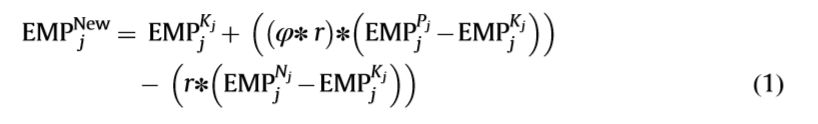
**SENARYOLAR**



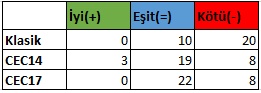
Yukarıdaki denklem Elektromanyetik Alan Optimizasyon (EFO) algoritmasının en önemli ve tek matematiksel denklemidir. Bu denklemde, komşuluk aramasında kullanılan çözüm adaylarının popülasyondaki indeksleri şu şekildedir:

* j , yeni elektromanyetik parçacığın seçilecek olan elektromıknatısının indeksidir.
* Pj , pozitif alandan seçilen elektromanyetik parçacığın j. indeksidir.
* Kj , nötr alandan seçilen elektromanyetik parçacığın j. indeksidir.
* Nj , negatif alandan seçilen elektromanyetik parçacığın j. indeksidir.

**Senaryo-1:**

Komşuluk araması yapılırken pozitif alandan seçilme olasılığı düşükse, pozitif alandan seçilen çözüm adayının yerine FDB seçim yöntemi ile belirlenen çözüm adayının kullanılması durumudur.

* Pj , FDB seçim yöntemi ile seçilecektir.
* Kj , popülasyonun nötr alanından rastgele seçilecektir.
* Nj , popülasyonun negatif alanından rastgele seçilecektir.



**Şekil.1**  - Case-1 Genel Sonuçlar

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-1** |
|  |  |  |
| *f1* | 2.05E+01(1.03E-01) = | 2.05E+01(8.05E-02) = |
| *f2* | 4.19E-13(2.73E-12) = | 5.17E-04(2.06E-03) - |
| *f3* | 1.44E-36(6.22E-36) = | 8.45E-26(4.72E-25) - |
| *f4* | 6.67E-01(3.15E-16) = | 6.41E-01(1.31E-01) - |
| *f5* | 2.09E-39(1.11E-38) = | 2.36E-33(1.00E-32) - |
| *f6* | 7.18E-66(3.98E-70) = | 7.18E-66(1.91E-68) - |
| *f7* | 7.27E-03(1.40E-02) = | 1.06E-02(1.98E-02) = |
| *f8* | 5.30E-01(2.98E-01) = | 6.81E-01(2.92E-01) - |
| *f9* | 1.29E-02(3.58E-02) = | 8.62E-03(2.98E-02) = |
| *f10* | 7.21E-01(1.16E-01) = | 8.65E-01(3.28E-01) - |
| *f11* | 4.07E-03(2.03E-02) = | 2.03E-03(1.45E-02) = |
| *f12* | 8.66E-03(1.54E-02) = | 1.22E-02(1.72E-02) - |
| *f13* | 9.94E-03(2.74E-03) = | 1.54E-02(5.04E-03) - |
| *f14* | 1.96E+01(4.60E+00) = | 1.80E+01(4.76E+00) = |
| *f15* | 2.41E+01(2.51E+01) = | 2.48E+01(2.61E+01) = |
| *f16* | 2.75E+00(2.75E+00) = | 1.59E+01(2.67E+01) - |
| *f17* | 3.65E-01(1.15E-01) = | 4.21E-01(1.02E-01) - |
| *f18* | 7.13E-03(3.63E-03) = | 8.99E-03(4.83E-03) - |
| *f19* | 1.82E-03(1.30E-02) = | 1.05E-11(3.38E-12) = |
| *f20* | 2.09E-21(1.13E-20) = | 6.67E-17(4.71E-16) - |
| *f21* | 1.98E+00(7.99E-01) = | 5.19E+00(1.50E+00) - |
| *f22* | 6.29E-22(3.67E-21) = | 6.01E-19(3.17E-18) - |
| *f23* | 4.85E-43(2.76E-42) = | 1.22E-37(8.24E-37) - |
| *f24* | 1.54E-31(4.77E-31) = | 2.16E-31(5.17E-31) = |
| *f25* | 5.35E-14(2.89E-12) = | -1.96E-13(5.24E-13) = |
| *f26* | 3.93E-81(2.78E-80) = | 1.09E-62(7.80E-62) - |
| *f27* | 3.75E-43(1.86E-42) = | 7.98E-39(2.15E-38) - |
| *f28* | 3.34E-63(2.38E-62) = | 1.40E-54(7.40E-54) - |
| *f29* | 2.22E-01(1.89E-01) = | 1.46E+00(2.85E+00) - |
| *f30* | 3.73E-01(3.67E-01) = | 4.67E-01(8.30E-01) = |
| + / = / - |  | 0/ 10 / 20 |

**Şekil.2 –** Case-1 Klasik Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-1** |
|  |  |  |
| *f1* | 6.12E+05(2.85E+05) = | 9.24E+05(5.37E+05) - |
| *f2* | 1.03E+03(1.96E+03) = | 6.33E+03(6.72E+03) - |
| *f3* | 2.11E+03(3.13E+03) = | 2.93E+03(5.22E+03) = |
| *f4* | 5.03E+01(4.32E+01) = | 5.02E+01(4.43E+01) = |
| *f5* | 2.11E+01(4.81E-02) = | 2.10E+01(6.27E-02) = |
| *f6* | 5.30E+00(1.62E+00) = | 6.16E+00(2.05E+00) - |
| *f7* | 6.36E-03(1.22E-02) = | 1.78E-02(3.09E-02) - |
| *f8* | 7.54E-01(7.85E-01) = | 6.32E-01(8.24E-01) = |
| *f9* | 1.35E+02(6.63E+01) = | 1.25E+02(6.65E+01) = |
| *f10* | 4.13E+00(2.76E+00) = | 4.61E+00(2.62E+00) = |
| *f11* | 7.22E+03(3.46E+02) = | 7.23E+03(4.50E+02) = |
| *f12* | 3.05E+00(4.24E-01) = | 3.06E+00(3.55E-01) = |
| *f13* | 4.20E-01(7.26E-02) = | 4.53E-01(9.51E-02) - |
| *f14* | 3.71E-01(8.60E-02) = | 3.45E-01(1.06E-01) + |
| *f15* | 1.55E+01(2.48E+00) = | 1.60E+01(3.09E+00) = |
| *f16* | 1.24E+01(4.03E-01) = | 1.25E+01(3.38E-01) = |
| *f17* | 2.13E+05(1.03E+05) = | 4.17E+05(3.50E+05) - |
| *f18* | 3.49E+03(3.83E+03) = | 2.59E+03(3.46E+03) = |
| *f19* | 1.54E+01(2.20E+01) = | 1.20E+01(1.86E+01) = |
| *f20* | 8.51E+03(6.36E+03) = | 8.76E+03(5.86E+03) = |
| *f21* | 1.66E+05(1.45E+05) = | 2.06E+05(2.60E+05) = |
| *f22* | 2.80E+02(2.28E+02) = | 3.83E+02(2.12E+02) - |
| *f23* | 3.15E+02(6.52E-12) = | 3.15E+02(2.81E-12) + |
| *f24* | 2.31E+02(4.93E+00) = | 2.32E+02(5.13E+00) = |
| *f25* | 2.08E+02(2.72E+00) = | 2.07E+02(2.62E+00) + |
| *f26* | 1.31E+02(4.58E+01) = | 1.37E+02(5.18E+01) = |
| *f27* | 4.83E+02(6.37E+01) = | 5.19E+02(7.74E+01) - |
| *f28* | 9.18E+02(4.13E+01) = | 9.16E+02(5.84E+01) = |
| *f29* | 1.41E+03(4.24E+02) = | 1.32E+03(4.29E+02) = |
| *f30* | 2.81E+03(9.23E+02) = | 2.94E+03(9.45E+02) = |
| + / = / - |  | 3/ 19 / 8 |

