
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_time <= %.2f", i, path_time, max_path_time);
    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;
```

```

end

if any(stop_code.Data(:,2)) == 1
    fprintf('[INFO] true system position error threshold exceeded on i: %d\tmission_id: %d\n', i, mission_id);
    %break;
end

if any(stop_code.Data(:,3)) == 1
    fprintf('[INFO] success on i: %d\tmission_id: %d\n', i, mission_id)
end

clear('trajectory', 'battery_actual', 'battery_observed', 'ctrl_err', 'current', 'current_r

```

define placeholder variables

```

twin_ctr = 1;
twin_count = 1;
times = zeros(1, twin_count);
vs = zeros(1, twin_count);
socs = zeros(1, twin_count);
r0s = zeros(1, twin_count);
qs = zeros(1, twin_count);
ms = zeros(1, twin_count);
dist = zeros(1, twin_count);
errs = zeros(1, twin_count);
degs = zeros(3, twin_count);

```

Update twin degradation parameters

```

if i > lookback
    disp('[INFO] forecasting degradation values');
    x = double(((i - (lookback-1)):1:i)');
    r_poly = polyfit(x, smoothdata(r_deg(x), 'rlowess', 5), 1);
    q_poly = polyfit(x, smoothdata(q_deg(x), 'rlowess', 5), 1);
    m_poly = polyfit(x, smoothdata(m_deg(x), 'rlowess', 5), 1);

    polys(i, 1, :) = r_poly;
    polys(i, 2, :) = q_poly;
    polys(i, 3, :) = m_poly;

    r_mu = polyval(r_poly, i + horizon);
    q_mu = polyval(q_poly, i + horizon);
    m_mu = polyval(m_poly, i + horizon);
    batterytwin.R0 = max(abs(normrnd(r_mu, r_var)), .0001);
    batterytwin.Q = min(abs(normrnd(q_mu, q_var)), 15.5);
    Motortwin2.Req = max(abs(normrnd(m_mu, m_var)), .001);
else
    batterytwin.R0 = max(abs(normrnd(rdeg(i), r_var)), .0001);
    batterytwin.Q = min(abs(normrnd(qdeg(i), q_var)), 15.5);
    Motortwin2.Req = max(abs(normrnd(mdeg(i), m_var)), .001);
end
fprintf("[INFO] digital twin degradation parameters: %.4f\t%.4f\t%.4f", batterytwin.R0, bat

```

```
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 4
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 5
Elapsed time is 215.061058 seconds.
[INFO] updating degradation parameter variance on mission: 5
[INFO] updating degradation parameter values via random sampling on mission: 5
[INFO] mission_id: 5 rul_hat: 18.00 flight_time: 16.37 distance: 1218.99 R0: 0.00373 Q: 15.50 Req: 0.21913
[INFO] success on mission 5
[INFO] digital twin degradation parameters: 0.0007 14.4183 0.2146
[INFO] simulating digital twin on mission: 5
[INFO] digital twin mission success on 5
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 6
Elapsed time is 224.992131 seconds.
[INFO] updating degradation parameter variance on mission: 6
[INFO] updating degradation parameter values via random sampling on mission: 6
[INFO] mission_id: 6 rul_hat: 18.00 flight_time: 16.36 distance: 1218.73 R0: 0.00031 Q: 14.43 Req: 0.23180
[INFO] success on mission 6
[INFO] digital twin degradation parameters: 0.0017 13.7384 0.2808
[INFO] simulating digital twin on mission: 6
[INFO] digital twin mission success on 6
[INFO] selecting trajectory: <3> with path_time: 17.83 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 7
Elapsed time is 228.404390 seconds.
[INFO] updating degradation parameter variance on mission: 7
[INFO] updating degradation parameter values via random sampling on mission: 7
[INFO] mission_id: 7 rul_hat: 18.00 flight_time: 17.83 distance: 1301.97 R0: 0.00010 Q: 14.42 Req: 0.24955
[INFO] success on mission 7
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0020 14.7994 0.2069
[INFO] simulating digital twin on mission: 7
[INFO] digital twin mission success on 7
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 8
Elapsed time is 228.575493 seconds.
[INFO] updating degradation parameter variance on mission: 8
[INFO] updating degradation parameter values via random sampling on mission: 8
[INFO] mission_id: 8 rul_hat: 18.00 flight_time: 16.36 distance: 1218.63 R0: 0.00218 Q: 14.73 Req: 0.27343
[INFO] success on mission 8
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0001 15.4889 0.2419
[INFO] simulating digital twin on mission: 8
[INFO] digital twin mission success on 8
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 9
Elapsed time is 198.052715 seconds.
[INFO] updating degradation parameter variance on mission: 9
[INFO] updating degradation parameter values via random sampling on mission: 9
[INFO] mission_id: 9 rul_hat: 18.00 flight_time: 14.83 distance: 1083.67 R0: 0.00230 Q: 14.98 Req: 0.22181
[INFO] success on mission 9
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0028 13.9134 0.2766
[INFO] simulating digital twin on mission: 9
[INFO] digital twin mission success on 9
[INFO] selecting trajectory: <3> with path_time: 17.83 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 10
Elapsed time is 219.809908 seconds.
[INFO] updating degradation parameter variance on mission: 10
[INFO] updating degradation parameter values via random sampling on mission: 10
[INFO] mission_id: 10 rul_hat: 18.00 flight_time: 17.83 distance: 1302.00 R0: 0.00202 Q: 15.50 Req: 0.24868
[INFO] success on mission 10
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0023 15.5000 0.2148
[INFO] simulating digital twin on mission: 10
[INFO] digital twin mission success on 10

```

```

[INFO] selecting trajectory: <3> with path_time: 17.83 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 11
Elapsed time is 220.364615 seconds.
[INFO] updating degradation parameter variance on mission: 11
[INFO] updating degradation parameter values via random sampling on mission: 11
[INFO] mission_id: 11 rul_hat: 18.00 flight_time: 17.84 distance: 1302.07 R0: 0.00207 Q: 14.86 Req: 0.20661
[INFO] success on mission 11
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0020 14.2044 0.2806
[INFO] simulating digital twin on mission: 11
[INFO] digital twin mission success on 11
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 12
Elapsed time is 187.393493 seconds.
[INFO] updating degradation parameter variance on mission: 12
[INFO] updating degradation parameter values via random sampling on mission: 12
[INFO] mission_id: 12 rul_hat: 18.00 flight_time: 13.94 distance: 1048.05 R0: 0.00101 Q: 15.50 Req: 0.27050
[INFO] success on mission 12
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0037 14.6873 0.1953
[INFO] simulating digital twin on mission: 12
[INFO] digital twin mission success on 12
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 13
Elapsed time is 196.515816 seconds.
[INFO] updating degradation parameter variance on mission: 13
[INFO] updating degradation parameter values via random sampling on mission: 13
[INFO] mission_id: 13 rul_hat: 18.00 flight_time: 14.83 distance: 1083.62 R0: 0.00011 Q: 14.56 Req: 0.21105
[INFO] success on mission 13
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0012 15.1033 0.2605
[INFO] simulating digital twin on mission: 13
[INFO] digital twin mission success on 13
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 14
Elapsed time is 203.132389 seconds.
[INFO] updating degradation parameter variance on mission: 14
[INFO] updating degradation parameter values via random sampling on mission: 14
[INFO] mission_id: 14 rul_hat: 18.00 flight_time: 14.83 distance: 1083.20 R0: 0.00102 Q: 14.29 Req: 0.25625
[INFO] success on mission 14
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0018 13.4653 0.1962
[INFO] simulating digital twin on mission: 14
[INFO] digital twin mission success on 14
[INFO] selecting trajectory: <15> with path_time: 17.63 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 15
Elapsed time is 239.997507 seconds.
[INFO] updating degradation parameter variance on mission: 15
[INFO] updating degradation parameter values via random sampling on mission: 15
[INFO] mission_id: 15 rul_hat: 18.00 flight_time: 17.63 distance: 1283.72 R0: 0.00088 Q: 15.19 Req: 0.23306
[INFO] success on mission 15
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0006 15.0789 0.2621
[INFO] simulating digital twin on mission: 15
[INFO] digital twin mission success on 15
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 16
Elapsed time is 191.205377 seconds.
[INFO] updating degradation parameter variance on mission: 16
[INFO] updating degradation parameter values via random sampling on mission: 16
[INFO] mission_id: 16 rul_hat: 18.00 flight_time: 13.94 distance: 1047.99 R0: 0.00024 Q: 13.67 Req: 0.22746
[INFO] success on mission 16
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0002 14.6960 0.2085
[INFO] simulating digital twin on mission: 16

