Solution to Optimal Power flow by Genetic Algorithm
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1. Introduction

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Optimal Power flow(OPF) is allocating loads to plants for minimum cost while meeting the network constraints. It is formulated as an optimization problem of minimizing the total fuel cost of all committed plant while meeting the network(power flow) constraints. The variants of the problems are numerous which model the objective and the constraints in different ways.

The basic OPF problem can described mathematically as a minimization of problem of minimizing the total fuel cost of all committed plants subject to the constraints.

$$Minimize \sum_{i=1}^{n} \mathrm{F_i}(P_i) \tag{A1}$$

$F_i(P_i)$ is the fuel cost equation of the 'i'th plant. It is the variation of fuel cost ($ or Rs) with generated power (MW).Normally it is expressed as continuous quadratic equation.

$$F_i(P_i) = a_i P_i^2 + b_i P_i + c_i, \quad P_i^{\min} \le P_i \le P_i^{\max} \tag{A2}$$

The total generation should meet the total demand and transmission loss. The transmission loss can be determined from power flow.

$$\sum_{i=1}^{n} P_i = D + P_l \tag{A3}$$

$$P_l = real(\sum_{j}^{n} V_i Y_{ij}{}^{*} V_j), i = 1,2,..n \tag{A4}$$

$$Q_l = imag(\sum_{j}^{n} V_i Y_{ij}{}^{*} V_j), i = 1,2,..n \tag{A5}$$

2. Solution by Genetic Algorithm

1.Collect the busdata,line data and cost coefficients and their limits.

2. Convert the constrained optimization problem as an unconstrained problem by penalty function method.

Minimize

$$\sum_{i=1}^{n} \mathrm{F_i}(P_i) + 1000 * abs(\sum_{i=1}^{n} P_i - D - P_l)$$

3. This software contain two files gaopf.m and opf1.m.opf1.m is a function file which returns the fuel cost,voltage ,Generation, and transmission loss.The ieee 30 bus system is considered for simulation..

4.Change your default folder as opf.Just run gaopf.The results will be displayed on the command window.

Generation	Best f-count	f(x)	Mean f(x)	Stall Generations
1	50	805	1167	0
2	100	803.3	1533	0
3	150	803.3	1614	1
4	200	803.3	1436	2
5	250	803	2066	0
6	300	803	1537	1
7	350	803	1475	2
8	400	803	2278	3
9	450	803	2173	4
10	500	802.7	2009	0
11	550	802.7	2072	1

12	600	802.7	2179	2
13	650	802.7	2040	3
14	700	802.7	1765	0
15	750	802.7	1797	1
16	800	802.7	1861	2
17	850	802.7	1575	3
18	900	802.7	1371	4
19	950	802.7	1606	5
20	1000	802.7	1526	6
21	1050	802.7	1620	7
22	1100	802.7	1843	8
23	1150	802.7	1751	9
24	1200	802.7	1992	10
25	1250	802.5	1837	0
26	1300	802.5	1809	1
27	1350	802.5	1760	2
28	1400	802.5	1847	3
29	1450	802.5	1855	4
30	1500	802.5	1799	5
31	1550	802.5	1487	6
32	1600	802.4	1627	0
33	1650	802.4	1757	1
34	1700	802.4	1752	2
35	1750	802.4	1831	3
36	1800	802.4	1598	4
37	1850	802.4	1808	5
38	1900	802.4	1405	6
39	1950	802.4	1880	7
40	2000	802.4	1914	8
41	2050	802.4	1877	9
42	2100	802.4	1440	10

43	2150	802.4	1286	11
44	2200	802.4	1365	12
45	2250	802.4	1444	13
46	2300	802.4	1371	14
47	2350	802.4	1514	15
48	2400	802.4	1725	16
49	2450	802.4	1673	0
50	2500	802.4	1372	1
51	2550	802.4	1708	2
52	2600	802.3	1830	0
53	2650	802.3	1682	1
54	2700	802.3	1522	2
55	2750	802.3	1338	3
56	2800	802.3	1305	4
57	2850	802.3	1078	5
58	2900	802.3	1249	6
59	2950	802.3	1359	7
60	3000	802.3	1057	8
61	3050	802.3	1223	9
62	3100	802.3	1357	10
63	3150	802.3	1480	0
64	3200	802.3	1424	1
65	3250	802.3	1489	2
66	3300	802.3	1217	3
67	3350	802.3	1557	4
68	3400	802.3	1118	5
69	3450	802.3	1254	6
70	3500	802.3	1144	7
71	3550	802.3	1522	8
72	3600	802.3	1313	9
73	3650	802	1406	0