**Şekil.3 –** Case-1 CEC14 Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-1** |
|  |  |  |
| *f1* | 3.61E+03(3.93E+03) = | 3.55E+03(4.06E+03) = |
| *f2* | 5.79E+13(4.03E+14) = | 1.37E+12(5.64E+12) - |
| *f3* | 4.40E+04(1.20E+04) = | 4.47E+04(1.42E+04) = |
| *f4* | 6.65E+01(2.70E+01) = | 6.86E+01(3.33E+01) = |
| *f5* | 1.41E+02(6.04E+01) = | 1.35E+02(6.57E+01) = |
| *f6* | 1.72E-02(1.76E-02) = | 2.77E-02(2.16E-02) - |
| *f7* | 2.07E+02(3.42E+01) = | 2.12E+02(4.57E+01) = |
| *f8* | 1.17E+02(7.53E+01) = | 1.26E+02(6.74E+01) = |
| *f9* | 1.73E+01(1.45E+01) = | 5.58E+01(1.23E+02) - |
| *f10* | 7.41E+03(3.04E+02) = | 7.32E+03(4.34E+02) = |
| *f11* | 8.79E+01(6.67E+01) = | 8.87E+01(6.26E+01) = |
| *f12* | 1.16E+05(9.12E+04) = | 1.40E+05(6.48E+04) - |
| *f13* | 7.29E+03(1.00E+04) = | 1.21E+04(1.21E+04) - |
| *f14* | 1.41E+04(9.83E+03) = | 2.22E+04(2.10E+04) = |
| *f15* | 5.71E+03(6.12E+03) = | 7.24E+03(1.01E+04) = |
| *f16* | 1.26E+03(5.61E+02) = | 1.26E+03(5.22E+02) = |
| *f17* | 1.67E+02(1.84E+02) = | 1.94E+02(1.83E+02) = |
| *f18* | 9.85E+05(6.78E+05) = | 1.63E+06(1.33E+06) - |
| *f19* | 8.51E+03(1.10E+04) = | 9.45E+03(1.17E+04) = |
| *f20* | 1.95E+02(2.09E+02) = | 2.62E+02(2.69E+02) = |
| *f21* | 3.42E+02(5.74E+01) = | 3.14E+02(6.83E+01) = |
| *f22* | 1.39E+03(2.82E+03) = | 2.15E+03(3.38E+03) - |
| *f23* | 3.90E+02(3.44E+01) = | 3.94E+02(3.22E+01) = |
| *f24* | 5.96E+02(4.53E+01) = | 5.97E+02(4.58E+01) = |
| *f25* | 3.89E+02(8.20E+00) = | 3.91E+02(1.12E+01) = |
| *f26* | 1.37E+03(3.43E+02) = | 1.44E+03(4.25E+02) - |
| *f27* | 5.32E+02(1.08E+01) = | 5.32E+02(9.21E+00) = |
| *f28* | 3.54E+02(6.12E+01) = | 3.77E+02(5.17E+01) = |
| *f29* | 5.93E+02(1.42E+02) = | 5.93E+02(1.33E+02) = |
| *f30* | 5.45E+03(2.75E+03) = | 5.95E+03(2.98E+03) = |
| + / = / - |  | 0/ 22 / 8 |

**Şekil.4 –** Case-1 CEC17 Problem Sonuçları

**Senaryo-2:**

Komşuluk araması yapılırken pozitif alandan seçilme olasılığı düşükse, negatif alandan seçilen çözüm adayının yerine FDB seçim yöntemi ile belirlenen çözüm adayının kullanılması durumudur.

* Pj , popülasyonun pozitif alanından rastgele seçilecektir.
* Kj , popülasyonun nötr alanından rastgele seçilecektir.
* Nj , FDB seçim yöntemi ile seçilecektir.

|  |  |  |  |
| --- | --- | --- | --- |
|  | İyi(+) | Eşit(=) | Kötü(-) |
| **Klasik** | 0 | 1 | 29 |
| **CEC14** | 4 | 6 | 20 |
| **CEC17** | 5 | 6 | 19 |