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```

[INFO] digital twin mission success on 16
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 18.00
[INFO] simulating true system on mission: 17
Elapsed time is 224.330626 seconds.
[INFO] updating degradation parameter variance on mission: 17
[INFO] updating degradation parameter values via random sampling on mission: 17
[INFO] mission_id: 17 rul_hat: 18.00 flight_time: 16.36 distance: 1218.63 R0: 0.00188 Q: 13.95 Req: 0.22972
[INFO] success on mission 17
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0001 13.2611 0.2384
[INFO] simulating digital twin on mission: 17
[INFO] digital twin low soc threshold exceeded on mission 17
[INFO] updating RUL from 18.00 to 16.54
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 18
Elapsed time is 193.147185 seconds.
[INFO] updating degradation parameter variance on mission: 18
[INFO] updating degradation parameter values via random sampling on mission: 18
[INFO] mission_id: 18 rul_hat: 16.54 flight_time: 13.58 distance: 1020.87 R0: 0.00010 Q: 13.97 Req: 0.25036
[INFO] success on mission 18
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0007 13.1513 0.2287
[INFO] simulating digital twin on mission: 18
[INFO] digital twin mission success on 18
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 19
Elapsed time is 189.036838 seconds.
[INFO] updating degradation parameter variance on mission: 19
[INFO] updating degradation parameter values via random sampling on mission: 19
[INFO] mission_id: 19 rul_hat: 16.54 flight_time: 13.47 distance: 994.77 R0: 0.00078 Q: 14.88 Req: 0.25744
[INFO] success on mission 19
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0009 14.6816 0.2782
[INFO] simulating digital twin on mission: 19
[INFO] digital twin mission success on 19
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 20
Elapsed time is 192.482465 seconds.
[INFO] updating degradation parameter variance on mission: 20
[INFO] updating degradation parameter values via random sampling on mission: 20
[INFO] mission_id: 20 rul_hat: 16.54 flight_time: 13.94 distance: 1047.79 R0: 0.00073 Q: 15.50 Req: 0.23328
[INFO] success on mission 20
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0003 13.1158 0.2626
[INFO] simulating digital twin on mission: 20
[INFO] digital twin mission success on 20
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 21
Elapsed time is 222.694296 seconds.
[INFO] updating degradation parameter variance on mission: 21
[INFO] updating degradation parameter values via random sampling on mission: 21
[INFO] mission_id: 21 rul_hat: 16.54 flight_time: 16.36 distance: 1218.67 R0: 0.00186 Q: 14.91 Req: 0.24812
[INFO] success on mission 21
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0013 15.4587 0.2699
[INFO] simulating digital twin on mission: 21
[INFO] digital twin mission success on 21
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 22
Elapsed time is 224.862322 seconds.
[INFO] updating degradation parameter variance on mission: 22
[INFO] updating degradation parameter values via random sampling on mission: 22
[INFO] mission_id: 22 rul_hat: 16.54 flight_time: 16.36 distance: 1218.59 R0: 0.00078 Q: 14.34 Req: 0.23216
[INFO] success on mission 22
[INFO] forecasting degradation values

```

```

[INFO] digital twin degradation parameters: 0.0022 14.8798 0.2448
[INFO] simulating digital twin on mission: 22
[INFO] digital twin mission success on 22
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 23
Elapsed time is 194.449165 seconds.
[INFO] updating degradation parameter variance on mission: 23
[INFO] updating degradation parameter values via random sampling on mission: 23
[INFO] mission_id: 23 rul_hat: 16.54 flight_time: 13.58 distance: 1020.90 R0: 0.00267 Q: 15.21 Req: 0.27252
[INFO] success on mission 23
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0012 14.1401 0.2753
[INFO] simulating digital twin on mission: 23
[INFO] digital twin mission success on 23
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 24
Elapsed time is 185.315411 seconds.
[INFO] updating degradation parameter variance on mission: 24
[INFO] updating degradation parameter values via random sampling on mission: 24
[INFO] mission_id: 24 rul_hat: 16.54 flight_time: 13.94 distance: 1047.88 R0: 0.00144 Q: 14.51 Req: 0.23150
[INFO] success on mission 24
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0020 14.9523 0.2853
[INFO] simulating digital twin on mission: 24
[INFO] digital twin mission success on 24
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 25
Elapsed time is 204.950368 seconds.
[INFO] updating degradation parameter variance on mission: 25
[INFO] updating degradation parameter values via random sampling on mission: 25
[INFO] mission_id: 25 rul_hat: 16.54 flight_time: 14.83 distance: 1083.23 R0: 0.00203 Q: 14.88 Req: 0.26518
[INFO] success on mission 25
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0022 15.5000 0.2355
[INFO] simulating digital twin on mission: 25
[INFO] digital twin mission success on 25
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 26
Elapsed time is 189.352968 seconds.
[INFO] updating degradation parameter variance on mission: 26
[INFO] updating degradation parameter values via random sampling on mission: 26
[INFO] mission_id: 26 rul_hat: 16.54 flight_time: 13.94 distance: 1047.78 R0: 0.00200 Q: 14.74 Req: 0.23554
[INFO] success on mission 26
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0036 15.0251 0.2902
[INFO] simulating digital twin on mission: 26
[INFO] digital twin mission success on 26
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 27
Elapsed time is 207.771571 seconds.
[INFO] updating degradation parameter variance on mission: 27
[INFO] updating degradation parameter values via random sampling on mission: 27
[INFO] mission_id: 27 rul_hat: 16.54 flight_time: 14.83 distance: 1083.26 R0: 0.00316 Q: 14.67 Req: 0.24120
[INFO] success on mission 27
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0019 15.1528 0.2190
[INFO] simulating digital twin on mission: 27
[INFO] digital twin mission success on 27
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 28
Elapsed time is 194.384877 seconds.
[INFO] updating degradation parameter variance on mission: 28
[INFO] updating degradation parameter values via random sampling on mission: 28
[INFO] mission_id: 28 rul_hat: 16.54 flight_time: 13.58 distance: 1020.82 R0: 0.00121 Q: 14.21 Req: 0.28183
[INFO] success on mission 28

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```

[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0039 15.1511 0.2369
[INFO] simulating digital twin on mission: 28
[INFO] digital twin mission success on 28
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 29
Elapsed time is 216.103880 seconds.
[INFO] updating degradation parameter variance on mission: 29
[INFO] updating degradation parameter values via random sampling on mission: 29
[INFO] mission_id: 29 rul_hat: 16.54 flight_time: 16.36 distance: 1218.88 R0: 0.00073 Q: 14.00 Req: 0.26974
[INFO] success on mission 29
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0039 14.3807 0.2795
[INFO] simulating digital twin on mission: 29
[INFO] digital twin mission success on 29
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 30
Elapsed time is 184.794325 seconds.
[INFO] updating degradation parameter variance on mission: 30
[INFO] updating degradation parameter values via random sampling on mission: 30
[INFO] mission_id: 30 rul_hat: 16.54 flight_time: 13.58 distance: 1020.89 R0: 0.00104 Q: 14.92 Req: 0.26861
[INFO] success on mission 30
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0020 13.5584 0.3185
[INFO] simulating digital twin on mission: 30
[INFO] digital twin mission success on 30
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 31
Elapsed time is 183.689295 seconds.
[INFO] updating degradation parameter variance on mission: 31
[INFO] updating degradation parameter values via random sampling on mission: 31
[INFO] mission_id: 31 rul_hat: 16.54 flight_time: 13.58 distance: 1021.03 R0: 0.00183 Q: 14.93 Req: 0.26678
[INFO] success on mission 31
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0009 14.3599 0.2932
[INFO] simulating digital twin on mission: 31
[INFO] digital twin mission success on 31
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 32
Elapsed time is 182.530501 seconds.
[INFO] updating degradation parameter variance on mission: 32
[INFO] updating degradation parameter values via random sampling on mission: 32
[INFO] mission_id: 32 rul_hat: 16.54 flight_time: 13.47 distance: 994.76 R0: 0.00144 Q: 14.00 Req: 0.25843
[INFO] success on mission 32
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0014 15.0526 0.2968
[INFO] simulating digital twin on mission: 32
[INFO] digital twin mission success on 32
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 33
Elapsed time is 193.206603 seconds.
[INFO] updating degradation parameter variance on mission: 33
[INFO] updating degradation parameter values via random sampling on mission: 33
[INFO] mission_id: 33 rul_hat: 16.54 flight_time: 13.94 distance: 1047.90 R0: 0.00302 Q: 14.03 Req: 0.25913
[INFO] success on mission 33
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0001 14.5017 0.3084
[INFO] simulating digital twin on mission: 33
[INFO] digital twin mission success on 33
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 34
Elapsed time is 190.543067 seconds.
[INFO] updating degradation parameter variance on mission: 34
[INFO] updating degradation parameter values via random sampling on mission: 34
[INFO] mission_id: 34 rul_hat: 16.54 flight_time: 13.94 distance: 1047.80 R0: 0.00185 Q: 14.24 Req: 0.27924