74	3700	802	1356	1
75	3750	802	1460	2
76	3800	802	1538	3
77	3850	802	1241	4
78	3900	802	1578	5
79	3950	802	1697	6
80	4000	801.9	1539	0
81	4050	801.9	1318	0
82	4100	801.9	1392	0
83	4150	801.9	1195	1
84	4200	801.9	1115	2
85	4250	801.9	1115	3
86	4300	801.9	1228	4
87	4350	801.9	1278	5
88	4400	801.9	1416	6
89	4450	801.9	1285	7
90	4500	801.8	1492	0
91	4550	801.8	1363	1
92	4600	801.8	1233	2
93	4650	801.8	1331	3
94	4700	801.8	1393	4
95	4750	801.8	1324	5
96	4800	801.8	987	6
97	4850	801.8	1273	7
98	4900	801.8	1072	8
99	4950	801.8	1231	9
100	5000	801.8	1243	10
101	5050	801.8	1001	11
102	5100	801.8	1085	12
103	5150	801.8	955.5	13
104	5200	801.8	1010	14

105	5250	801.8	1323	15
106	5300	801.8	1119	16
107	5350	801.8	998.8	17
108	5400	801.8	1154	18
109	5450	801.8	973.9	19
110	5500	801.8	914	20
111	5550	801.8	1175	21
112	5600	801.8	1027	0
113	5650	801.8	1019	1
114	5700	801.8	1046	2
115	5750	801.8	1044	3
116	5800	801.8	1150	4
117	5850	801.8	1010	5
118	5900	801.8	1207	6
119	5950	801.8	1219	7
120	6000	801.8	1123	8
121	6050	801.8	1024	9
122	6100	801.8	1008	10
123	6150	801.8	1031	0
124	6200	801.8	982.3	1
125	6250	801.8	1048	0
126	6300	801.8	1118	1
127	6350	801.8	952.8	0
128	6400	801.8	1113	1
129	6450	801.8	1118	2
130	6500	801.8	912.4	3
131	6550	801.8	1058	0
132	6600	801.8	976.3	1
133	6650	801.8	1111	2
134	6700	801.8	1047	3
135	6750	801.8	993	4

136	6800	801.8	962.9	5
137	6850	801.8	1014	6
138	6900	801.8	892.5	7
139	6950	801.8	872.6	8
140	7000	801.8	895.6	9
141	7050	801.8	1084	10
142	7100	801.8	1036	11
143	7150	801.8	863.5	12
144	7200	801.8	995.7	13
145	7250	801.8	941.4	14
146	7300	801.8	927.3	15
147	7350	801.8	937.4	16
148	7400	801.8	940	17
149	7450	801.8	900.3	18
150	7500	801.8	913.6	19
151	7550	801.8	905.9	20
152	7600	801.8	898.6	21
153	7650	801.8	904.2	22
154	7700	801.8	844.3	23
155	7750	801.8	918	24
156	7800	801.8	811.2	25
157	7850	801.8	813.4	26
158	7900	801.8	859.7	27
159	7950	801.8	878.7	28
160	8000	801.8	889.8	29
161	8050	801.8	852.7	30
162	8100	801.8	822.7	31
163	8150	801.8	845.8	32
164	8200	801.8	886.9	33
165	8250	801.8	845.7	34
166	8300	801.8	805.7	35

167	8350	801.8	804.5	36
168	8400	801.8	805.4	37
169	8450	801.8	804.7	38
170	8500	801.8	835.1	39
171	8550	801.8	839.2	40
172	8600	801.8	856.1	41
173	8650	801.8	826	42
174	8700	801.8	820.6	43
175	8750	801.8	820.5	44
176	8800	801.8	826.2	0
177	8850	801.8	803.5	0
178	8900	801.8	803.5	1
179	8950	801.8	803.1	2
180	9000	801.8	805.5	3
181	9050	801.8	803.1	4
182	9100	801.8	802.8	5
183	9150	801.8	808.5	6
184	9200	801.8	808.3	7
185	9250	801.8	808.3	8
186	9300	801.8	802.5	0
187	9350	801.8	802.5	1
188	9400	801.8	802.2	2
189	9450	801.8	802.2	3
190	9500	801.8	802.1	0
191	9550	801.8	802.1	1
192	9600	801.8	802.1	2
193	9650	801.8	802	3
194	9700	801.8	802	0
195	9750	801.8	801.9	1
196	9800	801.8	801.9	0
197	9850	801.8	801.9	1

198 9900 801.8 801.8 2

199 9950 801.8 801.8 0

200 10000 801.8 801.8 0

Optimization terminated: maximum number of generations exceeded.

F =

801.8295

Pgg =

176.9346 49.1776 21.4519 21.8496 12.1616 11.2210

vv =

Columns 1 through 15

1.0600 1.0430 1.0253 1.0170 1.0100 1.0147 1.0050 1.0100 1.0530 1.0468 1.0820 1.0598 1.0710 1.0449 1.0402

Columns 16 through 30

1.0471 1.0415 1.0304 1.0277 1.0317 1.0345 1.0350 1.0295 1.0237 1.0204 1.0027 1.0269 1.0128 1.0071 0.9957

TL = 9.3962

ALL THE BEST