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```
clc; clear; close all;
```

Includes

```
addpath("functions\");
addpath("Models\");
addpath("Models\capacitors\");
addpath("Models\capacitors\functions\");
addpath("Models\diods\");
addpath("Models\diods\functions\");
addpath("Models\resistors\");
addpath("Models\resistors\functions\");
addpath("Models\transistors\")
addpath("Models\transistors\functions\");

FilenameSystem.Capacitors = 'table_reliability_capacitor.xlsx';
FilenameSystem.Diods = 'table_reliability_diod.xlsx';
FilenameSystem.Resistors = 'table_reliability_resistor.xlsx';
FilenameSystem.Transistors = 'table_reliability_transistor.xlsx';

[DataSystem] = getTableSystemData(FilenameSystem);

IteratorCapacitor   = 1;
IteratorDiod        = 1;
IteratorResistor_B  = 1;
IteratorResistor_K  = 1;
IteratorTransistor  = 1;
t    = 30;
capacity    = 1000;
U_ratio     = 1/2;
iRelative   = 1/2;
power_b     = 0.5;
resistance_b= 200;
P_ratio_b   = 1/2;
power_k     = 0.5;
resistance_k = 200;
```

```
P_ratio_k    = 1/2;
pRelative    = 1/2;
s1   = 1/2;
```

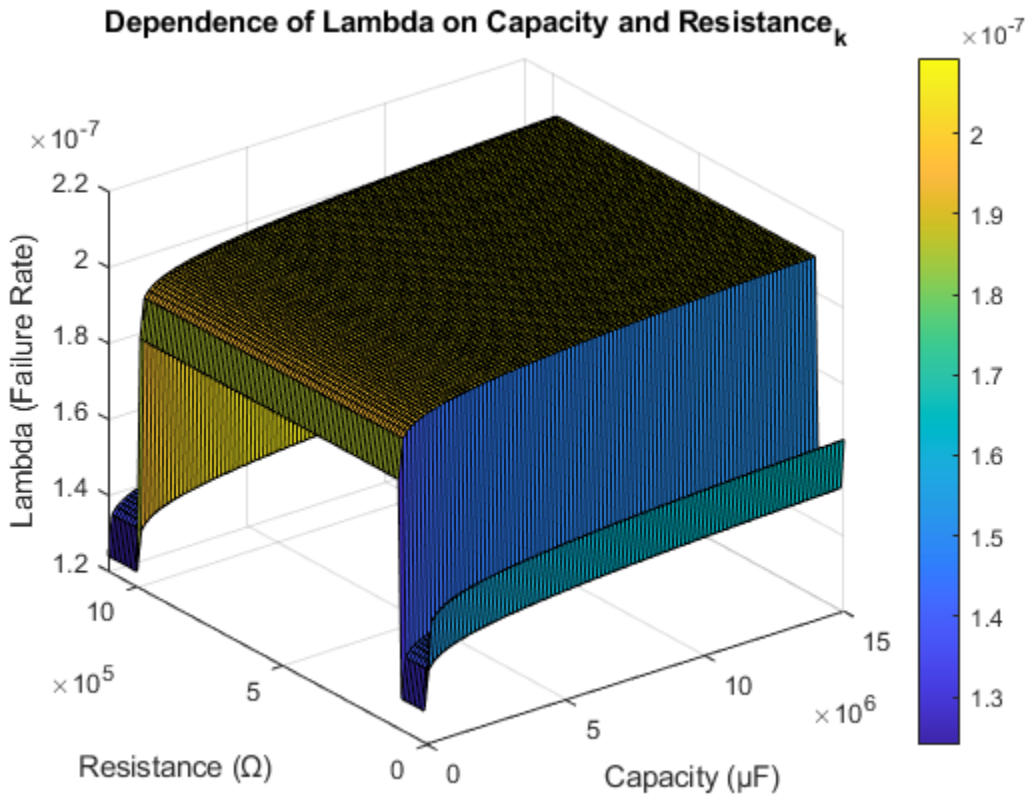
prototype

[lambda] = getReliabilitySystemFromData(DataSystem,... IteratorCapacitor, IteratorDiod, IteratorResistor_B, IteratorResistor_K, IteratorTransistor,... t, capacity, U_ratio, iRelative, power_b, resistance_b, P_ratio_b,... power_k, resistance_k, P_ratio_k, pRelative, s1)

строить поверхность долго

Задаем диапазоны значений для capacity и resistance_k

```
capacity_range = linspace(100, 15000000, 100); % от 500 до 1500
resistance_k_range = linspace(100, 1100000, 100); % от 100 до 300