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[INFO] success on mission 34
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0024 14.3726 0.2558
[INFO] simulating digital twin on mission: 34
[INFO] digital twin mission success on 34
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 35
Elapsed time is 184.274098 seconds.
[INFO] updating degradation parameter variance on mission: 35
[INFO] updating degradation parameter values via random sampling on mission: 35
[INFO] mission_id: 35 rul_hat: 16.54 flight_time: 13.94 distance: 1047.89 R0: 0.00286 Q: 14.00 Req: 0.25559
[INFO] success on mission 35
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0008 13.6937 0.2741
[INFO] simulating digital twin on mission: 35
[INFO] digital twin mission success on 35
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 36
Elapsed time is 187.487246 seconds.
[INFO] updating degradation parameter variance on mission: 36
[INFO] updating degradation parameter values via random sampling on mission: 36
[INFO] mission_id: 36 rul_hat: 16.54 flight_time: 13.47 distance: 994.79 R0: 0.00207 Q: 14.42 Req: 0.25025
[INFO] success on mission 36
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0026 14.3591 0.2374
[INFO] simulating digital twin on mission: 36
[INFO] digital twin mission success on 36
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 37
Elapsed time is 201.587549 seconds.
[INFO] updating degradation parameter variance on mission: 37
[INFO] updating degradation parameter values via random sampling on mission: 37
[INFO] mission_id: 37 rul_hat: 16.54 flight_time: 14.83 distance: 1083.25 R0: 0.00219 Q: 14.32 Req: 0.26986
[INFO] success on mission 37
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0036 14.2988 0.2193
[INFO] simulating digital twin on mission: 37
[INFO] digital twin mission success on 37
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 38
Elapsed time is 220.478804 seconds.
[INFO] updating degradation parameter variance on mission: 38
[INFO] updating degradation parameter values via random sampling on mission: 38
[INFO] mission_id: 38 rul_hat: 16.54 flight_time: 16.36 distance: 1218.80 R0: 0.00286 Q: 14.35 Req: 0.23667
[INFO] success on mission 38
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0034 14.1121 0.2529
[INFO] simulating digital twin on mission: 38
[INFO] digital twin mission success on 38
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 39
Elapsed time is 227.326558 seconds.
[INFO] updating degradation parameter variance on mission: 39
[INFO] updating degradation parameter values via random sampling on mission: 39
[INFO] mission_id: 39 rul_hat: 16.54 flight_time: 16.36 distance: 1218.57 R0: 0.00293 Q: 14.69 Req: 0.24233
[INFO] success on mission 39
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0029 15.0700 0.2246
[INFO] simulating digital twin on mission: 39
[INFO] digital twin mission success on 39
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 40
Elapsed time is 203.956884 seconds.
[INFO] updating degradation parameter variance on mission: 40
[INFO] updating degradation parameter values via random sampling on mission: 40

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[INFO] mission_id: 40 rul_hat: 16.54 flight_time: 14.83 distance: 1083.23 R0: 0.00219 Q: 15.07 Req: 0.26895
[INFO] success on mission 40
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0050 14.3955 0.2179
[INFO] simulating digital twin on mission: 40
[INFO] digital twin mission success on 40
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 41
Elapsed time is 196.456037 seconds.
[INFO] updating degradation parameter variance on mission: 41
[INFO] updating degradation parameter values via random sampling on mission: 41
[INFO] mission_id: 41 rul_hat: 16.54 flight_time: 14.83 distance: 1083.69 R0: 0.00229 Q: 14.33 Req: 0.22663
[INFO] success on mission 41
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0027 14.7331 0.2429
[INFO] simulating digital twin on mission: 41
[INFO] digital twin mission success on 41
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 42
Elapsed time is 192.337977 seconds.
[INFO] updating degradation parameter variance on mission: 42
[INFO] updating degradation parameter values via random sampling on mission: 42
[INFO] mission_id: 42 rul_hat: 16.54 flight_time: 13.58 distance: 1020.96 R0: 0.00253 Q: 14.39 Req: 0.26281
[INFO] success on mission 42
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0019 14.9796 0.2127
[INFO] simulating digital twin on mission: 42
[INFO] digital twin mission success on 42
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 43
Elapsed time is 222.345786 seconds.
[INFO] updating degradation parameter variance on mission: 43
[INFO] updating degradation parameter values via random sampling on mission: 43
[INFO] mission_id: 43 rul_hat: 16.54 flight_time: 16.36 distance: 1218.67 R0: 0.00214 Q: 13.29 Req: 0.27276
[INFO] success on mission 43
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0025 14.6553 0.2494
[INFO] simulating digital twin on mission: 43
[INFO] digital twin mission success on 43
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 44
Elapsed time is 181.509944 seconds.
[INFO] updating degradation parameter variance on mission: 44
[INFO] updating degradation parameter values via random sampling on mission: 44
[INFO] mission_id: 44 rul_hat: 16.54 flight_time: 13.47 distance: 994.72 R0: 0.00137 Q: 13.81 Req: 0.27074
[INFO] success on mission 44
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0033 13.6390 0.2821
[INFO] simulating digital twin on mission: 44
[INFO] digital twin mission success on 44
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 45
Elapsed time is 219.414015 seconds.
[INFO] updating degradation parameter variance on mission: 45
[INFO] updating degradation parameter values via random sampling on mission: 45
[INFO] mission_id: 45 rul_hat: 16.54 flight_time: 16.36 distance: 1218.78 R0: 0.00230 Q: 14.77 Req: 0.24809
[INFO] success on mission 45
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0008 13.6228 0.2506
[INFO] simulating digital twin on mission: 45
[INFO] digital twin mission success on 45
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 46
Elapsed time is 186.066250 seconds.
[INFO] updating degradation parameter variance on mission: 46

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[INFO] updating degradation parameter values via random sampling on mission: 46
[INFO] mission_id: 46 rul_hat: 16.54 flight_time: 13.47 distance: 994.73 R0: 0.00224 Q: 14.79 Req: 0.26620
[INFO] success on mission 46
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0012 13.6976 0.2806
[INFO] simulating digital twin on mission: 46
[INFO] digital twin mission success on 46
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 47
Elapsed time is 189.811002 seconds.
[INFO] updating degradation parameter variance on mission: 47
[INFO] updating degradation parameter values via random sampling on mission: 47
[INFO] mission_id: 47 rul_hat: 16.54 flight_time: 13.94 distance: 1047.82 R0: 0.00234 Q: 14.88 Req: 0.28694
[INFO] success on mission 47
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0011 13.4933 0.2542
[INFO] simulating digital twin on mission: 47
[INFO] digital twin mission success on 47
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 48
Elapsed time is 183.913117 seconds.
[INFO] updating degradation parameter variance on mission: 48
[INFO] updating degradation parameter values via random sampling on mission: 48
[INFO] mission_id: 48 rul_hat: 16.54 flight_time: 13.94 distance: 1047.81 R0: 0.00291 Q: 13.86 Req: 0.26212
[INFO] success on mission 48
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0028 13.9704 0.2948
[INFO] simulating digital twin on mission: 48
[INFO] digital twin mission success on 48
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 49
Elapsed time is 187.203453 seconds.
[INFO] updating degradation parameter variance on mission: 49
[INFO] updating degradation parameter values via random sampling on mission: 49
[INFO] mission_id: 49 rul_hat: 16.54 flight_time: 13.47 distance: 994.72 R0: 0.00285 Q: 14.21 Req: 0.26810
[INFO] success on mission 49
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0017 14.5453 0.2812
[INFO] simulating digital twin on mission: 49
[INFO] digital twin mission success on 49
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 50
Elapsed time is 196.180053 seconds.
[INFO] updating degradation parameter variance on mission: 50
[INFO] updating degradation parameter values via random sampling on mission: 50
[INFO] mission_id: 50 rul_hat: 16.54 flight_time: 14.83 distance: 1083.75 R0: 0.00275 Q: 13.72 Req: 0.25802
[INFO] success on mission 50
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0029 14.7702 0.2435
[INFO] simulating digital twin on mission: 50
[INFO] digital twin mission success on 50
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 51
Elapsed time is 186.016529 seconds.
[INFO] updating degradation parameter variance on mission: 51
[INFO] updating degradation parameter values via random sampling on mission: 51
[INFO] mission_id: 51 rul_hat: 16.54 flight_time: 13.47 distance: 994.73 R0: 0.00304 Q: 13.87 Req: 0.26283
[INFO] success on mission 51
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0035 15.0046 0.2473
[INFO] simulating digital twin on mission: 51
[INFO] digital twin mission success on 51
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 52
Elapsed time is 185.893146 seconds.

