summarized in [1, Table VII] for generating unit 2 is 407.9727 MW. This value of power output of generating unit 2 violates the constraint [1, eq. (6)]. In what way does this result validate the feasibility of the PSO method?

2) In [1, Table V], the author tabulated the generating unit data for Example 2 (15-Unit system). The previous power output of the generating unit 5 is recorded as 90 MW. But the minimum and maximum generation capabilities of this unit are 150 and 470 MW, respectively. Can a generating unit provide such a power output value, which is outside the limits?
3) [1, Table XI] summarizes the comparison of computation efficiency of the PSO method and the Genetic Algorithm method for the three examples adopted in the paper. For Example 2 (15-unit system), it is reported that, the average generation cost obtained using the PSO method after the 100th iteration is 3,3105 ($). Why this sudden change in average generation cost in-between the progress of the iterations and why is this value the average for 20 trial runs? What is the minimum value obtained out of all these 20 trial runs? Also, provide the corresponding generating unit outputs.
4) When we studied and verified the results recorded in the article for Example 1, we found that the total transmission network losses reported in [1, Table III] do not match with our results obtained by substituting the same values of power outputs of the generating units. When the $\mathrm{B_{oo}}$ value of 0.056 is changed to 0.0056 (after experimenting), then it matches. In the same manner, when we studied and verified the results recorded for Example 2, we found that the total transmission network losses reported in [1, Table VII] do not match with our results obtained by substituting the same values of power outputs of the generating units. When the $\mathrm{B_{ij}}$ ($\mathrm{i} = 1$ and $\mathrm{j} = 10$) value of 0.0005 is changed to -0.0005 (as the B loss coefficient matrix is a symmetric matrix, hence $\mathrm{B_{ji}} = -0.0005$), then it matches. Does the author have any comments on the changes in some of these B loss coefficients?
5) [1, eq. (2)] discusses the unit ramp rate limit when the generation decreases for a generating unit. It is noticed that there is a typing mistake. The equation is given as $\mathrm{P_i} - \mathrm{P_i^0} \leq \mathrm{DR_i}$, but it shall be $\mathrm{P_i^0} - \mathrm{P_i} \leq \mathrm{DR_i}$. If it is not, explain how [1, eq. (6)] is formulated.
6) Is there any difference between the Total generation cost ($\$/\mathrm{h}$) of [1, Tables III, VII, and IX] and Minimum generation cost ($) of [1, Tables IV, VIII, and X]? If yes, what is the difference? If not, why two different units ($\$/\mathrm{h}$ and $) for the same quantity?
7) While discussing about the evaluation function, the author states that, in order to limit the evaluation value of each individual of the population within a feasible range, the generation power output must satisfy the constraints in [1, eq. (6)–(8)]. Conversely, in Step 7 of the search procedure, the author states that the new position of the agents must satisfy the constraints of [1, eq. (6) and (7)]. What happened to the constraint [1, eq. (8)], would it be automatically satisfied?
8) What is the explanation for symbol "l" in [1, eq. (5), (7), and (8)]—does this have any significant effect in the formulation of the economic dispatch problem?

References

[1] Z.-L. Gaing, "Particle swarm optimization to solving the economic dispatch considering the generator constraints," *IEEE Trans. Power Syst.*, vol. 18, pp. 1187–1195, Aug. 2003.

Closure to "Discussion of 'Particle Swarm Optimization to Solving the Economic Dispatch Considering the Generator Constraints'"

Zwe-Lee Gaing

The author would like to thank the discussers for their insightful comments which have added significant value to this paper [1]. Below are the responses to their suggestions.

1) After re-checking the previous power output data (P_i^0) of a 15-unit system (Example 2) in [1, Table VII], two typing mistakes must be corrected. The power output of the generating unit 2 should be modified to be 360 MW, while that of the generating unit 5 should be modified to be 190 MW. With such modification, the generation capability of the generating units 2 and 5 would not violate the ramp rate limit (constraint [1, eq. (6)]), respectively.
2) The typing mistakes have been corrected and explained as above.
3) Because the PSO method is one of the stochastic optimization methods, different results may be generated by every trial. Hence, each sample system performed 20 trial runs at different number of iterations (20, 50, 100, 150, and 200) using the two proposed methods to verify independently the computation efficiency. In the case of Example 2, when the number of iterations is set to be 100, the average generation cost obtained using the PSO method is 33 105 ($). Owing to space limitations, we will list merely both the minimum generation costs obtained by both PSO and GA through 20 trial runs (number of iterations is 100) in Example 2. The results are as shown in the following table.