% Создаем сетку значений
[CapacityGrid, ResistanceKGrid] = meshgrid(capacity_range,
resistance_k_range);

% % Предварительно создаем матрицу для хранения результатов
% lambda_surface = zeros(size(CapacityGrid));
%
% % Вычисляем lambda для каждой комбинации capacity и resistance_k
% for i = 1:size(CapacityGrid, 1)
%     for j = 1:size(CapacityGrid, 2)
%         lambda_surface(i, j) = getReliabilitySystemFromData(DataSystem, ...
%             IteratorCapacitor, IteratorDiod, IteratorResistor_B,
IteratorResistor_K, IteratorTransistor, ...
%             t, CapacityGrid(i, j), U_ratio, iRelative, power_b,
resistance_b, P_ratio_b, ...
%             power_k, ResistanceKGrid(i, j), P_ratio_k, pRelative, s1);
%     end
% end
lambda_surface = load("lambda","lambda_surface");
% save("lambda","lambda_surface")
% Построение 3D поверхности
figure;
surf(CapacityGrid, ResistanceKGrid, lambda_surface.lambda_surface);
xlabel('Capacity (μF)');
ylabel('Resistance (Ω)');
zlabel('Lambda (Failure Rate)');
title('Dependence of Lambda on Capacity and Resistance_k');
colorbar; % Добавляем цветовую панель для обозначения значений lambda
```



Оптимизация

```
x0 = [200e-12 1e6];
lb = [100e-12 100];
ub = [1e-1 1e7];
numStarts = 200;
```

Multistart

```
[best_params,fval,tElapsed] = run_multistartContRC(DataSystem,
IteratorCapacitor, IteratorDiod, IteratorResistor_B, IteratorResistor_K,
IteratorTransistor,...
                            t, U_ratio, iRelative, power_b, resistance_b,
P_ratio_b, power_k, P_ratio_k,...
                            pRelative, s1, ...
                            x0, lb, ub, numStarts)
```

MultiStart completed the runs from all start points.

All 200 local solver runs converged with a positive local solver exitflag.

best_params =

*1.0e+06 **