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[INFO] updating degradation parameter variance on mission: 52
[INFO] updating degradation parameter values via random sampling on mission: 52
[INFO] mission_id: 52 rul_hat: 16.54 flight_time: 13.47 distance: 994.79 R0: 0.00250 Q: 13.78 Req: 0.28022
[INFO] success on mission 52
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0039 13.3862 0.2508
[INFO] simulating digital twin on mission: 52
[INFO] digital twin mission success on 52
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 53
Elapsed time is 185.307887 seconds.
[INFO] updating degradation parameter variance on mission: 53
[INFO] updating degradation parameter values via random sampling on mission: 53
[INFO] mission_id: 53 rul_hat: 16.54 flight_time: 14.83 distance: 1083.94 R0: 0.00329 Q: 14.18 Req: 0.27811
[INFO] success on mission 53
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0029 13.3197 0.2688
[INFO] simulating digital twin on mission: 53
[INFO] digital twin mission success on 53
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 54
Elapsed time is 218.247344 seconds.
[INFO] updating degradation parameter variance on mission: 54
[INFO] updating degradation parameter values via random sampling on mission: 54
[INFO] mission_id: 54 rul_hat: 16.54 flight_time: 16.36 distance: 1218.89 R0: 0.00325 Q: 14.46 Req: 0.26930
[INFO] success on mission 54
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0030 13.5798 0.2765
[INFO] simulating digital twin on mission: 54
[INFO] digital twin mission success on 54
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 55
Elapsed time is 222.486913 seconds.
[INFO] updating degradation parameter variance on mission: 55
[INFO] updating degradation parameter values via random sampling on mission: 55
[INFO] mission_id: 55 rul_hat: 16.54 flight_time: 16.36 distance: 1218.83 R0: 0.00313 Q: 14.96 Req: 0.25893
[INFO] success on mission 55
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0036 13.4797 0.2747
[INFO] simulating digital twin on mission: 55
[INFO] digital twin mission success on 55
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 56
Elapsed time is 188.336736 seconds.
[INFO] updating degradation parameter variance on mission: 56
[INFO] updating degradation parameter values via random sampling on mission: 56
[INFO] mission_id: 56 rul_hat: 16.54 flight_time: 13.47 distance: 994.85 R0: 0.00402 Q: 13.28 Req: 0.25036
[INFO] success on mission 56
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0028 14.8523 0.2766
[INFO] simulating digital twin on mission: 56
[INFO] digital twin mission success on 56
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 57
Elapsed time is 185.629646 seconds.
[INFO] updating degradation parameter variance on mission: 57
[INFO] updating degradation parameter values via random sampling on mission: 57
[INFO] mission_id: 57 rul_hat: 16.54 flight_time: 13.47 distance: 994.78 R0: 0.00370 Q: 13.90 Req: 0.26895
[INFO] success on mission 57
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0047 13.6324 0.2390
[INFO] simulating digital twin on mission: 57
[INFO] digital twin mission success on 57
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 58

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Elapsed time is 185.176754 seconds.

[INFO] updating degradation parameter variance on mission: 58

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

[INFO] mission_id: 58 rul_hat: 16.54 flight_time: 13.58 distance: 1021.10 R0: 0.00406 Q: 14.18 Req: 0.28334

[INFO] success on mission 58

[INFO] forecasting degradation values

[INFO] digital twin degradation parameters: 0.0041 14.1719 0.2804

[INFO] simulating digital twin on mission: 58

[INFO] digital twin mission success on 58

[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54

[INFO] simulating true system on mission: 59

Elapsed time is 215.007218 seconds.

[INFO] updating degradation parameter variance on mission: 59

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

[INFO] mission_id: 59 rul_hat: 16.54 flight_time: 16.36 distance: 1218.82 R0: 0.00376 Q: 13.83 Req: 0.27834

[INFO] success on mission 59

[INFO] forecasting degradation values

[INFO] digital twin degradation parameters: 0.0045 14.7579 0.2638

[INFO] simulating digital twin on mission: 59

[INFO] digital twin mission success on 59

[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54

[INFO] simulating true system on mission: 60

Elapsed time is 217.832390 seconds.

[INFO] updating degradation parameter variance on mission: 60

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

[INFO] mission_id: 60 rul_hat: 16.54 flight_time: 16.36 distance: 1218.73 R0: 0.00435 Q: 13.36 Req: 0.26111

[INFO] success on mission 60

[INFO] forecasting degradation values

[INFO] digital twin degradation parameters: 0.0052 13.2509 0.2758

[INFO] simulating digital twin on mission: 60

[INFO] digital twin mission success on 60

[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54

[INFO] simulating true system on mission: 61

Elapsed time is 197.786007 seconds.

[INFO] updating degradation parameter variance on mission: 61

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

[INFO] mission_id: 61 rul_hat: 16.54 flight_time: 14.83 distance: 1083.42 R0: 0.00422 Q: 13.45 Req: 0.28673

[INFO] success on mission 61

[INFO] forecasting degradation values

[INFO] digital twin degradation parameters: 0.0046 13.4040 0.2530

[INFO] simulating digital twin on mission: 61

[INFO] digital twin mission success on 61

[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54

[INFO] simulating true system on mission: 62

Elapsed time is 179.999276 seconds.

[INFO] updating degradation parameter variance on mission: 62

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

[INFO] mission_id: 62 rul_hat: 16.54 flight_time: 13.58 distance: 1021.18 R0: 0.00380 Q: 14.01 Req: 0.26518

[INFO] success on mission 62

[INFO] forecasting degradation values

[INFO] digital twin degradation parameters: 0.0046 13.1744 0.2925

[INFO] simulating digital twin on mission: 62

[INFO] digital twin mission success on 62

[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54

[INFO] simulating true system on mission: 63

Elapsed time is 197.480912 seconds.

[INFO] updating degradation parameter variance on mission: 63

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

[INFO] mission_id: 63 rul_hat: 16.54 flight_time: 14.83 distance: 1083.54 R0: 0.00415 Q: 13.42 Req: 0.28195

[INFO] success on mission 63

[INFO] forecasting degradation values

[INFO] digital twin degradation parameters: 0.0045 13.2571 0.2795

[INFO] simulating digital twin on mission: 63

[INFO] digital twin mission success on 63

[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54


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[INFO] simulating true system on mission: 64
Elapsed time is 182.836837 seconds.
[INFO] updating degradation parameter variance on mission: 64
[INFO] updating degradation parameter values via random sampling on mission: 64
[INFO] mission_id: 64 rul_hat: 16.54 flight_time: 13.94 distance: 1047.85 R0: 0.00522 Q: 13.79 Req: 0.26803
[INFO] success on mission 64
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0048 13.0290 0.2905
[INFO] simulating digital twin on mission: 64
[INFO] digital twin mission success on 64
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 65
Elapsed time is 182.982117 seconds.
[INFO] updating degradation parameter variance on mission: 65
[INFO] updating degradation parameter values via random sampling on mission: 65
[INFO] mission_id: 65 rul_hat: 16.54 flight_time: 13.47 distance: 994.78 R0: 0.00474 Q: 13.76 Req: 0.27322
[INFO] success on mission 65
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0053 13.6171 0.2621
[INFO] simulating digital twin on mission: 65
[INFO] digital twin mission success on 65
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 66
Elapsed time is 195.711842 seconds.
[INFO] updating degradation parameter variance on mission: 66
[INFO] updating degradation parameter values via random sampling on mission: 66
[INFO] mission_id: 66 rul_hat: 16.54 flight_time: 14.83 distance: 1083.83 R0: 0.00519 Q: 13.96 Req: 0.26529
[INFO] success on mission 66
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0050 12.7752 0.2679
[INFO] simulating digital twin on mission: 66
[INFO] digital twin mission success on 66
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 67
Elapsed time is 190.103788 seconds.
[INFO] updating degradation parameter variance on mission: 67
[INFO] updating degradation parameter values via random sampling on mission: 67
[INFO] mission_id: 67 rul_hat: 16.54 flight_time: 13.94 distance: 1047.71 R0: 0.00541 Q: 13.87 Req: 0.27867
[INFO] success on mission 67
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0050 13.7985 0.2649
[INFO] simulating digital twin on mission: 67
[INFO] digital twin mission success on 67
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 68
Elapsed time is 186.690421 seconds.
[INFO] updating degradation parameter variance on mission: 68
[INFO] updating degradation parameter values via random sampling on mission: 68
[INFO] mission_id: 68 rul_hat: 16.54 flight_time: 14.83 distance: 1083.85 R0: 0.00567 Q: 13.71 Req: 0.28959
[INFO] success on mission 68
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0059 14.1524 0.2783
[INFO] simulating digital twin on mission: 68
[INFO] digital twin mission success on 68
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 69
Elapsed time is 215.307571 seconds.
[INFO] updating degradation parameter variance on mission: 69
[INFO] updating degradation parameter values via random sampling on mission: 69
[INFO] mission_id: 69 rul_hat: 16.54 flight_time: 16.36 distance: 1218.91 R0: 0.00619 Q: 13.53 Req: 0.27567
[INFO] success on mission 69
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0072 14.1707 0.2778
[INFO] simulating digital twin on mission: 69
[INFO] digital twin mission success on 69