**Şekil.5** – Case-2 Genel Sonuçlar

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-2** |
|  |  |  |
| *f1* | 8.66E-03(1.54E-02) = | 4.54E-02(3.81E-02) - |
| *f2* | 9.94E-03(2.74E-03) = | 3.06E+00(2.04E+00) - |
| *f3* | 1.96E+01(4.60E+00) = | 2.62E+01(6.16E+00) - |
| *f4* | 2.41E+01(2.51E+01) = | 1.21E+02(3.71E+01) - |
| *f5* | 2.75E+00(2.75E+00) = | 1.85E+03(6.61E+02) - |
| *f6* | 3.65E-01(1.15E-01) = | 7.85E-01(2.16E-01) - |
| *f7* | 7.13E-03(3.63E-03) = | 5.42E-02(2.65E-02) - |
| *f8* | 1.82E-03(1.30E-02) = | 2.99E+00(2.44E+00) - |
| *f9* | 2.09E-21(1.13E-20) = | 8.44E-01(5.31E-01) - |
| *f10* | 1.98E+00(7.99E-01) = | 8.56E+00(1.71E+00) - |
| *f11* | 6.29E-22(3.67E-21) = | 7.90E-02(4.81E-02) - |
| *f12* | 4.85E-43(2.76E-42) = | 8.10E-01(7.70E-01) - |
| *f13* | 1.54E-31(4.77E-31) = | 5.67E-01(5.90E-01) - |
| *f14* | 5.35E-14(2.89E-12) = | 3.43E-02(3.06E-02) - |
| *f15* | 3.93E-81(2.78E-80) = | 5.24E-04(2.55E-03) - |
| *f16* | 3.75E-43(1.86E-42) = | 1.57E-01(1.71E-01) - |
| *f17* | 3.34E-63(2.38E-62) = | 3.21E-03(1.02E-02) - |
| *f18* | 2.22E-01(1.89E-01) = | 5.36E-01(2.06E-01) - |
| *f19* | 3.73E-01(3.67E-01) = | 7.63E+00(5.90E+00) - |
| *f20* | 1.95E+02(2.09E+02) = | 2.62E+02(2.69E+02) = |
| *f21* | 3.42E+02(5.74E+01) = | 3.14E+02(6.83E+01) = |
| *f22* | 1.39E+03(2.82E+03) = | 2.15E+03(3.38E+03) - |
| *f23* | 3.90E+02(3.44E+01) = | 3.94E+02(3.22E+01) = |
| *f24* | 5.96E+02(4.53E+01) = | 5.97E+02(4.58E+01) = |
| *f25* | 3.89E+02(8.20E+00) = | 3.91E+02(1.12E+01) = |
| *f26* | 1.37E+03(3.43E+02) = | 1.44E+03(4.25E+02) - |
| *f27* | 5.32E+02(1.08E+01) = | 5.32E+02(9.21E+00) = |
| *f28* | 3.54E+02(6.12E+01) = | 3.77E+02(5.17E+01) = |
| *f29* | 5.93E+02(1.42E+02) = | 5.93E+02(1.33E+02) = |
| *f30* | 5.45E+03(2.75E+03) = | 5.95E+03(2.98E+03) = |
| + / = / - |  | 0/ 1 / 29 |

**Şekil.6 –** Case-2 Klasik Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-2** |
|  |  |  |
| *f1* | 6.12E+05(2.85E+05) = | 3.82E+07(2.18E+07) - |
| *f2* | 1.03E+03(1.96E+03) = | 8.24E+06(6.51E+06) - |
| *f3* | 2.11E+03(3.13E+03) = | 1.02E+04(1.17E+04) - |
| *f4* | 5.03E+01(4.32E+01) = | 1.32E+02(4.35E+01) - |
| *f5* | 2.11E+01(4.81E-02) = | 2.10E+01(6.11E-02) = |
| *f6* | 5.30E+00(1.62E+00) = | 9.61E+00(2.11E+00) - |
| *f7* | 6.36E-03(1.22E-02) = | 1.03E+00(9.29E-02) - |
| *f8* | 7.54E-01(7.85E-01) = | 1.60E+00(8.77E-01) - |
| *f9* | 1.35E+02(6.63E+01) = | 6.96E+01(6.10E+01) + |
| *f10* | 4.13E+00(2.76E+00) = | 7.34E+00(3.44E+00) - |
| *f11* | 7.22E+03(3.46E+02) = | 7.00E+03(4.82E+02) + |
| *f12* | 3.05E+00(4.24E-01) = | 3.15E+00(3.70E-01) = |
| *f13* | 4.20E-01(7.26E-02) = | 4.08E-01(8.13E-02) = |
| *f14* | 3.71E-01(8.60E-02) = | 3.00E-01(5.10E-02) + |
| *f15* | 1.55E+01(2.48E+00) = | 1.70E+01(8.01E+00) = |
| *f16* | 1.24E+01(4.03E-01) = | 1.21E+01(3.89E-01) + |
| *f17* | 2.13E+05(1.03E+05) = | 3.42E+06(2.09E+06) - |
| *f18* | 3.49E+03(3.83E+03) = | 1.39E+05(2.11E+05) - |
| *f19* | 1.54E+01(2.20E+01) = | 2.12E+01(1.83E+01) - |
| *f20* | 8.51E+03(6.36E+03) = | 1.66E+04(8.11E+03) - |
| *f21* | 1.66E+05(1.45E+05) = | 6.59E+05(4.90E+05) - |
| *f22* | 2.80E+02(2.28E+02) = | 3.11E+02(1.94E+02) = |
| *f23* | 3.15E+02(6.52E-12) = | 3.18E+02(1.49E+00) - |
| *f24* | 2.31E+02(4.93E+00) = | 2.32E+02(5.07E+00) = |
| *f25* | 2.08E+02(2.72E+00) = | 2.14E+02(2.15E+00) - |
| *f26* | 1.31E+02(4.58E+01) = | 1.55E+02(5.03E+01) - |
| *f27* | 4.83E+02(6.37E+01) = | 6.07E+02(8.08E+01) - |
| *f28* | 9.18E+02(4.13E+01) = | 9.91E+02(8.83E+01) - |
| *f29* | 1.41E+03(4.24E+02) = | 2.83E+03(2.96E+03) - |
| *f30* | 2.81E+03(9.23E+02) = | 1.05E+04(6.08E+03) - |
| + / = / - |  | 4/ 6 / 20 |