```
    0.0000    1.0000


fval =

   1.2468e-07


tElapsed =

    2.8705
```

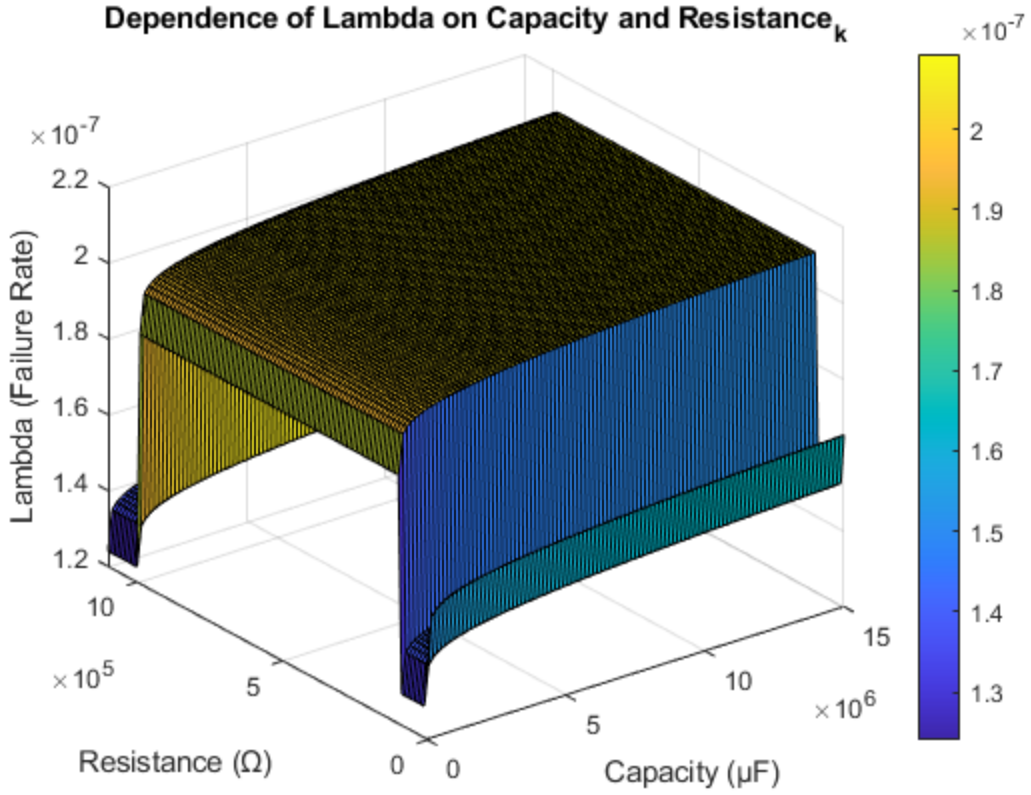
Globalsearch

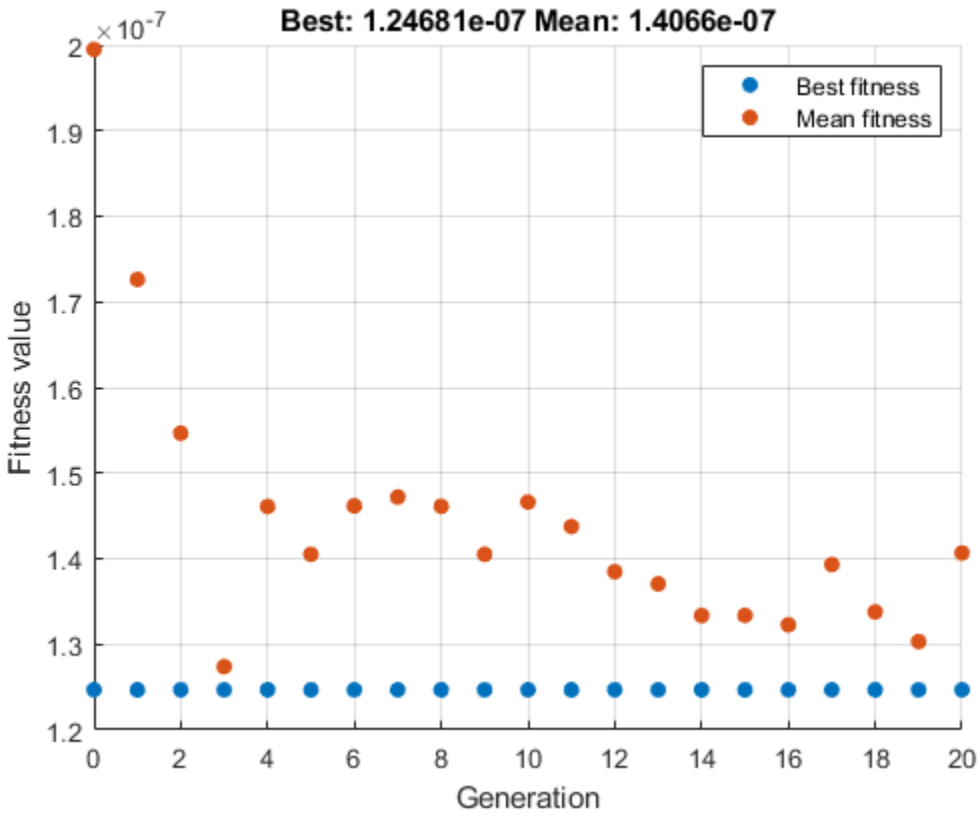
```
[best_params,fval,tElapsed] = run_globalsearchContRC(DataSystem,
IteratorCapacitor, IteratorDiod, IteratorResistor_B, IteratorResistor_K,
IteratorTransistor,...
                              t, U_ratio, iRelative, power_b, resistance_b,
P_ratio_b, power_k, P_ratio_k,...
                              pRelative, s1, ...
                              x0, lb, ub)


GlobalSearch stopped because it analyzed all the trial points.

All 51 local solver runs converged with a positive local solver exit flag.

best_params =

   1.0e+06 *

    0.0000    1.8660


fval =

   1.2404e-07


tElapsed =

    8.3165
```

Genetic

```
[best_params,fval,tElapsed] = run_geneticContRC(DataSystem,
IteratorCapacitor, IteratorDiod, IteratorResistor_B, IteratorResistor_K,
IteratorTransistor,...
                              t, U_ratio, iRelative, power_b, resistance_b,
P_ratio_b, power_k, P_ratio_k,...
```

```
                                pRelative, s1, ...
                                x0, lb, ub)

Starting parallel pool (parpool) using the 'Processes' profile ...
Connected to parallel pool with 14 workers.
ga stopped because it exceeded options.MaxGenerations.