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[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 70
Elapsed time is 182.649081 seconds.
[INFO] updating degradation parameter variance on mission: 70
[INFO] updating degradation parameter values via random sampling on mission: 70
[INFO] mission_id: 70 rul_hat: 16.54 flight_time: 13.58 distance: 1021.02 R0: 0.00646 Q: 13.52 Req: 0.28520
[INFO] success on mission 70
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0067 13.3995 0.2937
[INFO] simulating digital twin on mission: 70
[INFO] digital twin mission success on 70
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 71
Elapsed time is 216.062625 seconds.
[INFO] updating degradation parameter variance on mission: 71
[INFO] updating degradation parameter values via random sampling on mission: 71
[INFO] mission_id: 71 rul_hat: 16.54 flight_time: 16.36 distance: 1218.89 R0: 0.00696 Q: 13.52 Req: 0.27208
[INFO] success on mission 71
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0077 13.6640 0.2817
[INFO] simulating digital twin on mission: 71
[INFO] digital twin mission success on 71
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 72
Elapsed time is 186.611730 seconds.
[INFO] updating degradation parameter variance on mission: 72
[INFO] updating degradation parameter values via random sampling on mission: 72
[INFO] mission_id: 72 rul_hat: 16.54 flight_time: 13.94 distance: 1047.79 R0: 0.00674 Q: 13.15 Req: 0.28225
[INFO] success on mission 72
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0076 13.2918 0.2898
[INFO] simulating digital twin on mission: 72
[INFO] digital twin mission success on 72
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 73
Elapsed time is 184.295077 seconds.
[INFO] updating degradation parameter variance on mission: 73
[INFO] updating degradation parameter values via random sampling on mission: 73
[INFO] mission_id: 73 rul_hat: 16.54 flight_time: 13.94 distance: 1047.76 R0: 0.00704 Q: 13.65 Req: 0.28232
[INFO] success on mission 73
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0079 13.1358 0.2817
[INFO] simulating digital twin on mission: 73
[INFO] digital twin mission success on 73
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 74
Elapsed time is 180.249425 seconds.
[INFO] updating degradation parameter variance on mission: 74
[INFO] updating degradation parameter values via random sampling on mission: 74
[INFO] mission_id: 74 rul_hat: 16.54 flight_time: 13.47 distance: 994.78 R0: 0.00738 Q: 13.36 Req: 0.28388
[INFO] success on mission 74
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0077 13.3451 0.3025
[INFO] simulating digital twin on mission: 74
[INFO] digital twin mission success on 74
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 75
Elapsed time is 179.738033 seconds.
[INFO] updating degradation parameter variance on mission: 75
[INFO] updating degradation parameter values via random sampling on mission: 75
[INFO] mission_id: 75 rul_hat: 16.54 flight_time: 13.58 distance: 1021.04 R0: 0.00773 Q: 13.57 Req: 0.28231
[INFO] success on mission 75
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0078 13.7199 0.2850
[INFO] simulating digital twin on mission: 75

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[INFO] digital twin mission success on 75
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 76
Elapsed time is 179.056599 seconds.
[INFO] updating degradation parameter variance on mission: 76
[INFO] updating degradation parameter values via random sampling on mission: 76
[INFO] mission_id: 76 rul_hat: 16.54 flight_time: 13.47 distance: 994.83 R0: 0.00769 Q: 13.42 Req: 0.28762
[INFO] success on mission 76
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0087 13.4649 0.2888
[INFO] simulating digital twin on mission: 76
[INFO] digital twin mission success on 76
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 77
Elapsed time is 183.103707 seconds.
[INFO] updating degradation parameter variance on mission: 77
[INFO] updating degradation parameter values via random sampling on mission: 77
[INFO] mission_id: 77 rul_hat: 16.54 flight_time: 14.83 distance: 1083.79 R0: 0.00801 Q: 12.78 Req: 0.27619
[INFO] success on mission 77
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0082 13.4370 0.2949
[INFO] simulating digital twin on mission: 77
[INFO] digital twin mission success on 77
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 78
Elapsed time is 184.903799 seconds.
[INFO] updating degradation parameter variance on mission: 78
[INFO] updating degradation parameter values via random sampling on mission: 78
[INFO] mission_id: 78 rul_hat: 16.54 flight_time: 13.94 distance: 1047.83 R0: 0.00859 Q: 13.12 Req: 0.28392
[INFO] success on mission 78
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0084 12.9451 0.2725
[INFO] simulating digital twin on mission: 78
[INFO] digital twin mission success on 78
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 79
Elapsed time is 179.325625 seconds.
[INFO] updating degradation parameter variance on mission: 79
[INFO] updating degradation parameter values via random sampling on mission: 79
[INFO] mission_id: 79 rul_hat: 16.54 flight_time: 13.47 distance: 994.69 R0: 0.00874 Q: 13.35 Req: 0.29372
[INFO] success on mission 79
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0089 12.8020 0.2831
[INFO] simulating digital twin on mission: 79
[INFO] digital twin mission success on 79
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 80
Elapsed time is 182.477665 seconds.
[INFO] updating degradation parameter variance on mission: 80
[INFO] updating degradation parameter values via random sampling on mission: 80
[INFO] mission_id: 80 rul_hat: 16.54 flight_time: 14.83 distance: 1083.86 R0: 0.00917 Q: 13.67 Req: 0.27899
[INFO] success on mission 80
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0098 13.5711 0.2948
[INFO] simulating digital twin on mission: 80
[INFO] digital twin mission success on 80
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 81
Elapsed time is 195.818512 seconds.
[INFO] updating degradation parameter variance on mission: 81
[INFO] updating degradation parameter values via random sampling on mission: 81
[INFO] mission_id: 81 rul_hat: 16.54 flight_time: 14.83 distance: 1083.76 R0: 0.00961 Q: 13.30 Req: 0.29842
[INFO] success on mission 81
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0096 12.8696 0.2817

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[INFO] simulating digital twin on mission: 81
[INFO] digital twin mission success on 81
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 82
Elapsed time is 177.148086 seconds.
[INFO] updating degradation parameter variance on mission: 82
[INFO] updating degradation parameter values via random sampling on mission: 82
[INFO] mission_id: 82 rul_hat: 16.54 flight_time: 13.58 distance: 1021.17 R0: 0.01035 Q: 13.28 Req: 0.29202
[INFO] success on mission 82
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0105 12.9206 0.2933
[INFO] simulating digital twin on mission: 82
[INFO] digital twin mission success on 82
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 83
Elapsed time is 183.352094 seconds.
[INFO] updating degradation parameter variance on mission: 83
[INFO] updating degradation parameter values via random sampling on mission: 83
[INFO] mission_id: 83 rul_hat: 16.54 flight_time: 14.83 distance: 1083.60 R0: 0.01088 Q: 13.15 Req: 0.29068
[INFO] success on mission 83
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0112 13.3371 0.3140
[INFO] simulating digital twin on mission: 83
[INFO] digital twin mission success on 83
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 84
Elapsed time is 177.834025 seconds.
[INFO] updating degradation parameter variance on mission: 84
[INFO] updating degradation parameter values via random sampling on mission: 84
[INFO] mission_id: 84 rul_hat: 16.54 flight_time: 13.47 distance: 994.81 R0: 0.01143 Q: 13.53 Req: 0.27956
[INFO] success on mission 84
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0124 13.1896 0.2929
[INFO] simulating digital twin on mission: 84
[INFO] digital twin mission success on 84
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 85
Elapsed time is 181.878856 seconds.
[INFO] updating degradation parameter variance on mission: 85
[INFO] updating degradation parameter values via random sampling on mission: 85
[INFO] mission_id: 85 rul_hat: 16.54 flight_time: 13.47 distance: 994.76 R0: 0.01202 Q: 12.79 Req: 0.28512
[INFO] success on mission 85
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0129 13.6061 0.2966
[INFO] simulating digital twin on mission: 85
[INFO] digital twin mission success on 85
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 86
Elapsed time is 185.402647 seconds.
[INFO] updating degradation parameter variance on mission: 86
[INFO] updating degradation parameter values via random sampling on mission: 86
[INFO] mission_id: 86 rul_hat: 16.54 flight_time: 13.94 distance: 1047.79 R0: 0.01233 Q: 12.98 Req: 0.28602
[INFO] success on mission 86
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0133 12.8594 0.2879
[INFO] simulating digital twin on mission: 86
[INFO] digital twin mission success on 86
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 87
Elapsed time is 178.601727 seconds.
[INFO] updating degradation parameter variance on mission: 87
[INFO] updating degradation parameter values via random sampling on mission: 87
[INFO] mission_id: 87 rul_hat: 16.54 flight_time: 13.58 distance: 1021.14 R0: 0.01320 Q: 13.13 Req: 0.28633
[INFO] success on mission 87
[INFO] forecasting degradation values