**Şekil.7 –** Case-2 CEC14 Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-2** |
|  |  |  |
| *f1* | 3.61E+03(3.93E+03) = | 4.14E+06(2.77E+06) - |
| *f2* | 5.79E+13(4.03E+14) = | 2.06E+22(1.46E+23) - |
| *f3* | 4.40E+04(1.20E+04) = | 4.61E+04(1.52E+04) = |
| *f4* | 6.65E+01(2.70E+01) = | 1.16E+02(2.98E+01) - |
| *f5* | 1.41E+02(6.04E+01) = | 6.08E+01(5.21E+01) + |
| *f6* | 1.72E-02(1.76E-02) = | 1.45E-01(9.31E-02) - |
| *f7* | 2.07E+02(3.42E+01) = | 1.31E+02(6.32E+01) + |
| *f8* | 1.17E+02(7.53E+01) = | 6.42E+01(5.89E+01) + |
| *f9* | 1.73E+01(1.45E+01) = | 5.13E+01(4.44E+01) - |
| *f10* | 7.41E+03(3.04E+02) = | 7.28E+03(4.61E+02) = |
| *f11* | 8.79E+01(6.67E+01) = | 1.46E+03(1.57E+03) - |
| *f12* | 1.16E+05(9.12E+04) = | 3.56E+06(3.18E+06) - |
| *f13* | 7.29E+03(1.00E+04) = | 3.28E+06(3.32E+06) - |
| *f14* | 1.41E+04(9.83E+03) = | 7.84E+05(9.11E+05) - |
| *f15* | 5.71E+03(6.12E+03) = | 4.17E+05(6.14E+05) - |
| *f16* | 1.26E+03(5.61E+02) = | 1.11E+03(6.16E+02) = |
| *f17* | 1.67E+02(1.84E+02) = | 1.97E+02(1.78E+02) = |
| *f18* | 9.85E+05(6.78E+05) = | 1.77E+06(1.75E+06) - |
| *f19* | 8.51E+03(1.10E+04) = | 1.68E+05(3.47E+05) - |
| *f20* | 1.95E+02(2.09E+02) = | 2.18E+02(2.02E+02) = |
| *f21* | 3.42E+02(5.74E+01) = | 2.78E+02(6.08E+01) + |
| *f22* | 1.39E+03(2.82E+03) = | 6.75E+02(1.94E+03) - |
| *f23* | 3.90E+02(3.44E+01) = | 3.95E+02(1.44E+01) - |
| *f24* | 5.96E+02(4.53E+01) = | 5.39E+02(7.44E+01) + |
| *f25* | 3.89E+02(8.20E+00) = | 4.19E+02(2.18E+01) - |
| *f26* | 1.37E+03(3.43E+02) = | 1.77E+03(3.33E+02) - |
| *f27* | 5.32E+02(1.08E+01) = | 5.46E+02(1.28E+01) - |
| *f28* | 3.54E+02(6.12E+01) = | 4.71E+02(2.76E+01) - |
| *f29* | 5.93E+02(1.42E+02) = | 5.81E+02(1.15E+02) = |
| *f30* | 5.45E+03(2.75E+03) = | 8.71E+04(1.45E+05) - |
| + / = / - |  | 5/ 6 / 19 |

**Şekil.8 –** Case-2 CEC17 Problem Sonuçları

**Senaryo-3:**

Komşuluk araması yapılırken pozitif alandan seçilme olasılığı düşükse, nötr alandan seçilen çözüm adayının yerine FDB seçim yöntemi ile belirlenen çözüm adayının kullanılması durumudur.

* Pj , popülasyonun pozitif alanından rastgele seçilecektir.
* Kj , FDB seçim yöntemi ile seçilecektir.
* Nj , popülasyonun pozitif alanından rastgele seçilecektir.

|  |  |  |  |
| --- | --- | --- | --- |
|  | İyi(+) | Eşit(=) | Kötü(-) |
| **Klasik** | 2 | 2 | 26 |
| **CEC14** | 6 | 6 | 18 |
| **CEC17** | 7 | 2 | 21 |

**Şekil.9 –** Case-3 Genel Sonuçlar

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-3** |
|  |  |  |
| *f1* | 2.05E+01(1.03E-01) = | 2.04E+01(1.20E-01) + |
| *f2* | 4.19E-13(2.73E-12) = | 9.41E-02(1.07E-01) - |
| *f3* | 1.44E-36(6.22E-36) = | 1.12E-01(7.93E-01) - |
| *f4* | 6.67E-01(3.15E-16) = | 7.20E-01(6.32E-01) - |
| *f5* | 2.09E-39(1.11E-38) = | 4.13E-08(2.14E-07) - |
| *f6* | 7.18E-66(3.98E-70) = | 1.07E-65(2.24E-66) - |
| *f7* | 7.27E-03(1.40E-02) = | 5.23E-02(5.40E-02) - |
| *f8* | 5.30E-01(2.98E-01) = | 1.06E+00(4.56E-01) - |
| *f9* | 1.29E-02(3.58E-02) = | 1.71E-02(4.51E-02) - |
| *f10* | 7.21E-01(1.16E-01) = | 5.73E-01(9.18E-02) + |
| *f11* | 4.07E-03(2.03E-02) = | 4.07E-03(2.03E-02) - |
| *f12* | 8.66E-03(1.54E-02) = | 2.69E-02(3.41E-02) - |
| *f13* | 9.94E-03(2.74E-03) = | 1.92E-02(2.06E-02) - |
| *f14* | 1.96E+01(4.60E+00) = | 2.00E+01(7.55E+00) = |
| *f15* | 2.41E+01(2.51E+01) = | 2.10E+01(2.80E+01) = |
| *f16* | 2.75E+00(2.75E+00) = | 2.02E+02(2.22E+02) - |
| *f17* | 3.65E-01(1.15E-01) = | 1.33E+00(2.50E-01) - |
| *f18* | 7.13E-03(3.63E-03) = | 6.09E-02(2.54E-02) - |
| *f19* | 1.82E-03(1.30E-02) = | 5.18E-08(2.13E-07) - |
| *f20* | 2.09E-21(1.13E-20) = | 2.36E-03(1.17E-02) - |
| *f21* | 1.98E+00(7.99E-01) = | 4.98E+01(5.36E+00) - |
| *f22* | 6.29E-22(3.67E-21) = | 2.29E-04(1.17E-03) - |
| *f23* | 4.85E-43(2.76E-42) = | 1.28E-11(8.11E-11) - |
| *f24* | 1.54E-31(4.77E-31) = | 1.41E-09(7.63E-09) - |
| *f25* | 5.35E-14(2.89E-12) = | 5.29E-07(3.69E-06) - |
| *f26* | 3.93E-81(2.78E-80) = | 3.98E-24(2.61E-23) - |
| *f27* | 3.75E-43(1.86E-42) = | 1.17E-11(4.86E-11) - |
| *f28* | 3.34E-63(2.38E-62) = | 6.62E-20(3.81E-19) - |
| *f29* | 2.22E-01(1.89E-01) = | 1.49E+00(1.07E+00) - |
| *f30* | 3.73E-01(3.67E-01) = | 3.07E+00(3.92E+00) - |
| + / = / - |  | 2/ 2 / 26 |

