94 distance: 1047.80 R0: 0.00807 Q: 13.81 Req: 0.27069
[INFO] success on i: 76 mission_id: 263
[INFO] forecasting degradation values: r_mu: 0.008507 q_mu: 13.191046 m_mu: 0.285316
[INFO] digital twin degradation parameters: 0.0084 13.5657 0.2833
[INFO] simulating digital twin on i: 76
[INFO] digital twin mission success on i: 76 mission_id: 263
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 77
Elapsed time is 183.083556 seconds.
[INFO] updating degradation parameter variance on i: 77
[INFO] updating degradation parameter values via random sampling on i: 77
[INFO] i: 77 mission_id: 264 rul_hat: 15.65 flight_time: 13.58 distance: 1021.01 R0: 0.00810 Q: 13.17 Req: 0.28914
[INFO] success on i: 77 mission_id: 264
[INFO] forecasting degradation values: r_mu: 0.009184 q_mu: 13.623755 m_mu: 0.268447
[INFO] digital twin degradation parameters: 0.0087 13.5390 0.2621
[INFO] simulating digital twin on i: 77
[INFO] digital twin mission success on i: 77 mission_id: 264
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 78
Elapsed time is 184.619683 seconds.
[INFO] updating degradation parameter variance on i: 78
[INFO] updating degradation parameter values via random sampling on i: 78
[INFO] i: 78 mission_id: 265 rul_hat: 15.65 flight_time: 14.83 distance: 1083.79 R0: 0.00855 Q: 13.36 Req: 0.28316
[INFO] success on i: 78 mission_id: 265
[INFO] forecasting degradation values: r_mu: 0.009077 q_mu: 13.168437 m_mu: 0.291387
[INFO] digital twin degradation parameters: 0.0087 13.3305 0.2948
[INFO] simulating digital twin on i: 78
[INFO] digital twin mission success on i: 78 mission_id: 265
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 79
Elapsed time is 184.755026 seconds.
[INFO] updating degradation parameter variance on i: 79
[INFO] updating degradation parameter values via random sampling on i: 79
[INFO] i: 79 mission_id: 266 rul_hat: 15.65 flight_time: 13.94 distance: 1047.86 R0: 0.00910 Q: 13.15 Req: 0.27809
[INFO] success on i: 79 mission_id: 266
[INFO] forecasting degradation values: r_mu: 0.009317 q_mu: 13.303409 m_mu: 0.284168
[INFO] digital twin degradation parameters: 0.0092 13.1026 0.2893
[INFO] simulating digital twin on i: 79
[INFO] digital twin mission success on i: 79 mission_id: 266
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 80
Elapsed time is 186.086339 seconds.
[INFO] updating degradation parameter variance on i: 80
[INFO] updating degradation parameter values via random sampling on i: 80
[INFO] i: 80 mission_id: 267 rul_hat: 15.65 flight_time: 14.83 distance: 1083.84 R0: 0.00951 Q: 13.44 Req: 0.27841
[INFO] success on i: 80 mission_id: 267
[INFO] forecasting degradation values: r_mu: 0.010013 q_mu: 13.145287 m_mu: 0.285831
[INFO] digital twin degradation parameters: 0.0097 13.4933 0.2865
[INFO] simulating digital twin on i: 80
[INFO] digital twin mission success on i: 80 mission_id: 267
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 81
Elapsed time is 180.788375 seconds.
[INFO] updating degradation parameter variance on i: 81
[INFO] updating degradation parameter values via random sampling on i: 81
[INFO] i: 81 mission_id: 268 rul_hat: 15.65 flight_time: 13.47 distance: 994.73 R0: 0.00995 Q: 13.45 Req: 0.28755
[INFO] success on i: 81 mission_id: 268
[INFO] forecasting degradation values: r_mu: 0.010412 q_mu: 13.251130 m_mu: 0.278010
[INFO] digital twin degradation parameters: 0.0109 12.9777 0.2695

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[INFO] simulating digital twin on i: 81
[INFO] digital twin mission success on i: 81 mission_id: 268
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 82
Elapsed time is 181.209034 seconds.
[INFO] updating degradation parameter variance on i: 82
[INFO] updating degradation parameter values via random sampling on i: 82
[INFO] i: 82 mission_id: 269 rul_hat: 15.65 flight_time: 13.58 distance: 1021.05 R0: 0.01035 Q: 13.38 Req: 0.28859
[INFO] success on i: 82 mission_id: 269
[INFO] forecasting degradation values: r_mu: 0.010842 q_mu: 13.497106 m_mu: 0.286517
[INFO] digital twin degradation parameters: 0.0109 13.3531 0.2924
[INFO] simulating digital twin on i: 82
[INFO] digital twin mission success on i: 82 mission_id: 269
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 83
Elapsed time is 183.442040 seconds.
[INFO] updating degradation parameter variance on i: 83
[INFO] updating degradation parameter values via random sampling on i: 83
[INFO] i: 83 mission_id: 270 rul_hat: 15.65 flight_time: 13.94 distance: 1047.96 R0: 0.01073 Q: 13.25 Req: 0.29329
[INFO] success on i: 83 mission_id: 270
[INFO] forecasting degradation values: r_mu: 0.011343 q_mu: 13.357006 m_mu: 0.286444
[INFO] digital twin degradation parameters: 0.0115 12.9798 0.2892
[INFO] simulating digital twin on i: 83
[INFO] digital twin mission success on i: 83 mission_id: 270
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 84
Elapsed time is 177.172196 seconds.
[INFO] updating degradation parameter variance on i: 84
[INFO] updating degradation parameter values via random sampling on i: 84
[INFO] i: 84 mission_id: 271 rul_hat: 15.65 flight_time: 13.94 distance: 1047.81 R0: 0.01148 Q: 13.01 Req: 0.29254
[INFO] success on i: 84 mission_id: 271
[INFO] forecasting degradation values: r_mu: 0.011639 q_mu: 13.091772 m_mu: 0.299965
[INFO] digital twin degradation parameters: 0.0112 12.8053 0.2943
[INFO] simulating digital twin on i: 84
[INFO] digital twin mission success on i: 84 mission_id: 271
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 85
Elapsed time is 163.870170 seconds.
[INFO] updating degradation parameter variance on i: 85
[INFO] updating degradation parameter values via random sampling on i: 85
[INFO] i: 85 mission_id: 272 rul_hat: 15.65 flight_time: 13.27 distance: 989.81 R0: 0.01206 Q: 13.17 Req: 0.29458
[INFO] success on i: 85 mission_id: 272
[INFO] forecasting degradation values: r_mu: 0.012821 q_mu: 13.159039 m_mu: 0.294782
[INFO] digital twin degradation parameters: 0.0126 12.9009 0.2974
[INFO] simulating digital twin on i: 85
[INFO] digital twin mission success on i: 85 mission_id: 272
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 86
Elapsed time is 182.372114 seconds.
[INFO] updating degradation parameter variance on i: 86
[INFO] updating degradation parameter values via random sampling on i: 86
[INFO] i: 86 mission_id: 273 rul_hat: 15.65 flight_time: 13.94 distance: 1047.93 R0: 0.01255 Q: 12.71 Req: 0.28671
[INFO] success on i: 86 mission_id: 273
[INFO] forecasting degradation values: r_mu: 0.013439 q_mu: 13.070548 m_mu: 0.301963
[INFO] digital twin degradation parameters: 0.0134 12.6992 0.3004
[INFO] simulating digital twin on i: 86
[INFO] digital twin mission success on i: 86 mission_id: 273
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 87
Elapsed time is 178.818036 seconds.
[INFO] updating degradation parameter variance on i: 87
[INFO] updating degradation parameter values via random sampling on i: 87
[INFO] i: 87 mission_id: 274 rul_hat: 15.65 flight_time: 13.47 distance: 994.74 R0: 0.01311 Q: 13.13 Req: 0.28390
[INFO] success on i: 87 mission_id: 274
[INFO] forecasting degradation values: r_mu: 0.013979 q_mu: 12.620057 m_mu: 0.299031