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[INFO] digital twin degradation parameters: 0.0138 12.9661 0.2668
[INFO] simulating digital twin on mission: 87
[INFO] digital twin mission success on 87
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 88
Elapsed time is 215.295977 seconds.
[INFO] updating degradation parameter variance on mission: 88
[INFO] updating degradation parameter values via random sampling on mission: 88
[INFO] mission_id: 88 rul_hat: 16.54 flight_time: 16.36 distance: 1218.93 R0: 0.01369 Q: 12.89 Req: 0.29392
[INFO] success on mission 88
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0150 12.7435 0.2928
[INFO] simulating digital twin on mission: 88
[INFO] digital twin mission success on 88
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 89
Elapsed time is 178.943804 seconds.
[INFO] updating degradation parameter variance on mission: 89
[INFO] updating degradation parameter values via random sampling on mission: 89
[INFO] mission_id: 89 rul_hat: 16.54 flight_time: 13.58 distance: 1021.10 R0: 0.01423 Q: 12.39 Req: 0.29274
[INFO] success on mission 89
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0154 12.7664 0.2798
[INFO] simulating digital twin on mission: 89
[INFO] digital twin mission success on 89
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 90
Elapsed time is 214.402366 seconds.
[INFO] updating degradation parameter variance on mission: 90
[INFO] updating degradation parameter values via random sampling on mission: 90
[INFO] mission_id: 90 rul_hat: 16.54 flight_time: 16.36 distance: 1218.77 R0: 0.01496 Q: 13.04 Req: 0.29694
[INFO] success on mission 90
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0159 12.4133 0.2851
[INFO] simulating digital twin on mission: 90
[INFO] digital twin mission success on 90
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 91
Elapsed time is 182.677248 seconds.
[INFO] updating degradation parameter variance on mission: 91
[INFO] updating degradation parameter values via random sampling on mission: 91
[INFO] mission_id: 91 rul_hat: 16.54 flight_time: 14.83 distance: 1083.90 R0: 0.01581 Q: 13.33 Req: 0.30352
[INFO] success on mission 91
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0166 12.5923 0.2931
[INFO] simulating digital twin on mission: 91
[INFO] digital twin mission success on 91
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 92
Elapsed time is 214.297209 seconds.
[INFO] updating degradation parameter variance on mission: 92
[INFO] updating degradation parameter values via random sampling on mission: 92
[INFO] mission_id: 92 rul_hat: 16.54 flight_time: 16.37 distance: 1218.93 R0: 0.01653 Q: 12.76 Req: 0.30224
[INFO] success on mission 92
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0176 12.7998 0.3127
[INFO] simulating digital twin on mission: 92
[INFO] digital twin mission success on 92
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 93
Elapsed time is 215.084463 seconds.
[INFO] updating degradation parameter variance on mission: 93
[INFO] updating degradation parameter values via random sampling on mission: 93
[INFO] mission_id: 93 rul_hat: 16.54 flight_time: 16.37 distance: 1219.12 R0: 0.01750 Q: 12.95 Req: 0.30523
[INFO] success on mission 93

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[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0181 12.7182 0.3136
[INFO] simulating digital twin on mission: 93
[INFO] digital twin mission success on 93
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 94
Elapsed time is 213.286094 seconds.
[INFO] updating degradation parameter variance on mission: 94
[INFO] updating degradation parameter values via random sampling on mission: 94
[INFO] mission_id: 94 rul_hat: 16.54 flight_time: 16.37 distance: 1219.07 R0: 0.01826 Q: 12.37 Req: 0.29472
[INFO] success on mission 94
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0193 12.9199 0.3167
[INFO] simulating digital twin on mission: 94
[INFO] digital twin mission success on 94
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 95
Elapsed time is 177.187007 seconds.
[INFO] updating degradation parameter variance on mission: 95
[INFO] updating degradation parameter values via random sampling on mission: 95
[INFO] mission_id: 95 rul_hat: 16.54 flight_time: 13.47 distance: 994.81 R0: 0.01905 Q: 12.68 Req: 0.29139
[INFO] success on mission 95
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0203 12.5223 0.3143
[INFO] simulating digital twin on mission: 95
[INFO] digital twin mission success on 95
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 96
Elapsed time is 180.744504 seconds.
[INFO] updating degradation parameter variance on mission: 96
[INFO] updating degradation parameter values via random sampling on mission: 96
[INFO] mission_id: 96 rul_hat: 16.54 flight_time: 13.58 distance: 1021.05 R0: 0.02001 Q: 11.96 Req: 0.29852
[INFO] success on mission 96
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0212 12.8620 0.3001
[INFO] simulating digital twin on mission: 96
[INFO] digital twin mission success on 96
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 97
Elapsed time is 182.306110 seconds.
[INFO] updating degradation parameter variance on mission: 97
[INFO] updating degradation parameter values via random sampling on mission: 97
[INFO] mission_id: 97 rul_hat: 16.54 flight_time: 13.94 distance: 1047.90 R0: 0.02105 Q: 12.32 Req: 0.30074
[INFO] success on mission 97
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0225 11.7939 0.3060
[INFO] simulating digital twin on mission: 97
[INFO] digital twin mission success on 97
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 98
Elapsed time is 213.864908 seconds.
[INFO] updating degradation parameter variance on mission: 98
[INFO] updating degradation parameter values via random sampling on mission: 98
[INFO] mission_id: 98 rul_hat: 16.54 flight_time: 16.37 distance: 1218.95 R0: 0.02187 Q: 12.40 Req: 0.29885
[INFO] success on mission 98
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0235 11.7812 0.2962
[INFO] simulating digital twin on mission: 98
[INFO] digital twin mission success on 98
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 99
Elapsed time is 181.091809 seconds.
[INFO] updating degradation parameter variance on mission: 99
[INFO] updating degradation parameter values via random sampling on mission: 99
[INFO] mission_id: 99 rul_hat: 16.54 flight_time: 13.58 distance: 1021.13 R0: 0.02276 Q: 12.73 Req: 0.29838

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[INFO] success on mission 99
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0245 11.2760 0.2893
[INFO] simulating digital twin on mission: 99
[INFO] digital twin mission success on 99
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 100
Bumping sigma_x
Elapsed time is 182.628400 seconds.
[INFO] updating degradation parameter variance on mission: 100
[INFO] updating degradation parameter values via random sampling on mission: 100
[INFO] mission_id: 100 rul_hat: 16.54 flight_time: 13.94 distance: 1047.92 R0: 0.02354 Q: 12.55 Req: 0.29928
[INFO] success on mission 100
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0254 12.3656 0.2970
[INFO] simulating digital twin on mission: 100
[INFO] digital twin mission success on 100
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 101
Bumping sigma_x
Elapsed time is 184.133745 seconds.
[INFO] updating degradation parameter variance on mission: 101
[INFO] updating degradation parameter values via random sampling on mission: 101
[INFO] mission_id: 101 rul_hat: 16.54 flight_time: 14.83 distance: 1083.87 R0: 0.02483 Q: 12.09 Req: 0.31877
[INFO] success on mission 101
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0262 12.3515 0.2907
[INFO] simulating digital twin on mission: 101
[INFO] digital twin mission success on 101
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 102
Bumping sigma_x
Elapsed time is 171.729054 seconds.
[INFO] updating degradation parameter variance on mission: 102
[INFO] updating degradation parameter values via random sampling on mission: 102
[INFO] mission_id: 102 rul_hat: 16.54 flight_time: 13.93 distance: 1047.85 R0: 0.02538 Q: 12.31 Req: 0.29450
[INFO] success on mission 102
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0274 12.2006 0.3198
[INFO] simulating digital twin on mission: 102
[INFO] digital twin mission success on 102
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 103
Bumping sigma_x
Elapsed time is 208.783743 seconds.
[INFO] updating degradation parameter variance on mission: 103
[INFO] updating degradation parameter values via random sampling on mission: 103
[INFO] mission_id: 103 rul_hat: 16.54 flight_time: 15.95 distance: 1188.39 R0: 0.02662 Q: 12.34 Req: 0.30331
[INFO] true system low soc threshold exceeded on mission 103
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0282 12.3919 0.2949
[INFO] simulating digital twin on mission: 103
[INFO] digital twin mission success on 103
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 104
Bumping sigma_x
Elapsed time is 174.181872 seconds.
[INFO] updating degradation parameter variance on mission: 104
[INFO] updating degradation parameter values via random sampling on mission: 104
[INFO] mission_id: 104 rul_hat: 16.54 flight_time: 13.30 distance: 982.77 R0: 0.02767 Q: 12.20 Req: 0.31514
[INFO] true system position error threshold exceeded on mission 104
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0293 12.2396 0.3077
[INFO] simulating digital twin on mission: 104
[INFO] digital twin mission success on 104