best_params =

   1.0e+06 *

    0.0000    1.0000


fval =

   1.2468e-07


tElapsed =

   84.8197
```





PatternSearch

```
[best_params,fval,tElapsed] = run_patternSearchContRC(DataSystem,
IteratorCapacitor, IteratorDiod, IteratorResistor_B, IteratorResistor_K,
IteratorTransistor,...
                            t, U_ratio, iRelative, power_b, resistance_b,
P_ratio_b, power_k, P_ratio_k,...
                            pRelative, s1, ...
                            x0, lb, ub)
```

Iter	Func-count	f(x)	MeshSize	Method
0	1	1.24681e-07	1	
1	4	1.24681e-07	0.5	Refine Mesh
2	7	1.24681e-07	0.25	Refine Mesh
3	10	1.24681e-07	0.125	Refine Mesh
4	13	1.24681e-07	0.0625	Refine Mesh
5	16	1.24681e-07	0.03125	Refine Mesh
6	19	1.24681e-07	0.01562	Refine Mesh
7	22	1.24681e-07	0.007812	Refine Mesh
8	25	1.24681e-07	0.003906	Refine Mesh
9	28	1.24681e-07	0.001953	Refine Mesh
10	31	1.24681e-07	0.0009766	Refine Mesh
11	34	1.24681e-07	0.0004883	Refine Mesh
12	37	1.24681e-07	0.0002441	Refine Mesh

```
    13          40    1.24681e-07     0.0001221     Refine Mesh
    14          43    1.24681e-07     6.104e-05     Refine Mesh
    15          46    1.24681e-07     3.052e-05     Refine Mesh
    16          49    1.24681e-07     1.526e-05     Refine Mesh
    17          53    1.24356e-07     3.052e-05     Successful Poll
    18          56    1.24356e-07     1.526e-05     Refine Mesh
    19          59    1.24356e-07     7.629e-06     Refine Mesh
    20          63    1.24145e-07     1.526e-05     Successful Poll
    21          66    1.24145e-07     7.629e-06     Refine Mesh
    22          69    1.24145e-07     3.815e-06     Refine Mesh
    23          72    1.24145e-07     1.907e-06     Refine Mesh
    24          76    1.24085e-07     3.815e-06     Successful Poll
    25          79    1.24085e-07     1.907e-06     Refine Mesh
    26          82    1.24085e-07     9.537e-07     Refine Mesh
patternsearch stopped because the mesh size was less than
options.MeshTolerance.

best_params =

   1.0e+06 *

    0.0000    1.0000


fval =

   1.2409e-07


tElapsed =

    0.9769
```

Simulated Annealing

```
[best_params,fval,tElapsed] = run_simulatedAnnealingContRC(DataSystem,
IteratorCapacitor, IteratorDiod, IteratorResistor_B, IteratorResistor_K,
IteratorTransistor,...
                            t, U_ratio, iRelative, power_b, resistance_b,
P_ratio_b, power_k, P_ratio_k,...
                            pRelative, s1, ...
                            x0, lb, ub)