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[INFO] digital twin degradation parameters: 0.0138 12.9960 0.3002
[INFO] simulating digital twin on i: 87
[INFO] digital twin mission success on i: 87 mission_id: 274
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 88
Elapsed time is 183.646388 seconds.
[INFO] updating degradation parameter variance on i: 88
[INFO] updating degradation parameter values via random sampling on i: 88
[INFO] i: 88 mission_id: 275 rul_hat: 15.65 flight_time: 14.83 distance: 1083.87 R0: 0.01355 Q: 13.10 Req: 0.29043
[INFO] success on i: 88 mission_id: 275
[INFO] forecasting degradation values: r_mu: 0.014635 q_mu: 12.934076 m_mu: 0.291410
[INFO] digital twin degradation parameters: 0.0147 12.9685 0.2876
[INFO] simulating digital twin on i: 88
[INFO] digital twin mission success on i: 88 mission_id: 275
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 89
Elapsed time is 183.370484 seconds.
[INFO] updating degradation parameter variance on i: 89
[INFO] updating degradation parameter values via random sampling on i: 89
[INFO] i: 89 mission_id: 276 rul_hat: 15.65 flight_time: 14.83 distance: 1083.81 R0: 0.01428 Q: 12.85 Req: 0.29263
[INFO] success on i: 89 mission_id: 276
[INFO] forecasting degradation values: r_mu: 0.015178 q_mu: 12.921679 m_mu: 0.288823
[INFO] digital twin degradation parameters: 0.0151 12.5505 0.2897
[INFO] simulating digital twin on i: 89
[INFO] digital twin mission success on i: 89 mission_id: 276
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 90
Elapsed time is 182.788418 seconds.
[INFO] updating degradation parameter variance on i: 90
[INFO] updating degradation parameter values via random sampling on i: 90
[INFO] i: 90 mission_id: 277 rul_hat: 15.65 flight_time: 13.94 distance: 1047.92 R0: 0.01499 Q: 12.85 Req: 0.29558
[INFO] success on i: 90 mission_id: 277
[INFO] forecasting degradation values: r_mu: 0.015904 q_mu: 12.719551 m_mu: 0.290088
[INFO] digital twin degradation parameters: 0.0160 12.7124 0.2942
[INFO] simulating digital twin on i: 90
[INFO] digital twin mission success on i: 90 mission_id: 277
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 91
Elapsed time is 163.538135 seconds.
[INFO] updating degradation parameter variance on i: 91
[INFO] updating degradation parameter values via random sampling on i: 91
[INFO] i: 91 mission_id: 278 rul_hat: 15.65 flight_time: 13.27 distance: 989.92 R0: 0.01559 Q: 12.59 Req: 0.30202
[INFO] success on i: 91 mission_id: 278
[INFO] forecasting degradation values: r_mu: 0.016675 q_mu: 12.735953 m_mu: 0.292907
[INFO] digital twin degradation parameters: 0.0168 12.7554 0.2957
[INFO] simulating digital twin on i: 91
[INFO] digital twin mission success on i: 91 mission_id: 278
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 92
Elapsed time is 176.710700 seconds.
[INFO] updating degradation parameter variance on i: 92
[INFO] updating degradation parameter values via random sampling on i: 92
[INFO] i: 92 mission_id: 279 rul_hat: 15.65 flight_time: 13.94 distance: 1047.91 R0: 0.01650 Q: 12.85 Req: 0.29203
[INFO] success on i: 92 mission_id: 279
[INFO] forecasting degradation values: r_mu: 0.017263 q_mu: 12.558708 m_mu: 0.300308
[INFO] digital twin degradation parameters: 0.0175 12.6101 0.2975
[INFO] simulating digital twin on i: 92
[INFO] digital twin mission success on i: 92 mission_id: 279
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 93
Elapsed time is 164.319626 seconds.
[INFO] updating degradation parameter variance on i: 93
[INFO] updating degradation parameter values via random sampling on i: 93
[INFO] i: 93 mission_id: 280 rul_hat: 15.65 flight_time: 13.27 distance: 989.71 R0: 0.01733 Q: 12.72 Req: 0.29902
[INFO] success on i: 93 mission_id: 280