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[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 105
Bumping sigma_x
Elapsed time is 196.305460 seconds.
[INFO] updating degradation parameter variance on mission: 105
[INFO] updating degradation parameter values via random sampling on mission: 105
[INFO] mission_id: 105 rul_hat: 16.54 flight_time: 15.93 distance: 1187.56 R0: 0.02870 Q: 11.82 Req: 0.30171
[INFO] true system low soc threshold exceeded on mission 105
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0305 12.6217 0.3080
[INFO] simulating digital twin on mission: 105
[INFO] digital twin mission success on 105
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 106
Bumping sigma_x
Elapsed time is 167.369857 seconds.
[INFO] updating degradation parameter variance on mission: 106
[INFO] updating degradation parameter values via random sampling on mission: 106
[INFO] mission_id: 106 rul_hat: 16.54 flight_time: 13.47 distance: 994.79 R0: 0.02963 Q: 12.29 Req: 0.30665
[INFO] success on mission 106
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0317 11.5300 0.3124
[INFO] simulating digital twin on mission: 106
[INFO] digital twin mission success on 106
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 107
Bumping sigma_x
Elapsed time is 180.824763 seconds.
[INFO] updating degradation parameter variance on mission: 107
[INFO] updating degradation parameter values via random sampling on mission: 107
[INFO] mission_id: 107 rul_hat: 16.54 flight_time: 14.83 distance: 1083.82 R0: 0.03083 Q: 12.26 Req: 0.31188
[INFO] success on mission 107
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0327 11.9642 0.3003
[INFO] simulating digital twin on mission: 107
[INFO] digital twin mission success on 107
[INFO] selecting trajectory: <14> with path_time: 14.81 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 108
Bumping sigma_x
Elapsed time is 180.887892 seconds.
[INFO] updating degradation parameter variance on mission: 108
[INFO] updating degradation parameter values via random sampling on mission: 108
[INFO] mission_id: 108 rul_hat: 16.54 flight_time: 14.83 distance: 1083.91 R0: 0.03190 Q: 12.11 Req: 0.30430
[INFO] success on mission 108
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0340 11.8999 0.3117
[INFO] simulating digital twin on mission: 108
[INFO] digital twin mission success on 108
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 109
Bumping sigma_x
Elapsed time is 205.567262 seconds.
[INFO] updating degradation parameter variance on mission: 109
[INFO] updating degradation parameter values via random sampling on mission: 109
[INFO] mission_id: 109 rul_hat: 16.54 flight_time: 15.78 distance: 1180.00 R0: 0.03303 Q: 11.94 Req: 0.30693
[INFO] true system low soc threshold exceeded on mission 109
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0351 11.6958 0.2977
[INFO] simulating digital twin on mission: 109
[INFO] digital twin mission success on 109
[INFO] selecting trajectory: <11> with path_time: 16.38 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 110
Bumping sigma_x
Elapsed time is 203.440655 seconds.
[INFO] updating degradation parameter variance on mission: 110

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[INFO] updating degradation parameter values via random sampling on mission: 110
[INFO] mission_id: 110 rul_hat: 16.54 flight_time: 15.58 distance: 1167.31 R0: 0.03436 Q: 11.81 Req: 0.30952
[INFO] true system low soc threshold exceeded on mission 110
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0362 12.1868 0.3127
[INFO] simulating digital twin on mission: 110
[INFO] digital twin mission success on 110
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 16.54
[INFO] simulating true system on mission: 111
Bumping sigmax
Elapsed time is 167.904393 seconds.
[INFO] updating degradation parameter variance on mission: 111
[INFO] updating degradation parameter values via random sampling on mission: 111
[INFO] mission_id: 111 rul_hat: 16.54 flight_time: 13.28 distance: 980.01 R0: 0.03558 Q: 11.77 Req: 0.31224
[INFO] true system position error threshold exceeded on mission 111
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0375 11.7032 0.3038
[INFO] simulating digital twin on mission: 111
[INFO] digital twin low soc threshold exceeded on mission 111
[INFO] updating RUL from 16.54 to 14.76
[INFO] selecting trajectory: <9> with path_time: 13.45 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 112
Bumping sigmax
Elapsed time is 168.017345 seconds.
[INFO] updating degradation parameter variance on mission: 112
[INFO] updating degradation parameter values via random sampling on mission: 112
[INFO] mission_id: 112 rul_hat: 14.76 flight_time: 13.47 distance: 994.84 R0: 0.03701 Q: 12.08 Req: 0.32696
[INFO] success on mission 112
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0389 11.8528 0.3076
[INFO] simulating digital twin on mission: 112
[INFO] digital twin mission success on 112
[INFO] selecting trajectory: <5> with path_time: 13.30 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 113
Bumping sigmax
Elapsed time is 163.781531 seconds.
[INFO] updating degradation parameter variance on mission: 113
[INFO] updating degradation parameter values via random sampling on mission: 113
[INFO] mission_id: 113 rul_hat: 14.76 flight_time: 13.29 distance: 994.75 R0: 0.03823 Q: 11.37 Req: 0.32126
[INFO] success on mission 113
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0404 12.4685 0.3290
[INFO] simulating digital twin on mission: 113
[INFO] digital twin mission success on 113
[INFO] selecting trajectory: <13> with path_time: 13.94 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 114
Bumping sigmax
Elapsed time is 172.556176 seconds.
[INFO] updating degradation parameter variance on mission: 114
[INFO] updating degradation parameter values via random sampling on mission: 114
[INFO] mission_id: 114 rul_hat: 14.76 flight_time: 13.93 distance: 1047.92 R0: 0.03931 Q: 11.75 Req: 0.31603
[INFO] success on mission 114
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0417 11.3725 0.3246
[INFO] simulating digital twin on mission: 114
[INFO] digital twin mission success on 114
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 115
Bumping sigmax
Elapsed time is 166.721445 seconds.
[INFO] updating degradation parameter variance on mission: 115
[INFO] updating degradation parameter values via random sampling on mission: 115
[INFO] mission_id: 115 rul_hat: 14.76 flight_time: 13.28 distance: 980.06 R0: 0.04073 Q: 11.75 Req: 0.32532
[INFO] true system position error threshold exceeded on mission 115
[INFO] forecasting degradation values

```

```

[INFO] digital twin degradation parameters: 0.0432 11.4310 0.3270
[INFO] simulating digital twin on mission: 115
[INFO] digital twin mission success on 115
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 116
Bumping sigma_x
Elapsed time is 163.376993 seconds.
[INFO] updating degradation parameter variance on mission: 116
[INFO] updating degradation parameter values via random sampling on mission: 116
[INFO] mission_id: 116 rul_hat: 14.76 flight_time: 13.25 distance: 974.42 R0: 0.04222 Q: 11.39 Req: 0.32355
[INFO] true system position error threshold exceeded on mission 116
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0446 11.6492 0.3342
[INFO] simulating digital twin on mission: 116
[INFO] digital twin mission success on 116
[INFO] selecting trajectory: <5> with path_time: 13.30 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 117
Bumping sigma_x
Elapsed time is 164.777869 seconds.
[INFO] updating degradation parameter variance on mission: 117
[INFO] updating degradation parameter values via random sampling on mission: 117
[INFO] mission_id: 117 rul_hat: 14.76 flight_time: 13.30 distance: 994.92 R0: 0.04332 Q: 11.38 Req: 0.31134
[INFO] success on mission 117
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0462 11.1101 0.3389
[INFO] simulating digital twin on mission: 117
[INFO] digital twin mission success on 117
[INFO] selecting trajectory: <5> with path_time: 13.30 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 118
Bumping sigma_x
Elapsed time is 163.497088 seconds.
[INFO] updating degradation parameter variance on mission: 118
[INFO] updating degradation parameter values via random sampling on mission: 118
[INFO] mission_id: 118 rul_hat: 14.76 flight_time: 13.30 distance: 995.02 R0: 0.04487 Q: 11.40 Req: 0.31334
[INFO] success on mission 118
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0473 11.3324 0.3187
[INFO] simulating digital twin on mission: 118
[INFO] digital twin mission success on 118
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 119
Bumping sigma_x
Elapsed time is 162.191962 seconds.
[INFO] updating degradation parameter variance on mission: 119
[INFO] updating degradation parameter values via random sampling on mission: 119
[INFO] mission_id: 119 rul_hat: 14.76 flight_time: 13.27 distance: 989.98 R0: 0.04661 Q: 11.06 Req: 0.31924
[INFO] success on mission 119
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0486 11.2274 0.3205
[INFO] simulating digital twin on mission: 119
[INFO] digital twin mission success on 119
[INFO] selecting trajectory: <5> with path_time: 13.30 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 120
Bumping sigma_x
Elapsed time is 163.110847 seconds.
[INFO] updating degradation parameter variance on mission: 120
[INFO] updating degradation parameter values via random sampling on mission: 120
[INFO] mission_id: 120 rul_hat: 14.76 flight_time: 13.30 distance: 994.87 R0: 0.04782 Q: 11.31 Req: 0.32234
[INFO] success on mission 120
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0502 10.6094 0.3145
[INFO] simulating digital twin on mission: 120
[INFO] digital twin mission success on 120
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 121