                          Best        Current          Mean
Iteration   f-count         f(x)         f(x)        temperature
     0          1    1.24681e-07    1.24681e-07           100
    10         11    1.24123e-07    2.64316e-07         56.88
    20         21    1.24123e-07    2.67401e-07        34.0562
    30         31    1.24123e-07    2.31353e-07        20.3907
    40         41    1.24123e-07    2.46655e-07        12.2087
    50         51    1.24123e-07    2.61286e-07        7.30977
```

60	61	1.24123e-07	2.3701e-07	4.37663
70	71	1.24123e-07	2.44245e-07	2.62045
80	81	1.24123e-07	2.66819e-07	1.56896
90	91	1.24123e-07	2.58311e-07	0.939395
100	101	1.24123e-07	2.33167e-07	0.56245
110	111	1.24123e-07	2.58709e-07	0.33676
120	121	1.24123e-07	2.66868e-07	0.201631
130	131	1.24123e-07	2.32236e-07	0.120724
* 139	142	1.24123e-07	2.6566e-07	48.5722
140	143	1.24123e-07	2.60282e-07	46.1436
150	153	1.24123e-07	2.63687e-07	27.6279
160	163	1.24123e-07	2.39659e-07	16.5418
170	173	1.24123e-07	2.60211e-07	9.90421
180	183	1.24123e-07	2.62323e-07	5.93001
190	193	1.24123e-07	2.55962e-07	3.55052
200	203	1.24123e-07	2.26817e-07	2.12583
210	213	1.24123e-07	2.65342e-07	1.27281
220	223	1.24123e-07	2.35398e-07	0.762079
230	233	1.24123e-07	2.38818e-07	0.456285
240	243	1.24123e-07	2.45797e-07	0.273195
250	253	1.24123e-07	2.62659e-07	0.163572
260	263	1.24123e-07	2.3021e-07	0.0979364
* 262	267	1.24123e-07	2.25139e-07	46.4001
270	275	1.24123e-07	2.55268e-07	30.7828
280	285	1.24123e-07	2.60145e-07	18.4308
290	295	1.24123e-07	2.64678e-07	11.0352
300	305	1.24123e-07	2.60772e-07	6.60718

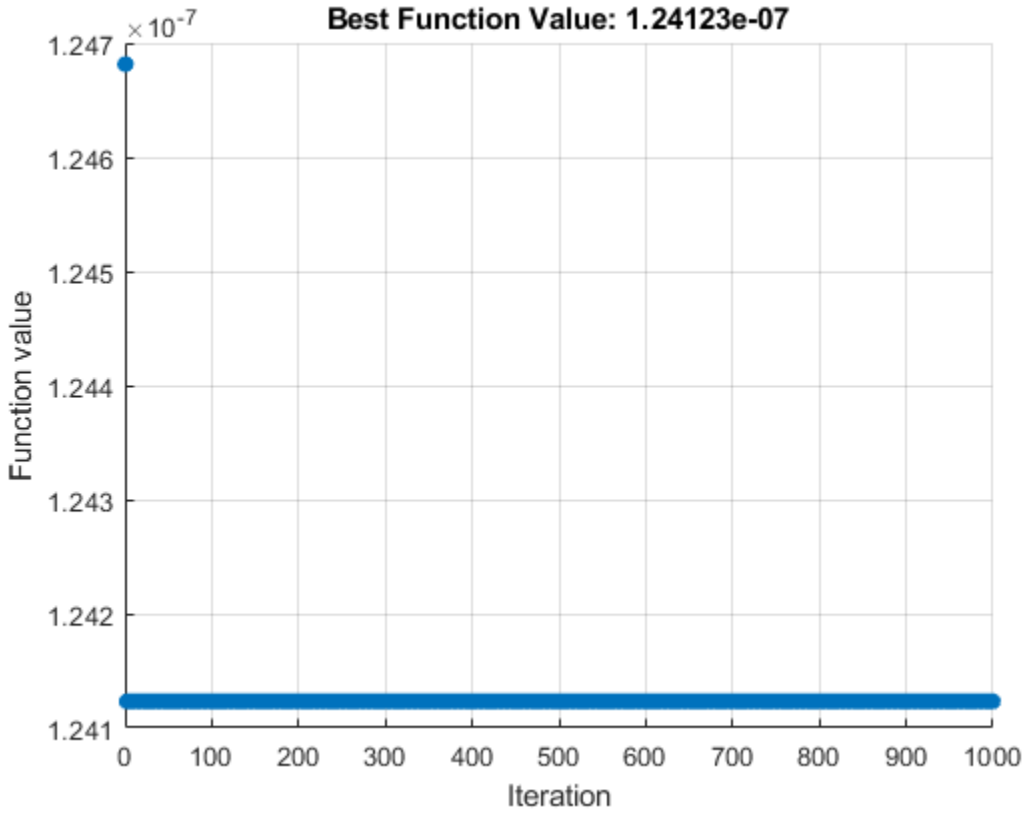
Iteration	f-count	Best f(x)	Current f(x)	Mean temperature