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[INFO] forecasting degradation values: r_mu: 0.018235 q_mu: 12.525357 m_mu: 0.297929
[INFO] digital twin degradation parameters: 0.0183 12.5597 0.3023
[INFO] simulating digital twin on i: 93
[INFO] digital twin mission success on i: 93 mission_id: 280
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 94
Elapsed time is 173.658290 seconds.
[INFO] updating degradation parameter variance on i: 94
[INFO] updating degradation parameter values via random sampling on i: 94
[INFO] i: 94 mission_id: 281 rul_hat: 15.65 flight_time: 13.47 distance: 994.77 R0: 0.01810 Q: 12.87 Req: 0.30192
[INFO] success on i: 94 mission_id: 281
[INFO] forecasting degradation values: r_mu: 0.019212 q_mu: 12.650693 m_mu: 0.308383
[INFO] digital twin degradation parameters: 0.0193 12.6542 0.3014
[INFO] simulating digital twin on i: 94
[INFO] digital twin mission success on i: 94 mission_id: 281
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 95
Elapsed time is 163.061776 seconds.
[INFO] updating degradation parameter variance on i: 95
[INFO] updating degradation parameter values via random sampling on i: 95
[INFO] i: 95 mission_id: 282 rul_hat: 15.65 flight_time: 13.27 distance: 989.92 R0: 0.01907 Q: 12.60 Req: 0.29209
[INFO] success on i: 95 mission_id: 282
[INFO] forecasting degradation values: r_mu: 0.020148 q_mu: 12.573445 m_mu: 0.309887
[INFO] digital twin degradation parameters: 0.0201 12.1826 0.3022
[INFO] simulating digital twin on i: 95
[INFO] digital twin mission success on i: 95 mission_id: 282
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 96
Elapsed time is 178.610405 seconds.
[INFO] updating degradation parameter variance on i: 96
[INFO] updating degradation parameter values via random sampling on i: 96
[INFO] i: 96 mission_id: 283 rul_hat: 15.65 flight_time: 13.47 distance: 994.64 R0: 0.01988 Q: 12.86 Req: 0.29056
[INFO] success on i: 96 mission_id: 283
[INFO] forecasting degradation values: r_mu: 0.021316 q_mu: 12.508513 m_mu: 0.298551
[INFO] digital twin degradation parameters: 0.0214 12.5882 0.3034
[INFO] simulating digital twin on i: 96
[INFO] digital twin mission success on i: 96 mission_id: 283
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 97
Elapsed time is 163.988181 seconds.
[INFO] updating degradation parameter variance on i: 97
[INFO] updating degradation parameter values via random sampling on i: 97
[INFO] i: 97 mission_id: 284 rul_hat: 15.65 flight_time: 13.27 distance: 989.86 R0: 0.02087 Q: 12.39 Req: 0.29779
[INFO] success on i: 97 mission_id: 284
[INFO] forecasting degradation values: r_mu: 0.022236 q_mu: 12.743866 m_mu: 0.292583
[INFO] digital twin degradation parameters: 0.0224 12.4714 0.2772
[INFO] simulating digital twin on i: 97
[INFO] digital twin mission success on i: 97 mission_id: 284
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 98
Elapsed time is 164.104614 seconds.
[INFO] updating degradation parameter variance on i: 98
[INFO] updating degradation parameter values via random sampling on i: 98
[INFO] i: 98 mission_id: 285 rul_hat: 15.65 flight_time: 13.27 distance: 989.90 R0: 0.02177 Q: 12.33 Req: 0.29307
[INFO] success on i: 98 mission_id: 285
[INFO] forecasting degradation values: r_mu: 0.023288 q_mu: 12.491698 m_mu: 0.293609
[INFO] digital twin degradation parameters: 0.0233 12.6582 0.2853
[INFO] simulating digital twin on i: 98
[INFO] digital twin mission success on i: 98 mission_id: 285
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 99
Bumping sigmax
Elapsed time is 180.328302 seconds.
[INFO] updating degradation parameter variance on i: 99
[INFO] updating degradation parameter values via random sampling on i: 99

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[INFO] i: 99 mission_id: 286 rul_hat: 15.65 flight_time: 13.58 distance: 1021.13 R0: 0.02277 Q: 12.60 Req: 0.31091
[INFO] success on i: 99 mission_id: 286
[INFO] forecasting degradation values: r_mu: 0.024349 q_mu: 12.322702 m_mu: 0.290544
[INFO] digital twin degradation parameters: 0.0242 11.9875 0.2855
[INFO] simulating digital twin on i: 99
[INFO] digital twin mission success on i: 99 mission_id: 286
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 100
Bumping sigma_x
Elapsed time is 182.217702 seconds.
[INFO] updating degradation parameter variance on i: 100
[INFO] updating degradation parameter values via random sampling on i: 100
[INFO] i: 100 mission_id: 287 rul_hat: 15.65 flight_time: 14.83 distance: 1084.12 R0: 0.02360 Q: 12.41 Req: 0.30198
[INFO] success on i: 100 mission_id: 287
[INFO] forecasting degradation values: r_mu: 0.025357 q_mu: 12.287569 m_mu: 0.307429
[INFO] digital twin degradation parameters: 0.0254 12.8000 0.3041
[INFO] simulating digital twin on i: 100
[INFO] digital twin mission success on i: 100 mission_id: 287
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 101
Bumping sigma_x
Elapsed time is 182.808346 seconds.
[INFO] updating degradation parameter variance on i: 101
[INFO] updating degradation parameter values via random sampling on i: 101
[INFO] i: 101 mission_id: 288 rul_hat: 15.65 flight_time: 14.83 distance: 1083.75 R0: 0.02494 Q: 12.53 Req: 0.29358
[INFO] success on i: 101 mission_id: 288
[INFO] forecasting degradation values: r_mu: 0.026325 q_mu: 12.235541 m_mu: 0.302360
[INFO] digital twin degradation parameters: 0.0263 12.3734 0.2987
[INFO] simulating digital twin on i: 101
[INFO] digital twin mission success on i: 101 mission_id: 288
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 102
Bumping sigma_x
Elapsed time is 163.776188 seconds.
[INFO] updating degradation parameter variance on i: 102
[INFO] updating degradation parameter values via random sampling on i: 102
[INFO] i: 102 mission_id: 289 rul_hat: 15.65 flight_time: 13.27 distance: 989.80 R0: 0.02543 Q: 12.72 Req: 0.30255
[INFO] success on i: 102 mission_id: 289
[INFO] forecasting degradation values: r_mu: 0.027708 q_mu: 12.256394 m_mu: 0.299328
[INFO] digital twin degradation parameters: 0.0278 11.8923 0.2945
[INFO] simulating digital twin on i: 102
[INFO] digital twin mission success on i: 102 mission_id: 289
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 103
Bumping sigma_x
Elapsed time is 176.275123 seconds.
[INFO] updating degradation parameter variance on i: 103
[INFO] updating degradation parameter values via random sampling on i: 103
[INFO] i: 103 mission_id: 290 rul_hat: 15.65 flight_time: 13.93 distance: 1047.75 R0: 0.02664 Q: 12.62 Req: 0.30993
[INFO] success on i: 103 mission_id: 290
[INFO] forecasting degradation values: r_mu: 0.028180 q_mu: 12.550788 m_mu: 0.306922
[INFO] digital twin degradation parameters: 0.0281 12.1666 0.3059
[INFO] simulating digital twin on i: 103
[INFO] digital twin mission success on i: 103 mission_id: 290
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 104
Bumping sigma_x
Elapsed time is 166.524356 seconds.
[INFO] updating degradation parameter variance on i: 104
[INFO] updating degradation parameter values via random sampling on i: 104
[INFO] i: 104 mission_id: 291 rul_hat: 15.65 flight_time: 13.47 distance: 994.82 R0: 0.02764 Q: 11.76 Req: 0.30220
[INFO] success on i: 104 mission_id: 291
[INFO] forecasting degradation values: r_mu: 0.029089 q_mu: 12.582571 m_mu: 0.314518
[INFO] digital twin degradation parameters: 0.0290 13.0191 0.3100
[INFO] simulating digital twin on i: 104