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Bumping sigma_{max}
Elapsed time is 167.225235 seconds.
[INFO] updating degradation parameter variance on mission: 121
[INFO] updating degradation parameter values via random sampling on mission: 121
[INFO] mission_id: 121 rul_hat: 14.76 flight_time: 13.25 distance: 974.32 R0: 0.04951 Q: 11.02 Req: 0.31355
[INFO] true system position error threshold exceeded on mission 121
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0520 11.1407 0.3139
[INFO] simulating digital twin on mission: 121
[INFO] digital twin mission success on 121
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 122
Bumping sigma_{max}
Elapsed time is 166.035538 seconds.
[INFO] updating degradation parameter variance on mission: 122
[INFO] updating degradation parameter values via random sampling on mission: 122
[INFO] mission_id: 122 rul_hat: 14.76 flight_time: 13.27 distance: 989.99 R0: 0.05150 Q: 11.10 Req: 0.33327
[INFO] success on mission 122
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0535 11.1360 0.3130
[INFO] simulating digital twin on mission: 122
[INFO] digital twin mission success on 122
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 123
Bumping sigma_{max}
Elapsed time is 165.702027 seconds.
[INFO] updating degradation parameter variance on mission: 123
[INFO] updating degradation parameter values via random sampling on mission: 123
[INFO] mission_id: 123 rul_hat: 14.76 flight_time: 13.28 distance: 990.26 R0: 0.05280 Q: 11.49 Req: 0.33169
[INFO] success on mission 123
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0557 10.3830 0.3259
[INFO] simulating digital twin on mission: 123
[INFO] digital twin mission success on 123
[INFO] selecting trajectory: <10> with path_time: 13.57 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 124
Bumping sigma_{max}
Elapsed time is 165.909588 seconds.
[INFO] updating degradation parameter variance on mission: 124
[INFO] updating degradation parameter values via random sampling on mission: 124
[INFO] mission_id: 124 rul_hat: 14.76 flight_time: 13.25 distance: 974.38 R0: 0.05496 Q: 10.96 Req: 0.32725
[INFO] true system position error threshold exceeded on mission 124
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0575 11.3186 0.3347
[INFO] simulating digital twin on mission: 124
[INFO] digital twin mission success on 124
[INFO] selecting trajectory: <8> with path_time: 13.31 that meets constraint: path_time < 14.76
[INFO] simulating true system on mission: 125
Bumping sigma_{max}
Elapsed time is 163.514901 seconds.
[INFO] updating degradation parameter variance on mission: 125
[INFO] updating degradation parameter values via random sampling on mission: 125
[INFO] mission_id: 125 rul_hat: 14.76 flight_time: 13.10 distance: 972.79 R0: 0.05678 Q: 10.89 Req: 0.32521
[INFO] true system low soc threshold exceeded on mission 125
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0598 10.8863 0.3358
[INFO] simulating digital twin on mission: 125
[INFO] digital twin position error threshold exceeded on mission 125
[INFO] updating RUL from 14.76 to 12.30
[INFO] selecting trajectory: <18> with path_time: 11.78 that meets constraint: path_time < 12.30
[INFO] simulating true system on mission: 126
Bumping sigma_{max}
Elapsed time is 146.658760 seconds.
[INFO] updating degradation parameter variance on mission: 126
[INFO] updating degradation parameter values via random sampling on mission: 126

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[INFO] mission_id: 126 rul_hat: 12.30 flight_time: 11.79 distance: 890.42 R0: 0.05812 Q: 10.83 Req: 0.33389
[INFO] success on mission 126
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0616 10.6668 0.3346
[INFO] simulating digital twin on mission: 126
[INFO] digital twin mission success on 126
[INFO] selecting trajectory: <18> with path_time: 11.78 that meets constraint: path_time < 12.30
[INFO] simulating true system on mission: 127
Bumping sigma_x
Elapsed time is 145.057866 seconds.
[INFO] updating degradation parameter variance on mission: 127
[INFO] updating degradation parameter values via random sampling on mission: 127
[INFO] mission_id: 127 rul_hat: 12.30 flight_time: 11.79 distance: 890.57 R0: 0.06041 Q: 10.73 Req: 0.33132
[INFO] success on mission 127
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0634 10.3639 0.3301
[INFO] simulating digital twin on mission: 127
[INFO] digital twin mission success on 127
[INFO] selecting trajectory: <18> with path_time: 11.78 that meets constraint: path_time < 12.30
[INFO] simulating true system on mission: 128
Bumping sigma_x
Elapsed time is 145.911403 seconds.
[INFO] updating degradation parameter variance on mission: 128
[INFO] updating degradation parameter values via random sampling on mission: 128
[INFO] mission_id: 128 rul_hat: 12.30 flight_time: 11.79 distance: 890.48 R0: 0.06260 Q: 10.53 Req: 0.33934
[INFO] success on mission 128
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0655 10.4666 0.3380
[INFO] simulating digital twin on mission: 128
[INFO] digital twin mission success on 128
[INFO] selecting trajectory: <18> with path_time: 11.78 that meets constraint: path_time < 12.30
[INFO] simulating true system on mission: 129
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Elapsed time is 27.575398 seconds.
[INFO] updating degradation parameter variance on mission: 129
[INFO] updating degradation parameter values via random sampling on mission: 129
[INFO] mission_id: 129 rul_hat: 12.30 flight_time: 1.89 distance: 177.54 R0: 0.06404 Q: 10.11 Req: 0.33559
[INFO] true system position error threshold exceeded on mission 129
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0678 10.2963 0.3413
[INFO] simulating digital twin on mission: 129
[INFO] digital twin mission success on 129
[INFO] selecting trajectory: <18> with path_time: 11.78 that meets constraint: path_time < 12.30
[INFO] simulating true system on mission: 130
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Elapsed time is 32.399918 seconds.
[INFO] updating degradation parameter variance on mission: 130
[INFO] updating degradation parameter values via random sampling on mission: 130
[INFO] mission_id: 130 rul_hat: 12.30 flight_time: 2.18 distance: 204.18 R0: 0.06673 Q: 10.63 Req: 0.33884
[INFO] true system position error threshold exceeded on mission 130
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0697 10.2725 0.3418
[INFO] simulating digital twin on mission: 130
[INFO] digital twin position error threshold exceeded on mission 130
[INFO] updating RUL from 12.30 to 10.74
[INFO] selecting trajectory: <16> with path_time: 6.38 that meets constraint: path_time < 10.74
[INFO] simulating true system on mission: 131
Bumping sigma_x
Bumping sigma_x
Bumping sigma_x
Elapsed time is 16.663506 seconds.

```

```

[INFO] updating degradation parameter variance on mission: 131
[INFO] updating degradation parameter values via random sampling on mission: 131
[INFO] mission_id: 131 rul_hat: 10.74 flight_time: 1.01 distance: 81.86 R0: 0.06913 Q: 10.71 Req: 0.33500
[INFO] true system position error threshold exceeded on mission 131
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0722 9.4763 0.3399
[INFO] simulating digital twin on mission: 131
[INFO] digital twin position error threshold exceeded on mission 131
[INFO] updating RUL from 10.74 to 3.35
[INFO] digital twin rul_hat: 3.35 does not meet the threshold: 10.00 on mission 131 with fail_count 1
[INFO] selecting trajectory: <7> with path_time: 0.91 that meets constraint: path_time < 3.35
[INFO] simulating true system on mission: 132
Bumping sigmax
Elapsed time is 14.990750 seconds.
[INFO] updating degradation parameter variance on mission: 132
[INFO] updating degradation parameter values via random sampling on mission: 132
[INFO] mission_id: 132 rul_hat: 3.35 flight_time: 0.91 distance: 69.48 R0: 0.07075 Q: 10.17 Req: 0.33327
[INFO] success on mission 132
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0741 10.5276 0.3477
[INFO] simulating digital twin on mission: 132
[INFO] digital twin mission success on 132
[INFO] digital twin rul_hat: 3.35 does not meet the threshold: 10.00 on mission 132 with fail_count 2
[INFO] selecting trajectory: <7> with path_time: 0.91 that meets constraint: path_time < 3.35
[INFO] simulating true system on mission: 133
Bumping sigmax
Elapsed time is 14.924239 seconds.
[INFO] updating degradation parameter variance on mission: 133
[INFO] updating degradation parameter values via random sampling on mission: 133
[INFO] mission_id: 133 rul_hat: 3.35 flight_time: 0.91 distance: 69.46 R0: 0.07341 Q: 10.15 Req: 0.33735
[INFO] success on mission 133
[INFO] forecasting degradation values
[INFO] digital twin degradation parameters: 0.0772 9.7063 0.3363
[INFO] simulating digital twin on mission: 133
[INFO] digital twin position error threshold exceeded on mission 133
[INFO] updating RUL from 3.35 to -0.79
[INFO] digital twin rul_hat: -0.79 does not meet the threshold: 10.00 on mission 133 with fail_count 3
[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
write_degradation_data;

```

now simulate digital twin

```

load_trajectory;
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
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 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))
    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_r

```

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_rs',
```

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
```