310	315	1.24123e-07	2.26973e-07	3.95596
320	325	1.24123e-07	2.67132e-07	2.36858
330	335	1.24123e-07	2.13976e-07	1.41816
340	345	1.24123e-07	2.51371e-07	0.849102
350	355	1.24123e-07	2.64291e-07	0.508389
360	365	1.24123e-07	2.67412e-07	0.304391
370	375	1.24123e-07	2.27769e-07	0.18225
380	385	1.24123e-07	2.59163e-07	0.10912
* 387	394	1.24123e-07	1.99079e-07	44.6482
390	397	1.24123e-07	2.59867e-07	38.2803
400	407	1.24123e-07	2.63422e-07	22.9198
410	417	1.24123e-07	2.62961e-07	13.7229
420	427	1.24123e-07	2.6352e-07	8.21643
430	437	1.24123e-07	2.53028e-07	4.91948
440	447	1.24123e-07	2.18072e-07	2.94547
450	457	1.24123e-07	2.66216e-07	1.76356
460	467	1.24123e-07	2.43314e-07	1.05591
470	477	1.24123e-07	2.17995e-07	0.632213
480	487	1.24123e-07	2.42846e-07	0.378529
490	497	1.24123e-07	2.5867e-07	0.226639
500	507	1.24123e-07	2.34737e-07	0.135697
510	517	1.24123e-07	2.47099e-07	0.0812471
* 516	525	1.24123e-07	2.44412e-07	46.8828
520	529	1.24123e-07	2.56471e-07	38.1863

530	539	1.24123e-07	2.66916e-07	22.8636
540	549	1.24123e-07	2.55569e-07	13.6893
550	559	1.24123e-07	2.65931e-07	8.19626
560	569	1.24123e-07	2.19666e-07	4.90741
570	579	1.24123e-07	2.48938e-07	2.93825
580	589	1.24123e-07	2.56768e-07	1.75924
590	599	1.24123e-07	2.47878e-07	1.05332
600	609	1.24123e-07	2.64897e-07	0.630661

	Iteration	f-count	Best f(x)	Current f(x)	Mean temperature
	610	619	1.24123e-07	2.27644e-07	0.3776
	620	629	1.24123e-07	1.86732e-07	0.226083
	630	639	1.24123e-07	2.63411e-07	0.135364
	640	649	1.24123e-07	2.6024e-07	0.0810477
	650	659	1.24123e-07	2.55612e-07	0.0485262
*	651	662	1.24123e-07	2.36298e-07	45.7195
	660	671	1.24123e-07	2.59848e-07	28.8147
	670	681	1.24123e-07	2.30381e-07	17.2524
	680	691	1.24123e-07	2.65205e-07	10.3297