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[INFO] digital twin mission success on i: 104 mission_id: 291
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 105
Bumping sigma_max
Elapsed time is 163.412229 seconds.
[INFO] updating degradation parameter variance on i: 105
[INFO] updating degradation parameter values via random sampling on i: 105
[INFO] i: 105 mission_id: 292 rul_hat: 15.65 flight_time: 13.27 distance: 989.87 R0: 0.02865 Q: 12.30 Req: 0.30914
[INFO] success on i: 105 mission_id: 292
[INFO] forecasting degradation values: r_mu: 0.030358 q_mu: 12.074748 m_mu: 0.308084
[INFO] digital twin degradation parameters: 0.0303 12.3908 0.3076
[INFO] simulating digital twin on i: 105
[INFO] digital twin mission success on i: 105 mission_id: 292
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 106
Bumping sigma_max
Elapsed time is 172.818400 seconds.
[INFO] updating degradation parameter variance on i: 106
[INFO] updating degradation parameter values via random sampling on i: 106
[INFO] i: 106 mission_id: 293 rul_hat: 15.65 flight_time: 13.93 distance: 1047.96 R0: 0.02964 Q: 12.57 Req: 0.29853
[INFO] success on i: 106 mission_id: 293
[INFO] forecasting degradation values: r_mu: 0.031490 q_mu: 12.484126 m_mu: 0.311179
[INFO] digital twin degradation parameters: 0.0315 12.4753 0.3123
[INFO] simulating digital twin on i: 106
[INFO] digital twin mission success on i: 106 mission_id: 293
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 107
Bumping sigma_max
Elapsed time is 177.889675 seconds.
[INFO] updating degradation parameter variance on i: 107
[INFO] updating degradation parameter values via random sampling on i: 107
[INFO] i: 107 mission_id: 294 rul_hat: 15.65 flight_time: 13.47 distance: 994.70 R0: 0.03077 Q: 12.61 Req: 0.30555
[INFO] success on i: 107 mission_id: 294
[INFO] forecasting degradation values: r_mu: 0.032580 q_mu: 12.468268 m_mu: 0.301113
[INFO] digital twin degradation parameters: 0.0326 12.4573 0.3019
[INFO] simulating digital twin on i: 107
[INFO] digital twin mission success on i: 107 mission_id: 294
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 108
Bumping sigma_max
Elapsed time is 162.855357 seconds.
[INFO] updating degradation parameter variance on i: 108
[INFO] updating degradation parameter values via random sampling on i: 108
[INFO] i: 108 mission_id: 295 rul_hat: 15.65 flight_time: 13.27 distance: 989.95 R0: 0.03195 Q: 11.96 Req: 0.30603
[INFO] success on i: 108 mission_id: 295
[INFO] forecasting degradation values: r_mu: 0.033816 q_mu: 12.505346 m_mu: 0.307673
[INFO] digital twin degradation parameters: 0.0340 12.8512 0.3080
[INFO] simulating digital twin on i: 108
[INFO] digital twin mission success on i: 108 mission_id: 295
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 109
Bumping sigma_max
Elapsed time is 163.065865 seconds.
[INFO] updating degradation parameter variance on i: 109
[INFO] updating degradation parameter values via random sampling on i: 109
[INFO] i: 109 mission_id: 296 rul_hat: 15.65 flight_time: 13.27 distance: 989.95 R0: 0.03320 Q: 12.27 Req: 0.30525
[INFO] success on i: 109 mission_id: 296
[INFO] forecasting degradation values: r_mu: 0.034768 q_mu: 12.029599 m_mu: 0.309858
[INFO] digital twin degradation parameters: 0.0348 12.2260 0.3182
[INFO] simulating digital twin on i: 109
[INFO] digital twin mission success on i: 109 mission_id: 296
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 110
Bumping sigma_max
Elapsed time is 182.669942 seconds.