Unit power output	*PSO method*	*GA method*
P_1*(MW)*	*450.2978*	*455.0000*
P_2*(MW)*	*440.0000*	*440.0000*
P_3*(MW)*	*118.1179*	*119.5719*
P_4*(MW)*	*122.4839*	*117.9836*
P_5*(MW)*	*270.0000*	*270.0000*
P_6*(MW)*	*284.0404*	*324.8959*
P_7*(MW)*	*430.0000*	*314.1524*
P_8*(MW)*	*151.2743*	*140.3805*
P_9*(MW)*	*111.3938*	*113.2752*
P_{10}*(MW)*	*75.1117*	*128.6250*
P_{11}*(MW)*	*50.4559*	*63.2303*
P_{12}*(MW)*	*44.6579*	*44.1564*
P_{13}*(MW)*	*47.3174*	*77.2804*
P_{14}*(MW)*	*37.1838*	*25.7138*
P_{15}*(MW)*	*35.0895*	*34.0248*
Total power output(MW)	*2667.4*	*2668.3*
Ploss(MW)	*37.3329*	*38.2499*
Total generation cost ($)	*33,020*	*33,149*

4) In this paper, a reasonable $\boldsymbol{B}$ loss coefficient matrix of a power system network was employed to draw the transmission line loss and satisfy the transmission capacity constraints. Moreover, $\boldsymbol{B}$ is a symmetric matrix. After re-checking the elements in the proposed $\boldsymbol{B}$ loss coefficients matrix, the B_{oo} value in Example 1 and the $B_{1,10}$ value in Example 2 should be corrected to be 0.0056 and -0.0005, respectively.

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5) There is one typing error in [1, eq. (6)]. The equation should be corrected to be $P_i^0 - P_i \leq DR_i$.
6) This paper deals mainly with the static ED problem taking into consideration the operating constraints of generators in the specific dispatch period. In general, the dispatch interval is set to be one hour. Hence, both units $(\$/\mathrm{h})$ and (\$) denote the generation cost.
7) In this paper, a constant reasonable $\boldsymbol{B}$ loss coefficients matrix of power system network was employed to draw the transmission line loss and satisfy the transmission capacity constraints in solving ED problem. When the generation power outputs of all on-line units were within a reasonable range, the transmission loss P_L of system would then be small and the evaluation function would generate an acceptable evaluation value. Otherwise, the transmission loss P_L would be large and the evaluation value would be unacceptable. Because the transmission loss P_L has been calculated in Step 2, therefore, the constraint [1, (8)] is omitted from Step 7. In constraint [1, (7)], symbols "l" and "u" denote the lower bound and upper bound of the prohibited zone of the generator, respectively [2]. Traditionally, for convenience in solving the ED problem, the unit generation output is usually assumed to be adjusted smoothly and instantaneously. The optimal generation dispatch among the operating units also satisfies the system constraints, such as power balance and line flow limit. Practically, the operating range of all on-line units is also restricted by their ramp rate limits for forcing the units to operate continually between two adjacent specific operation periods [3]. In addition, the prohibited operating zones in the input-output curve of generator are due to steam valve operation or vibration in a shaft bearing. References [2]–[4] have shown the input–output performance curve for a typical thermal unit with many valve points. These valve points generate many prohibited zones. Because it is difficult to determine the prohibited zone by actual performance testing or operating records, the best economy is achieved by avoiding operation in areas that are in actual operation. Hence, the two constraints of generator operation must be taken into account to achieve true economic operation. According to experimental experiences, the constraints of generator are embedded in the constraints of the traditional ED problem, they will degrade the solution quality, the convergence rate, and the computation efficiency of the proposed methods.

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