	690	701	1.24123e-07	2.40866e-07	6.18475
	700	711	1.24123e-07	2.65978e-07	3.70304
	710	721	1.24123e-07	2.52733e-07	2.21715
	720	731	1.24123e-07	2.5576e-07	1.32749
	730	741	1.24123e-07	2.57743e-07	0.794815
	740	751	1.24123e-07	2.37354e-07	0.475885
	750	761	1.24123e-07	2.45543e-07	0.28493
	760	771	1.24123e-07	2.45408e-07	0.170598
	770	781	1.24123e-07	2.16433e-07	0.102143
	780	791	1.24123e-07	2.44871e-07	0.0611571
*	789	802	1.24123e-07	2.39406e-07	45.5189
	790	803	1.24123e-07	2.39406e-07	43.2429
	800	813	1.24123e-07	2.57319e-07	25.8911
	810	823	1.24123e-07	2.44781e-07	15.502
	820	833	1.24123e-07	2.61498e-07	9.28161
	830	843	1.24123e-07	2.56295e-07	5.55724
	840	853	1.24123e-07	2.14174e-07	3.32733
	850	863	1.24123e-07	2.66578e-07	1.99219
	860	873	1.24123e-07	2.66486e-07	1.1928
	870	883	1.24123e-07	2.18562e-07	0.714173
	880	893	1.24123e-07	1.91502e-07	0.427602
	890	903	1.24123e-07	2.1253e-07	0.256021
	900	913	1.24123e-07	2.37232e-07	0.153289

	Iteration	f-count	Best f(x)	Current f(x)	Mean temperature
	910	923	1.24123e-07	2.389e-07	0.0917799
	920	933	1.24123e-07	2.6383e-07	0.054952
*	921	936	1.24123e-07	2.54047e-07	47.1952
	930	945	1.24123e-07	2.61387e-07	29.7448
	940	955	1.24123e-07	2.64764e-07	17.8093
	950	965	1.24123e-07	2.5865e-07	10.6631
	960	975	1.24123e-07	2.65723e-07	6.38438
	970	985	1.24123e-07	2.56035e-07	3.82256

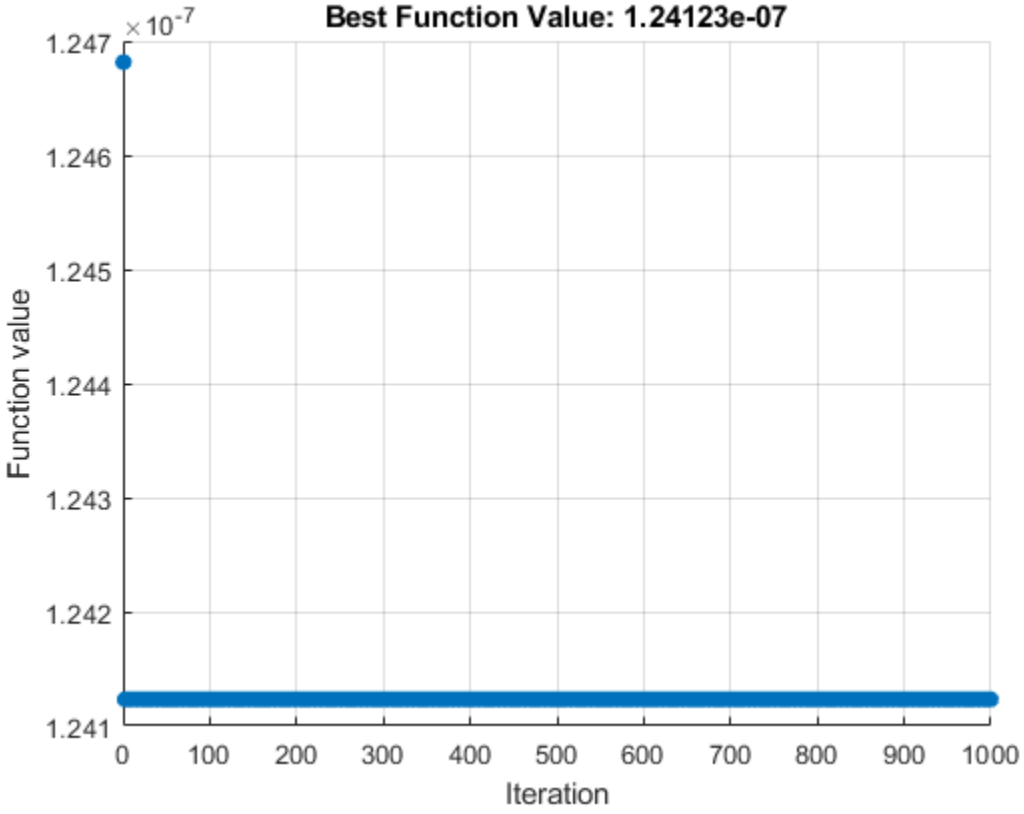
```
   980         995    1.24123e-07    2.67206e-07        2.28871
   990        1005    1.24123e-07    2.63235e-07        1.37034
  1000        1015    1.24123e-07    2.66244e-07        0.82047
simulannealbnd stopped because the change in best function value is less
than options.FunctionTolerance.