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[INFO] updating degradation parameter variance on i: 110
[INFO] updating degradation parameter values via random sampling on i: 110
[INFO] i: 110 mission_id: 297 rul_hat: 15.65 flight_time: 14.83 distance: 1083.97 R0: 0.03453 Q: 11.60 Req: 0.31425
[INFO] success on i: 110 mission_id: 297
[INFO] forecasting degradation values: r_mu: 0.036352 q_mu: 12.108880 m_mu: 0.305108
[INFO] digital twin degradation parameters: 0.0362 12.1884 0.3119
[INFO] simulating digital twin on i: 110
[INFO] digital twin mission success on i: 110 mission_id: 297
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 111
Bumping sigma_x
Elapsed time is 165.941269 seconds.
[INFO] updating degradation parameter variance on i: 111
[INFO] updating degradation parameter values via random sampling on i: 111
[INFO] i: 111 mission_id: 298 rul_hat: 15.65 flight_time: 13.28 distance: 980.02 R0: 0.03566 Q: 11.93 Req: 0.32040
[INFO] true system position error threshold exceeded on i: 111 mission_id: 298
[INFO] forecasting degradation values: r_mu: 0.037672 q_mu: 11.719351 m_mu: 0.310042
[INFO] digital twin degradation parameters: 0.0376 11.9496 0.3081
[INFO] simulating digital twin on i: 111
[INFO] digital twin mission success on i: 111 mission_id: 298
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 112
Bumping sigma_x
Elapsed time is 165.017812 seconds.
[INFO] updating degradation parameter variance on i: 112
[INFO] updating degradation parameter values via random sampling on i: 112
[INFO] i: 112 mission_id: 299 rul_hat: 15.65 flight_time: 13.27 distance: 977.18 R0: 0.03693 Q: 12.37 Req: 0.31384
[INFO] true system position error threshold exceeded on i: 112 mission_id: 299
[INFO] forecasting degradation values: r_mu: 0.038986 q_mu: 11.868669 m_mu: 0.323702
[INFO] digital twin degradation parameters: 0.0391 11.7889 0.3228
[INFO] simulating digital twin on i: 112
[INFO] digital twin mission success on i: 112 mission_id: 299
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 113
Bumping sigma_x
Elapsed time is 166.269152 seconds.
[INFO] updating degradation parameter variance on i: 113
[INFO] updating degradation parameter values via random sampling on i: 113
[INFO] i: 113 mission_id: 300 rul_hat: 15.65 flight_time: 13.30 distance: 982.78 R0: 0.03835 Q: 11.67 Req: 0.31580
[INFO] true system position error threshold exceeded on i: 113 mission_id: 300
[INFO] forecasting degradation values: r_mu: 0.040434 q_mu: 11.842256 m_mu: 0.321298
[INFO] digital twin degradation parameters: 0.0405 11.9733 0.3165
[INFO] simulating digital twin on i: 113
[INFO] digital twin mission success on i: 113 mission_id: 300
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 114
Bumping sigma_x
Elapsed time is 165.712062 seconds.
[INFO] updating degradation parameter variance on i: 114
[INFO] updating degradation parameter values via random sampling on i: 114
[INFO] i: 114 mission_id: 301 rul_hat: 15.65 flight_time: 13.28 distance: 979.94 R0: 0.03936 Q: 11.95 Req: 0.31454
[INFO] true system position error threshold exceeded on i: 114 mission_id: 301
[INFO] forecasting degradation values: r_mu: 0.041948 q_mu: 11.469450 m_mu: 0.325843
[INFO] digital twin degradation parameters: 0.0418 11.1881 0.3333
[INFO] simulating digital twin on i: 114
[INFO] digital twin mission success on i: 114 mission_id: 301
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 115
Bumping sigma_x
Elapsed time is 166.533617 seconds.
[INFO] updating degradation parameter variance on i: 115
[INFO] updating degradation parameter values via random sampling on i: 115
[INFO] i: 115 mission_id: 302 rul_hat: 15.65 flight_time: 13.30 distance: 982.75 R0: 0.04056 Q: 11.17 Req: 0.31211
[INFO] true system position error threshold exceeded on i: 115 mission_id: 302
[INFO] forecasting degradation values: r_mu: 0.043069 q_mu: 11.603248 m_mu: 0.321042

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[INFO] digital twin degradation parameters: 0.0430 11.5417 0.3095
[INFO] simulating digital twin on i: 115
[INFO] digital twin mission success on i: 115 mission_id: 302
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 116
Bumping sigma_max
Elapsed time is 173.139292 seconds.
[INFO] updating degradation parameter variance on i: 116
[INFO] updating degradation parameter values via random sampling on i: 116
[INFO] i: 116 mission_id: 303 rul_hat: 15.65 flight_time: 13.93 distance: 1047.73 R0: 0.04221 Q: 11.55 Req: 0.32135
[INFO] success on i: 116 mission_id: 303
[INFO] forecasting degradation values: r_mu: 0.044285 q_mu: 11.317093 m_mu: 0.317617
[INFO] digital twin degradation parameters: 0.0442 11.3875 0.3155
[INFO] simulating digital twin on i: 116
[INFO] digital twin mission success on i: 116 mission_id: 303
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 117
Bumping sigma_max
Elapsed time is 165.410106 seconds.
[INFO] updating degradation parameter variance on i: 117
[INFO] updating degradation parameter values via random sampling on i: 117
[INFO] i: 117 mission_id: 304 rul_hat: 15.65 flight_time: 13.27 distance: 977.15 R0: 0.04340 Q: 11.76 Req: 0.31014
[INFO] true system position error threshold exceeded on i: 117 mission_id: 304
[INFO] forecasting degradation values: r_mu: 0.045848 q_mu: 11.213804 m_mu: 0.322247
[INFO] digital twin degradation parameters: 0.0459 11.3415 0.3170
[INFO] simulating digital twin on i: 117
[INFO] digital twin mission success on i: 117 mission_id: 304
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 118
Bumping sigma_max
Elapsed time is 166.980189 seconds.
[INFO] updating degradation parameter variance on i: 118
[INFO] updating degradation parameter values via random sampling on i: 118
[INFO] i: 118 mission_id: 305 rul_hat: 15.65 flight_time: 13.30 distance: 982.69 R0: 0.04496 Q: 11.07 Req: 0.31657
[INFO] true system position error threshold exceeded on i: 118 mission_id: 305
[INFO] forecasting degradation values: r_mu: 0.047135 q_mu: 11.498519 m_mu: 0.310957
[INFO] digital twin degradation parameters: 0.0472 11.3095 0.3090
[INFO] simulating digital twin on i: 118
[INFO] digital twin mission success on i: 118 mission_id: 305
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 119
Bumping sigma_max
Elapsed time is 166.264352 seconds.
[INFO] updating degradation parameter variance on i: 119
[INFO] updating degradation parameter values via random sampling on i: 119
[INFO] i: 119 mission_id: 306 rul_hat: 15.65 flight_time: 13.28 distance: 980.00 R0: 0.04666 Q: 11.26 Req: 0.31943
[INFO] true system position error threshold exceeded on i: 119 mission_id: 306
[INFO] forecasting degradation values: r_mu: 0.048723 q_mu: 10.892091 m_mu: 0.312785
[INFO] digital twin degradation parameters: 0.0486 10.7611 0.3062
[INFO] simulating digital twin on i: 119
[INFO] digital twin mission success on i: 119 mission_id: 306
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 120
Bumping sigma_max
Elapsed time is 171.445576 seconds.
[INFO] updating degradation parameter variance on i: 120
[INFO] updating degradation parameter values via random sampling on i: 120
[INFO] i: 120 mission_id: 307 rul_hat: 15.65 flight_time: 13.93 distance: 1047.95 R0: 0.04785 Q: 10.68 Req: 0.31792
[INFO] success on i: 120 mission_id: 307
[INFO] forecasting degradation values: r_mu: 0.050463 q_mu: 10.732533 m_mu: 0.316184
[INFO] digital twin degradation parameters: 0.0503 10.4082 0.3204
[INFO] simulating digital twin on i: 120
[INFO] digital twin mission success on i: 120 mission_id: 307
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 121