**Şekil.10 –** Case-3 Klasik Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-2** |
|  |  |  |
| *f1* | 6.12E+05(2.85E+05) = | 1.53E+06(1.44E+06) - |
| *f2* | 1.03E+03(1.96E+03) = | 4.02E+05(1.55E+06) - |
| *f3* | 2.11E+03(3.13E+03) = | 5.81E+02(7.54E+02) + |
| *f4* | 5.03E+01(4.32E+01) = | 6.91E+01(3.99E+01) - |
| *f5* | 2.11E+01(4.81E-02) = | 2.10E+01(6.52E-02) + |
| *f6* | 5.30E+00(1.62E+00) = | 1.71E+01(3.95E+00) - |
| *f7* | 6.36E-03(1.22E-02) = | 6.89E-02(8.65E-02) - |
| *f8* | 7.54E-01(7.85E-01) = | 2.93E-01(5.65E-01) = |
| *f9* | 1.35E+02(6.63E+01) = | 9.71E+01(2.80E+01) + |
| *f10* | 4.13E+00(2.76E+00) = | 3.53E+00(1.83E+00) = |
| *f11* | 7.22E+03(3.46E+02) = | 4.58E+03(1.31E+03) + |
| *f12* | 3.05E+00(4.24E-01) = | 2.32E+00(5.73E-01) + |
| *f13* | 4.20E-01(7.26E-02) = | 5.85E-01(1.21E-01) - |
| *f14* | 3.71E-01(8.60E-02) = | 4.23E-01(2.23E-01) = |
| *f15* | 1.55E+01(2.48E+00) = | 1.96E+01(8.32E+00) - |
| *f16* | 1.24E+01(4.03E-01) = | 1.20E+01(5.26E-01) + |
| *f17* | 2.13E+05(1.03E+05) = | 7.00E+05(5.52E+05) - |
| *f18* | 3.49E+03(3.83E+03) = | 2.37E+04(1.28E+05) - |
| *f19* | 1.54E+01(2.20E+01) = | 2.33E+01(2.51E+01) - |
| *f20* | 8.51E+03(6.36E+03) = | 1.26E+04(1.33E+04) = |
| *f21* | 1.66E+05(1.45E+05) = | 2.19E+05(2.00E+05) = |
| *f22* | 2.80E+02(2.28E+02) = | 5.10E+02(1.79E+02) - |
| *f23* | 3.15E+02(6.52E-12) = | 3.15E+02(2.24E-05) - |
| *f24* | 2.31E+02(4.93E+00) = | 2.36E+02(7.15E+00) - |
| *f25* | 2.08E+02(2.72E+00) = | 2.09E+02(5.03E+00) = |
| *f26* | 1.31E+02(4.58E+01) = | 1.27E+02(5.27E+01) - |
| *f27* | 4.83E+02(6.37E+01) = | 7.54E+02(1.75E+02) - |
| *f28* | 9.18E+02(4.13E+01) = | 1.19E+03(2.41E+02) - |
| *f29* | 1.41E+03(4.24E+02) = | 1.77E+05(1.25E+06) - |
| *f30* | 2.81E+03(9.23E+02) = | 4.64E+03(4.47E+03) - |
| + / = / - |  | 6/ 6 / 18 |

**Şekil.11 –** Case-3 CEC14 Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-2** |
|  |  |  |
| *f1* | 3.61E+03(3.93E+03) = | 6.17E+03(6.02E+03) - |
| *f2* | 5.79E+13(4.03E+14) = | 1.14E+22(7.60E+22) - |
| *f3* | 4.40E+04(1.20E+04) = | 2.68E+04(1.31E+04) + |
| *f4* | 6.65E+01(2.70E+01) = | 7.36E+01(3.13E+01) - |
| *f5* | 1.41E+02(6.04E+01) = | 1.01E+02(3.17E+01) + |
| *f6* | 1.72E-02(1.76E-02) = | 5.71E-01(2.56E-01) - |
| *f7* | 2.07E+02(3.42E+01) = | 1.54E+02(3.87E+01) + |
| *f8* | 1.17E+02(7.53E+01) = | 1.05E+02(3.67E+01) = |
| *f9* | 1.73E+01(1.45E+01) = | 1.77E+03(1.44E+03) - |
| *f10* | 7.41E+03(3.04E+02) = | 4.88E+03(1.44E+03) + |
| *f11* | 8.79E+01(6.67E+01) = | 2.52E+02(5.62E+02) - |
| *f12* | 1.16E+05(9.12E+04) = | 5.64E+05(7.21E+05) - |
| *f13* | 7.29E+03(1.00E+04) = | 1.91E+04(1.98E+04) - |
| *f14* | 1.41E+04(9.83E+03) = | 2.82E+04(2.73E+04) - |
| *f15* | 5.71E+03(6.12E+03) = | 1.26E+04(1.24E+04) - |
| *f16* | 1.26E+03(5.61E+02) = | 1.12E+03(3.23E+02) + |
| *f17* | 1.67E+02(1.84E+02) = | 4.07E+02(2.07E+02) - |
| *f18* | 9.85E+05(6.78E+05) = | 3.34E+05(5.39E+05) + |
| *f19* | 8.51E+03(1.10E+04) = | 1.17E+04(1.51E+04) = |
| *f20* | 1.95E+02(2.09E+02) = | 3.77E+02(1.80E+02) - |
| *f21* | 3.42E+02(5.74E+01) = | 3.15E+02(3.92E+01) + |
| *f22* | 1.39E+03(2.82E+03) = | 2.64E+03(2.71E+03) - |
| *f23* | 3.90E+02(3.44E+01) = | 4.51E+02(2.90E+01) - |
| *f24* | 5.96E+02(4.53E+01) = | 6.37E+02(5.09E+01) - |
| *f25* | 3.89E+02(8.20E+00) = | 3.93E+02(1.30E+01) - |
| *f26* | 1.37E+03(3.43E+02) = | 2.27E+03(6.80E+02) - |
| *f27* | 5.32E+02(1.08E+01) = | 5.44E+02(1.79E+01) - |
| *f28* | 3.54E+02(6.12E+01) = | 4.11E+02(3.29E+01) - |
| *f29* | 5.93E+02(1.42E+02) = | 8.50E+02(1.75E+02) - |
| *f30* | 5.45E+03(2.75E+03) = | 8.53E+03(4.56E+03) - |
| + / = / - |  | 7/ 2 / 21 |

**Şekil.12 –** Case-3 CEC17 Problem Sonuçları

**Senaryo-4:**

Popülasyondaki çeşitlilik sağlanırken üretilen elektromanyetik parçacığın (çözüm adayı) elektromıknatıslarının (boyut) rastgele bir elektromanyetik parçacığın elektromıknatıslarından seçilme olasılığı yüksekse, rastgele seçilen çözüm adayının yerine FDB seçim yöntemi ile belirlenen çözüm adayının kullanılması durumudur.

|  |  |  |  |
| --- | --- | --- | --- |
|  | İyi(+) | Eşit(=) | Kötü(-) |
| **Klasik** | 13 | 6 | 11 |
| **CEC14** | 8 | 16 | 6 |
| **CEC17** | 8 | 17 | 5 |