best_params =

   1.0e+06 *

    0.0000    1.0000


fval =

   1.2412e-07


tElapsed =

   13.2479
```

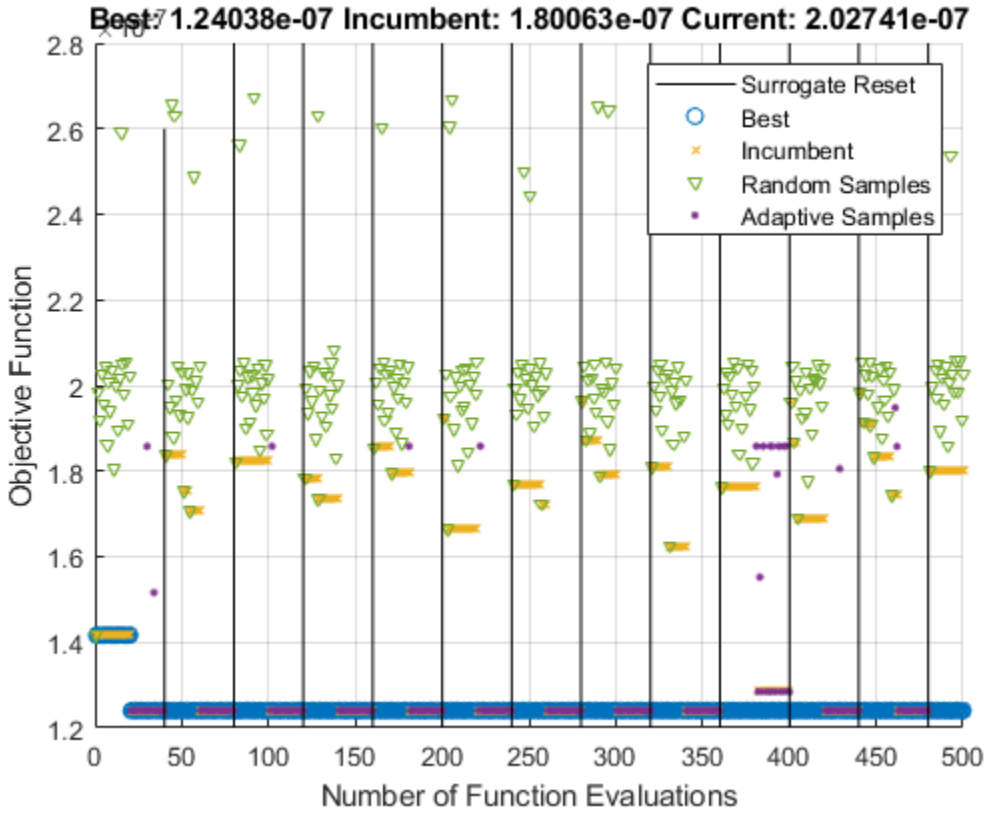


Surrogate

```
[best_params,fval,tElapsed] = run_surrogateContRC(DataSystem,
IteratorCapacitor, IteratorDiod, IteratorResistor_B, IteratorResistor_K,
IteratorTransistor,...
                              t, U_ratio, iRelative, power_b, resistance_b,
P_ratio_b, power_k, P_ratio_k,...
                              pRelative, s1, ...
                              x0, lb, ub)
```

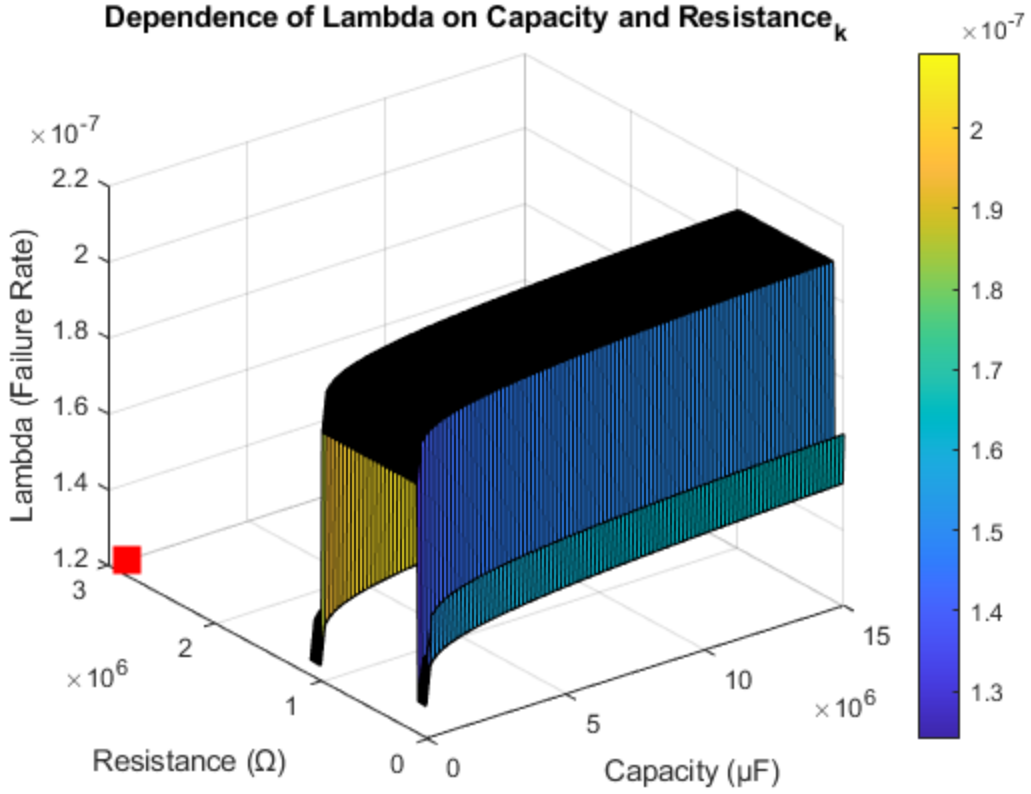
```
surrogateopt stopped because it exceeded the function evaluation limit set
by
'options.MaxFunctionEvaluations'.

best_params =

   1.0e+06 *

    0.0000    2.8126


fval =

   1.2404e-07


tElapsed =

   19.3029
```


Best Function Value: 1.24123e-07
×10^-7
1.247
1.246
1.245
1.244
1.243
1.242
1.241
Function value
0
100
200
300
400
500
600
700
800
900
1000
Iteration


Best: 1.24038e-07 Incumbent: 1.80063e-07 Current: 2.02741e-07
Surrogate Reset
Best
Incumbent
Random Samples
Adaptive Samples
Objective Function
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
0
50
100
150
200
250
300
350
400
450
500
Number of Function Evaluations

```
figure(1);
hold on
sc =
scatter3(best_params(1),best_params(2),fval,'red','square','filled','SizeData
',200);
min(min(lambda_surface.lambda_surface))

hold on
sc =
scatter3(best_params(1),best_params(2),fval,'red','square','filled','SizeData
',200);
```

```
ans =

   1.2404e-07
```



Published with MATLAB® R2023b