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Bumping sigmax
Elapsed time is 164.180995 seconds.
[INFO] updating degradation parameter variance on i: 121
[INFO] updating degradation parameter values via random sampling on i: 121
[INFO] i: 121 mission_id: 308 rul_hat: 15.65 flight_time: 13.28 distance: 986.87 R0: 0.04963 Q: 11.12 Req: 0.32796
[INFO] true system low soc threshold exceeded on i: 121 mission_id: 308
[INFO] forecasting degradation values: r_mu: 0.051989 q_mu: 10.547562 m_mu: 0.318038
[INFO] digital twin degradation parameters: 0.0518 10.6702 0.3191
[INFO] simulating digital twin on i: 121
[INFO] digital twin mission success on i: 121 mission_id: 308
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 15.65
[INFO] simulating true system on i: 122
Bumping sigmax
Elapsed time is 165.264598 seconds.
[INFO] updating degradation parameter variance on i: 122
[INFO] updating degradation parameter values via random sampling on i: 122
[INFO] i: 122 mission_id: 309 rul_hat: 15.65 flight_time: 13.25 distance: 974.45 R0: 0.05141 Q: 11.24 Req: 0.33086
[INFO] true system position error threshold exceeded on i: 122 mission_id: 309
[INFO] forecasting degradation values: r_mu: 0.053875 q_mu: 10.578642 m_mu: 0.327931
[INFO] digital twin degradation parameters: 0.0541 10.7224 0.3212
[INFO] simulating digital twin on i: 122
[INFO] digital twin low soc threshold exceeded on i: 122 mission_id: 309
[INFO] updating RUL from 15.65 to 13.36
[INFO] selecting trajectory: <5> with path_time: 13.30 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 123
Bumping sigmax
Elapsed time is 164.159045 seconds.
[INFO] updating degradation parameter variance on i: 123
[INFO] updating degradation parameter values via random sampling on i: 123
[INFO] i: 123 mission_id: 310 rul_hat: 13.36 flight_time: 13.29 distance: 994.81 R0: 0.05278 Q: 10.96 Req: 0.32746
[INFO] success on i: 123 mission_id: 310
[INFO] forecasting degradation values: r_mu: 0.055774 q_mu: 10.921860 m_mu: 0.337806
[INFO] digital twin degradation parameters: 0.0557 11.1284 0.3340
[INFO] simulating digital twin on i: 123
[INFO] digital twin mission success on i: 123 mission_id: 310
[INFO] selecting trajectory: <5> with path_time: 13.30 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 124
Bumping sigmax
Elapsed time is 163.823867 seconds.
[INFO] updating degradation parameter variance on i: 124
[INFO] updating degradation parameter values via random sampling on i: 124
[INFO] i: 124 mission_id: 311 rul_hat: 13.36 flight_time: 13.30 distance: 994.91 R0: 0.05475 Q: 11.08 Req: 0.32325
[INFO] success on i: 124 mission_id: 311
[INFO] forecasting degradation values: r_mu: 0.057365 q_mu: 10.658258 m_mu: 0.334268
[INFO] digital twin degradation parameters: 0.0575 10.6950 0.3374
[INFO] simulating digital twin on i: 124
[INFO] digital twin mission success on i: 124 mission_id: 311
[INFO] selecting trajectory: <16> with path_time: 6.38 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 125
Bumping sigmax
Elapsed time is 80.641679 seconds.
[INFO] updating degradation parameter variance on i: 125
[INFO] updating degradation parameter values via random sampling on i: 125
[INFO] i: 125 mission_id: 312 rul_hat: 13.36 flight_time: 6.37 distance: 481.41 R0: 0.05671 Q: 10.63 Req: 0.33319
[INFO] success on i: 125 mission_id: 312
[INFO] forecasting degradation values: r_mu: 0.059369 q_mu: 10.737659 m_mu: 0.335831
[INFO] digital twin degradation parameters: 0.0593 10.8751 0.3403
[INFO] simulating digital twin on i: 125
[INFO] digital twin mission success on i: 125 mission_id: 312
[INFO] selecting trajectory: <4> with path_time: 12.49 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 126
Bumping sigmax
Elapsed time is 153.397986 seconds.
[INFO] updating degradation parameter variance on i: 126
[INFO] updating degradation parameter values via random sampling on i: 126