**Şekil.13 –** Case-4 Genel Sonuçlar

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-4** |
|  |  |  |
| *f1* | 2.05E+01(1.03E-01) = | 2.05E+01(7.66E-02) = |
| *f2* | 4.19E-13(2.73E-12) = | 6.98E-14(1.02E-13) - |
| *f3* | 1.44E-36(6.22E-36) = | 2.87E-56(1.58E-55) + |
| *f4* | 6.67E-01(3.15E-16) = | 6.67E-01(5.63E-08) = |
| *f5* | 2.09E-39(1.11E-38) = | 2.15E-56(1.52E-55) + |
| *f6* | 7.18E-66(3.98E-70) = | 7.18E-66(4.00E-72) + |
| *f7* | 7.27E-03(1.40E-02) = | 1.45E-02(2.38E-02) = |
| *f8* | 5.30E-01(2.98E-01) = | 8.22E-01(3.65E-01) - |
| *f9* | 1.29E-02(3.58E-02) = | 6.26E-01(1.48E+00) - |
| *f10* | 7.21E-01(1.16E-01) = | 2.47E+00(4.93E-01) - |
| *f11* | 4.07E-03(2.03E-02) = | 3.34E-01(5.93E-01) - |
| *f12* | 8.66E-03(1.54E-02) = | 7.71E+00(5.71E+00) - |
| *f13* | 9.94E-03(2.74E-03) = | 5.13E-03(1.37E-03) + |
| *f14* | 1.96E+01(4.60E+00) = | 8.17E+01(6.12E+01) - |
| *f15* | 2.41E+01(2.51E+01) = | 1.53E+01(1.78E+01) + |
| *f16* | 2.75E+00(2.75E+00) = | 1.89E-01(7.94E-01) + |
| *f17* | 3.65E-01(1.15E-01) = | 4.29E-01(1.96E-01) = |
| *f18* | 7.13E-03(3.63E-03) = | 7.89E-03(5.22E-03) = |
| *f19* | 1.82E-03(1.30E-02) = | 4.44E+02(2.92E+02) - |
| *f20* | 2.09E-21(1.13E-20) = | 1.15E-32(7.54E-32) + |
| *f21* | 1.98E+00(7.99E-01) = | 5.09E+00(2.47E+00) - |
| *f22* | 6.29E-22(3.67E-21) = | 5.24E-33(2.69E-32) + |
| *f23* | 4.85E-43(2.76E-42) = | 9.93E-63(3.88E-62) + |
| *f24* | 1.54E-31(4.77E-31) = | 6.52E-30(4.53E-29) = |
| *f25* | 5.35E-14(2.89E-12) = | 4.49E+01(2.74E+01) - |
| *f26* | 3.93E-81(2.78E-80) = | 6.95E-120(2.80E-119) + |
| *f27* | 3.75E-43(1.86E-42) = | 5.06E-64(2.32E-63) + |
| *f28* | 3.34E-63(2.38E-62) = | 3.95E-93(1.93E-92) + |
| *f29* | 2.22E-01(1.89E-01) = | 1.28E+00(1.39E+00) - |
| *f30* | 3.73E-01(3.67E-01) = | 1.06E-02(1.07E-02) + |
| + / = / - |  | 13/ 6 / 11 |

**Şekil.14 –** Case-4 Klasik Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-4** |
|  |  |  |
| *f1* | 6.12E+05(2.85E+05) = | 4.26E+05(3.55E+05) + |
| *f2* | 1.03E+03(1.96E+03) = | 1.10E+02(3.02E+02) + |
| *f3* | 2.11E+03(3.13E+03) = | 1.08E+03(1.98E+03) + |
| *f4* | 5.03E+01(4.32E+01) = | 2.75E+01(3.73E+01) = |
| *f5* | 2.11E+01(4.81E-02) = | 2.10E+01(3.90E-02) = |
| *f6* | 5.30E+00(1.62E+00) = | 6.14E+00(1.66E+00) - |
| *f7* | 6.36E-03(1.22E-02) = | 1.75E-02(4.54E-02) = |
| *f8* | 7.54E-01(7.85E-01) = | 3.19E+01(8.45E+00) - |
| *f9* | 1.35E+02(6.63E+01) = | 8.27E+01(6.73E+01) + |
| *f10* | 4.13E+00(2.76E+00) = | 3.26E+02(1.95E+02) - |
| *f11* | 7.22E+03(3.46E+02) = | 7.17E+03(3.71E+02) = |
| *f12* | 3.05E+00(4.24E-01) = | 3.05E+00(4.27E-01) = |
| *f13* | 4.20E-01(7.26E-02) = | 4.12E-01(7.80E-02) = |
| *f14* | 3.71E-01(8.60E-02) = | 3.40E-01(8.29E-02) + |
| *f15* | 1.55E+01(2.48E+00) = | 1.38E+01(4.37E+00) = |
| *f16* | 1.24E+01(4.03E-01) = | 1.23E+01(3.66E-01) = |
| *f17* | 2.13E+05(1.03E+05) = | 1.57E+05(7.99E+04) + |
| *f18* | 3.49E+03(3.83E+03) = | 2.87E+03(3.51E+03) = |
| *f19* | 1.54E+01(2.20E+01) = | 1.11E+01(1.68E+01) = |
| *f20* | 8.51E+03(6.36E+03) = | 6.74E+03(6.05E+03) + |
| *f21* | 1.66E+05(1.45E+05) = | 9.22E+04(7.23E+04) + |
| *f22* | 2.80E+02(2.28E+02) = | 2.79E+02(1.87E+02) = |
| *f23* | 3.15E+02(6.52E-12) = | 3.15E+02(3.35E-12) = |
| *f24* | 2.31E+02(4.93E+00) = | 2.40E+02(6.43E+00) - |
| *f25* | 2.08E+02(2.72E+00) = | 2.07E+02(2.93E+00) = |
| *f26* | 1.31E+02(4.58E+01) = | 1.38E+02(4.87E+01) = |
| *f27* | 4.83E+02(6.37E+01) = | 5.12E+02(6.41E+01) - |
| *f28* | 9.18E+02(4.13E+01) = | 9.69E+02(7.02E+01) - |
| *f29* | 1.41E+03(4.24E+02) = | 1.37E+03(3.45E+02) = |
| *f30* | 2.81E+03(9.23E+02) = | 3.04E+03(7.64E+02) = |
| + / = / - |  | 8/ 16 / 6 |