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[INFO] i: 126 mission_id: 313 rul_hat: 13.36 flight_time: 12.47 distance: 929.31 R0: 0.05811 Q: 10.98 Req: 0.32815
[INFO] success on i: 126 mission_id: 313
[INFO] forecasting degradation values: r_mu: 0.061400 q_mu: 10.721639 m_mu: 0.338443
[INFO] digital twin degradation parameters: 0.0613 10.4886 0.3420
[INFO] simulating digital twin on i: 126
[INFO] digital twin mission success on i: 126 mission_id: 313
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 127
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Elapsed time is 81.887274 seconds.
[INFO] updating degradation parameter variance on i: 127
[INFO] updating degradation parameter values via random sampling on i: 127
[INFO] i: 127 mission_id: 314 rul_hat: 13.36 flight_time: 6.42 distance: 479.12 R0: 0.06039 Q: 10.46 Req: 0.32686
[INFO] true system position error threshold exceeded on i: 127 mission_id: 314
[INFO] forecasting degradation values: r_mu: 0.063145 q_mu: 10.774522 m_mu: 0.334967
[INFO] digital twin degradation parameters: 0.0632 11.2381 0.3279
[INFO] simulating digital twin on i: 127
[INFO] digital twin mission success on i: 127 mission_id: 314
[INFO] selecting trajectory: <4> with path_time: 12.49 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 128
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Elapsed time is 122.720032 seconds.
[INFO] updating degradation parameter variance on i: 128
[INFO] updating degradation parameter values via random sampling on i: 128
[INFO] i: 128 mission_id: 315 rul_hat: 13.36 flight_time: 9.76 distance: 657.31 R0: 0.06243 Q: 10.88 Req: 0.34173
[INFO] true system position error threshold exceeded on i: 128 mission_id: 315
[INFO] forecasting degradation values: r_mu: 0.065484 q_mu: 10.572201 m_mu: 0.331795
[INFO] digital twin degradation parameters: 0.0655 10.3653 0.3329
[INFO] simulating digital twin on i: 128
[INFO] digital twin mission success on i: 128 mission_id: 315
[INFO] selecting trajectory: <18> with path_time: 11.78 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 129
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Elapsed time is 27.220484 seconds.
[INFO] updating degradation parameter variance on i: 129
[INFO] updating degradation parameter values via random sampling on i: 129
[INFO] i: 129 mission_id: 316 rul_hat: 13.36 flight_time: 1.86 distance: 172.87 R0: 0.06413 Q: 10.39 Req: 0.33010
[INFO] true system position error threshold exceeded on i: 129 mission_id: 316
[INFO] forecasting degradation values: r_mu: 0.067723 q_mu: 10.489007 m_mu: 0.337610
[INFO] digital twin degradation parameters: 0.0675 10.5460 0.3310
[INFO] simulating digital twin on i: 129
[INFO] digital twin mission success on i: 129 mission_id: 316
[INFO] selecting trajectory: <16> with path_time: 6.38 that meets constraint: path_time < 13.36
[INFO] simulating true system on i: 130
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Elapsed time is 28.041254 seconds.
[INFO] updating degradation parameter variance on i: 130
[INFO] updating degradation parameter values via random sampling on i: 130
[INFO] i: 130 mission_id: 317 rul_hat: 13.36 flight_time: 1.88 distance: 168.33 R0: 0.06672 Q: 10.77 Req: 0.33867
[INFO] true system position error threshold exceeded on i: 130 mission_id: 317
[INFO] forecasting degradation values: r_mu: 0.069641 q_mu: 10.209511 m_mu: 0.334513
[INFO] digital twin degradation parameters: 0.0697 10.0922 0.3309
[INFO] simulating digital twin on i: 130
[INFO] digital twin mission success on i: 130 mission_id: 317
[INFO] selecting trajectory: <5> with path_time: 13.30 that meets constraint: path_time < 13.36

```

```

[INFO] simulating true system on i: 131
Bumping sigmax
Bumping sigmax
Bumping sigmax
Bumping sigmax
Bumping sigmax
Bumping sigmax
Elapsed time is 28.317346 seconds.
[INFO] updating degradation parameter variance on i: 131
[INFO] updating degradation parameter values via random sampling on i: 131
[INFO] i: 131 mission_id: 318 rul_hat: 13.36 flight_time: 1.93 distance: 155.86 R0: 0.06901 Q: 10.48 Req: 0.33795
[INFO] true system position error threshold exceeded on i: 131 mission_id: 318
[INFO] forecasting degradation values: r_mu: 0.072393 q_mu: 10.426656 m_mu: 0.341545
[INFO] digital twin degradation parameters: 0.0725 9.6440 0.3354
[INFO] simulating digital twin on i: 131
[INFO] digital twin position error threshold exceeded on i: 131 mission_id: 318
[INFO] updating RUL from 13.36 to 1.83
[INFO] digital twin rul_hat: 1.83 does not meet the threshold: 10.00 on i,mission 131,318 with fail_count 1
[INFO] selecting trajectory: <7> with path_time: 0.91 that meets constraint: path_time < 1.83
[INFO] simulating true system on i: 132
Bumping sigmax
Elapsed time is 14.915951 seconds.
[INFO] updating degradation parameter variance on i: 132
[INFO] updating degradation parameter values via random sampling on i: 132
[INFO] i: 132 mission_id: 319 rul_hat: 1.83 flight_time: 0.91 distance: 69.53 R0: 0.07074 Q: 10.65 Req: 0.34264
[INFO] success on i: 132 mission_id: 319
[INFO] forecasting degradation values: r_mu: 0.074809 q_mu: 10.333410 m_mu: 0.344113
[INFO] digital twin degradation parameters: 0.0747 10.7022 0.3407
[INFO] simulating digital twin on i: 132
[INFO] digital twin position error threshold exceeded on i: 132 mission_id: 319
[INFO] updating RUL from 1.83 to -0.38
[INFO] digital twin rul_hat: -0.38 does not meet the threshold: 10.00 on i,mission 132,319 with fail_count 2
[INFO] returning empty table
[INFO] no more valid trajectories. ending simulation.

```

***** end of simulation code