**Şekil.15 –** Case-4 CEC14 Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-4** |
|  |  |  |
| *f1* | 3.61E+03(3.93E+03) = | 3.35E+03(4.43E+03) = |
| *f2* | 5.79E+13(4.03E+14) = | 1.39E+17(9.93E+17) - |
| *f3* | 4.40E+04(1.20E+04) = | 3.92E+04(1.18E+04) = |
| *f4* | 6.65E+01(2.70E+01) = | 4.43E+01(3.55E+01) + |
| *f5* | 1.41E+02(6.04E+01) = | 7.29E+01(6.75E+01) + |
| *f6* | 1.72E-02(1.76E-02) = | 4.25E-01(3.99E-01) - |
| *f7* | 2.07E+02(3.42E+01) = | 1.74E+02(6.44E+01) + |
| *f8* | 1.17E+02(7.53E+01) = | 6.45E+01(6.26E+01) + |
| *f9* | 1.73E+01(1.45E+01) = | 6.93E+01(1.48E+02) - |
| *f10* | 7.41E+03(3.04E+02) = | 7.35E+03(4.53E+02) = |
| *f11* | 8.79E+01(6.67E+01) = | 4.40E+01(3.08E+01) + |
| *f12* | 1.16E+05(9.12E+04) = | 6.03E+04(4.26E+04) + |
| *f13* | 7.29E+03(1.00E+04) = | 9.84E+03(1.29E+04) = |
| *f14* | 1.41E+04(9.83E+03) = | 1.75E+04(1.23E+04) = |
| *f15* | 5.71E+03(6.12E+03) = | 5.32E+03(4.78E+03) = |
| *f16* | 1.26E+03(5.61E+02) = | 1.13E+03(6.09E+02) = |
| *f17* | 1.67E+02(1.84E+02) = | 1.35E+02(1.32E+02) = |
| *f18* | 9.85E+05(6.78E+05) = | 1.02E+06(1.22E+06) = |
| *f19* | 8.51E+03(1.10E+04) = | 8.80E+03(1.04E+04) = |
| *f20* | 1.95E+02(2.09E+02) = | 1.83E+02(1.88E+02) = |
| *f21* | 3.42E+02(5.74E+01) = | 3.03E+02(7.20E+01) + |
| *f22* | 1.39E+03(2.82E+03) = | 1.04E+03(2.39E+03) = |
| *f23* | 3.90E+02(3.44E+01) = | 3.89E+02(1.44E+01) = |
| *f24* | 5.96E+02(4.53E+01) = | 5.62E+02(7.27E+01) = |
| *f25* | 3.89E+02(8.20E+00) = | 3.91E+02(1.17E+01) = |
| *f26* | 1.37E+03(3.43E+02) = | 1.55E+03(2.85E+02) - |
| *f27* | 5.32E+02(1.08E+01) = | 5.39E+02(1.70E+01) - |
| *f28* | 3.54E+02(6.12E+01) = | 3.47E+02(5.80E+01) + |
| *f29* | 5.93E+02(1.42E+02) = | 6.08E+02(1.27E+02) = |
| *f30* | 5.45E+03(2.75E+03) = | 5.47E+03(2.22E+03) = |
| + / = / - |  | 8/ 17 / 5 |

**Şekil.16 –** Case-4 CEC17 Problem Sonuçları

**Senaryo-5:**

Sınır değeri kontrolü yapılırken, üretilen elektromanyetik parçacığın (çözüm adayı) elektromıknatısının (boyut) rastgele bir elektromanyetik parçacığın elektromıknatısı ile değiştirilmesi yerine FDB seçim yöntemi ile belirlenen elektromanyetik parçacığın elektromıknatısı ile değiştirilmesi durumudur.

|  |  |  |  |
| --- | --- | --- | --- |
|  | İyi(+) | Eşit(=) | Kötü(-) |
| **Klasik** | 2 | 26 | 2 |
| **CEC14** | 2 | 28 | 0 |
| **CEC17** | 2 | 27 | 1 |

**Şekil.17 –** Case-5 Genel Sonuçlar

|  |  |  |  |
| --- | --- | --- | --- |
| **Fx** | **EFO** | **CASE-5** | |
|  |  | |  |
| *f1* | 2.05E+01(1.03E-01) = | | 2.06E+01(8.08E-02) - |
| *f2* | 4.19E-13(2.73E-12) = | | 6.41E-06(4.58E-05) = |
| *f3* | 1.44E-36(6.22E-36) = | | 4.62E-36(1.81E-35) = |
| *f4* | 6.67E-01(3.15E-16) = | | 6.67E-01(4.12E-16) = |
| *f5* | 2.09E-39(1.11E-38) = | | 9.17E-40(4.43E-39) = |
| *f6* | 7.18E-66(3.98E-70) = | | 7.18E-66(3.67E-71) + |
| *f7* | 7.27E-03(1.40E-02) = | | 9.96E-03(1.78E-02) = |
| *f8* | 5.30E-01(2.98E-01) = | | 5.19E-01(2.75E-01) = |
| *f9* | 1.29E-02(3.58E-02) = | | 4.31E-03(2.15E-02) = |
| *f10* | 7.21E-01(1.16E-01) = | | 7.23E-01(1.35E-01) = |
| *f11* | 4.07E-03(2.03E-02) = | | 4.07E-03(2.03E-02) = |
| *f12* | 8.66E-03(1.54E-02) = | | 5.71E-03(1.22E-02) = |
| *f13* | 9.94E-03(2.74E-03) = | | 1.07E-02(3.61E-03) = |
| *f14* | 1.96E+01(4.60E+00) = | | 1.91E+01(5.62E+00) = |
| *f15* | 2.41E+01(2.51E+01) = | | 2.04E+01(2.37E+01) = |
| *f16* | 2.75E+00(2.75E+00) = | | 4.08E+00(6.61E+00) = |
| *f17* | 3.65E-01(1.15E-01) = | | 3.63E-01(1.04E-01) = |
| *f18* | 7.13E-03(3.63E-03) = | | 6.38E-03(2.18E-03) = |
| *f19* | 1.82E-03(1.30E-02) = | | 1.61E-04(1.10E-03) = |
| *f20* | 2.09E-21(1.13E-20) = | | 3.39E-22(1.33E-21) = |
| *f21* | 1.98E+00(7.99E-01) = | | 2.00E+00(7.89E-01) = |
| *f22* | 6.29E-22(3.67E-21) = | | 4.32E-23(2.66E-22) + |
| *f23* | 4.85E-43(2.76E-42) = | | 9.03E-43(3.47E-42) = |
| *f24* | 1.54E-31(4.77E-31) = | | 6.57E-32(1.43E-31) = |
| *f25* | 5.35E-14(2.89E-12) = | | -2.59E-13(3.61E-13) = |
| *f26* | 3.93E-81(2.78E-80) = | | 4.82E-83(2.06E-82) = |
| *f27* | 3.75E-43(1.86E-42) = | | 1.36E-44(5.38E-44) - |
| *f28* | 3.34E-63(2.38E-62) = | | 7.73E-62(5.51E-61) = |
| *f29* | 2.22E-01(1.89E-01) = | | 1.89E-01(1.21E-01) = |
| *f30* | 3.73E-01(3.67E-01) = | | 4.89E-01(4.89E-01) = |
| + / = / - |  | | 2/ 26 / 2 |

**Şekil.18 –** Case-5 Klasik Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-5** |
|  |  |  |
| *f1* | 6.12E+05(2.85E+05) = | 6.34E+05(4.03E+05) = |
| *f2* | 1.03E+03(1.96E+03) = | 2.43E+02(4.57E+02) + |
| *f3* | 2.11E+03(3.13E+03) = | 2.71E+03(4.00E+03) = |
| *f4* | 5.03E+01(4.32E+01) = | 4.92E+01(4.20E+01) = |
| *f5* | 2.11E+01(4.81E-02) = | 2.10E+01(5.44E-02) = |
| *f6* | 5.30E+00(1.62E+00) = | 5.25E+00(1.59E+00) = |
| *f7* | 6.36E-03(1.22E-02) = | 6.70E-03(1.17E-02) = |
| *f8* | 7.54E-01(7.85E-01) = | 7.22E-01(7.19E-01) = |
| *f9* | 1.35E+02(6.63E+01) = | 1.28E+02(6.38E+01) = |
| *f10* | 4.13E+00(2.76E+00) = | 3.42E+00(2.50E+00) = |
| *f11* | 7.22E+03(3.46E+02) = | 7.20E+03(3.64E+02) = |
| *f12* | 3.05E+00(4.24E-01) = | 3.05E+00(3.32E-01) = |
| *f13* | 4.20E-01(7.26E-02) = | 4.12E-01(7.68E-02) = |
| *f14* | 3.71E-01(8.60E-02) = | 3.75E-01(8.16E-02) = |
| *f15* | 1.55E+01(2.48E+00) = | 1.64E+01(2.02E+00) = |
| *f16* | 1.24E+01(4.03E-01) = | 1.23E+01(3.57E-01) = |
| *f17* | 2.13E+05(1.03E+05) = | 2.14E+05(1.22E+05) = |
| *f18* | 3.49E+03(3.83E+03) = | 2.82E+03(2.97E+03) = |
| *f19* | 1.54E+01(2.20E+01) = | 1.49E+01(2.16E+01) = |
| *f20* | 8.51E+03(6.36E+03) = | 9.57E+03(6.37E+03) = |
| *f21* | 1.66E+05(1.45E+05) = | 1.21E+05(9.88E+04) = |
| *f22* | 2.80E+02(2.28E+02) = | 3.20E+02(2.27E+02) = |
| *f23* | 3.15E+02(6.52E-12) = | 3.15E+02(3.35E-12) = |
| *f24* | 2.31E+02(4.93E+00) = | 2.32E+02(5.45E+00) = |
| *f25* | 2.08E+02(2.72E+00) = | 2.07E+02(3.02E+00) = |
| *f26* | 1.31E+02(4.58E+01) = | 1.22E+02(4.14E+01) = |
| *f27* | 4.83E+02(6.37E+01) = | 5.04E+02(7.41E+01) = |
| *f28* | 9.18E+02(4.13E+01) = | 9.06E+02(7.98E+01) + |
| *f29* | 1.41E+03(4.24E+02) = | 1.40E+03(4.07E+02) = |
| *f30* | 2.81E+03(9.23E+02) = | 2.80E+03(7.84E+02) = |
| + / = / - |  | 2/ 28 / 0 |

**Şekil.19 –** Case-5 CEC14 Problem Sonuçları

|  |  |  |
| --- | --- | --- |
| **Fx** | **EFO** | **CASE-5** |
|  |  |  |
| *f1* | 3.61E+03(3.93E+03) = | 3.95E+03(4.09E+03) = |
| *f2* | 5.79E+13(4.03E+14) = | 1.75E+13(1.25E+14) = |
| *f3* | 4.40E+04(1.20E+04) = | 3.87E+04(1.41E+04) + |
| *f4* | 6.65E+01(2.70E+01) = | 6.25E+01(3.17E+01) = |
| *f5* | 1.41E+02(6.04E+01) = | 1.45E+02(5.66E+01) = |
| *f6* | 1.72E-02(1.76E-02) = | 1.46E-02(1.41E-02) = |
| *f7* | 2.07E+02(3.42E+01) = | 2.16E+02(3.11E+01) = |
| *f8* | 1.17E+02(7.53E+01) = | 1.47E+02(5.83E+01) = |
| *f9* | 1.73E+01(1.45E+01) = | 1.71E+01(2.02E+01) = |
| *f10* | 7.41E+03(3.04E+02) = | 7.38E+03(3.54E+02) = |
| *f11* | 8.79E+01(6.67E+01) = | 8.40E+01(8.53E+01) = |
| *f12* | 1.16E+05(9.12E+04) = | 1.24E+05(6.35E+04) = |
| *f13* | 7.29E+03(1.00E+04) = | 1.23E+04(1.52E+04) = |
| *f14* | 1.41E+04(9.83E+03) = | 1.56E+04(1.27E+04) = |
| *f15* | 5.71E+03(6.12E+03) = | 9.15E+03(8.66E+03) = |
| *f16* | 1.26E+03(5.61E+02) = | 1.25E+03(5.47E+02) = |
| *f17* | 1.67E+02(1.84E+02) = | 1.69E+02(1.94E+02) = |
| *f18* | 9.85E+05(6.78E+05) = | 1.34E+06(1.50E+06) = |
| *f19* | 8.51E+03(1.10E+04) = | 8.49E+03(9.58E+03) = |
| *f20* | 1.95E+02(2.09E+02) = | 1.95E+02(1.94E+02) = |
| *f21* | 3.42E+02(5.74E+01) = | 3.50E+02(5.63E+01) = |
| *f22* | 1.39E+03(2.82E+03) = | 2.78E+03(3.52E+03) = |
| *f23* | 3.90E+02(3.44E+01) = | 4.02E+02(5.01E+01) = |
| *f24* | 5.96E+02(4.53E+01) = | 5.91E+02(4.54E+01) = |
| *f25* | 3.89E+02(8.20E+00) = | 3.91E+02(9.20E+00) - |
| *f26* | 1.37E+03(3.43E+02) = | 1.35E+03(2.09E+02) = |
| *f27* | 5.32E+02(1.08E+01) = | 5.25E+02(1.27E+01) + |
| *f28* | 3.54E+02(6.12E+01) = | 3.71E+02(6.27E+01) = |
| *f29* | 5.93E+02(1.42E+02) = | 5.80E+02(1.52E+02) = |
| *f30* | 5.45E+03(2.75E+03) = | 5.29E+03(2.35E+03) = |
| + / = / - |  | 2/ 27 / 1 |

**Şekil.20 –** Case-5 CEC17 Problem Sonuçları