```
sprintf("[INFO] digital twin degradation parameters: %.4f\t%.4f\t%.4f", batterytwin.R0, battery
```

```
ans =
"[INFO] digital twin degradation parameters: 0.0747 10.7022 0.3407"
```

```
write_degradation_data;
```

now simulate digital twin

```
load_trajectory;
```

```
[INFO] returning empty table
```

```

sys = "DigitalTwin";
octomodel.sampletime = twin_sample_rate;
for twin_ctr=1:twin_count
    sprintf('[INFO] simulating digital twin on mission: %d', i)
    out = sim('digitaltwin1c.slx');
    % get the output from each parallel worker
    times(twin_ctr) = flight_time.Data(end);
    vs(twin_ctr) = battery_actual.Data(end, 1);
    socs(twin_ctr) = battery_actual.Data(end, 2);
    r0s(twin_ctr) = battery_actual.Data(end, 3);

```

```

qs(twin_ctr) = battery_actual.Data(end, 6);
ms(twin_ctr) = motors.Data(end, 1);
errs(twin_ctr) = mean(euclidean_pos_err);
dist(twin_ctr) = calculatedistance([pos_actual.Data(:,1) pos_actual.Data(:,2)]);
degs(:, twin_ctr) = [batterytwin.R0 batterytwin.Q Motortwin2.Req]';

% resample the degradation parameters if more than one digital twin
% simulation
if twin_count > 1
    if i > lookback
        disp(['[INFO] using forecast degradation values']);
        batterytwin.R0 = normrnd(r_mu, r_var);
        batterytwin.Q = normrnd(q_mu, q_var);
        Motortwin2.Req = normrnd(m_mu, m_var);
    else
        batterytwin.R0 = max(abs(normrnd(rdeg(i), r_var)), .00075);
        batterytwin.Q = min(abs(normrnd(qdeg(i), q_var)), 15.5);
        Motortwin2.Req = max(abs(normrnd(mdeg(i), m_var)), .001);
    end
end
end

```

```

ans =
'[INFO] simulating digital twin on mission: 133'
Error due to multiple causes.

```

Caused by:

```

Error using experiment2 (line 252)
Invalid setting in 'digitaltwin1c/Constant4' for parameter 'Value'.
    Error using experiment2 (line 252)
    Error evaluating parameter 'Value' in 'digitaltwin1c/Constant4'
        Error using experiment2 (line 252)
        Unrecognized table variable name 'waypoints'.
Error using experiment2 (line 252)
Invalid setting in 'digitaltwin1c/From Workspace' for parameter 'VariableName'.
    Error using experiment2 (line 252)
    Error evaluating parameter 'VariableName' in 'digitaltwin1c/From Workspace'
        Error using experiment2 (line 252)
        Unrecognized table variable name 'x_ref_points'.
Error using experiment2 (line 252)
Invalid setting in 'digitaltwin1c/From Workspace1' for parameter 'VariableName'.
    Error using experiment2 (line 252)
    Error evaluating parameter 'VariableName' in 'digitaltwin1c/From Workspace1'
        Error using experiment2 (line 252)
        Unrecognized table variable name 'y_ref_points'.
Error using experiment2 (line 252)
Invalid setting in 'digitaltwin1c/From Workspace2' for parameter 'VariableName'.
    Error using experiment2 (line 252)
    Error evaluating parameter 'VariableName' in 'digitaltwin1c/From Workspace2'
        Error using experiment2 (line 252)
        Unrecognized table variable name 'x_ref_points'.
Error using experiment2 (line 252)
Invalid setting in 'digitaltwin1c/From Workspace3' for parameter 'VariableName'.
    Error using experiment2 (line 252)
    Error evaluating parameter 'VariableName' in 'digitaltwin1c/From Workspace3'
        Error using experiment2 (line 252)
        Unrecognized table variable name 'y_ref_points'.

```

do some checks on when to stop the simulation

```
if any(stop_code.Data(:,1)) == 1
    fprintf('[INFO] digital twin low soc threshold exceeded on mission %d\n', i)
    fprintf('[INFO] updating RUL from %.2f to %.2f', rul_hat, min(mean(times(:)) - 1, rul_init))
    rul_hat = min(mean(times(:)) - 1, rul_init); % rul is now 1 minute less than the digital twin
end

if any(stop_code.Data(:,2)) == 1
    fprintf('[INFO] digital twin position error threshold exceeded on mission %d\n', i)
    fprintf('[INFO] updating RUL from %.2f to %.2f', rul_hat, min(mean(times(:)) - 1, rul_init))
    rul_hat = min(mean(times(:)) - 1, rul_init); % rul is now 1 minute less than the digital twin
end

if any(stop_code.Data(:,3)) == 1 && ~any(stop_code.Data(:,1)) == 1 && ~any(stop_code.Data(:,2)) == 1
    fprintf('[INFO] digital twin mission success on %d\n', i)
    if mean(times(:)) - 1 > rul_hat
        fprintf('[INFO] new RUL update is available, %.2f replaces %.2f\n', mean(times(:)) - 1, rul_hat)
        rul_hat = mean(times(:)) - 1;
    end
end

% otherwise, end of life was never reached so the current rul estimate
% is the best estimate

if rul_hat <= rul_threshold
    fprintf('[INFO] digital twin rul_hat: %.2f does not meet the threshold: %.2f on mission %d\n', rul_hat, rul_threshold, i)
end

clear('trajectory', 'battery_actual', 'battery_observed', 'ctrl_err', 'current', 'current_rul')
```

test sim digital twin (for testing)

```
i = 1;
sys = "DigitalTwin";
octomodel.sampletime = true_sample_rate;
sprintf('[INFO] simulating digital twin on mission: %d', i);
tic
sim('digitaltwin1c.slx');
toc
```

```
clear('trajectory', 'battery_actual', 'battery_observed', 'ctrl_err', 'current', 'current_rul')
```

test sim true system (for testing)

```
i = 1;
sys = "TrueSystem";
octomodel.sampletime = true_sample_rate;
```

```
sprintf('[INFO] simulating true system on mission: %d', i);  
tic  
sim('truesystem.slx');  
toc
```