Table Ⅰ

Optimization Method (Method), Peak Sidelobe Level (PSLL),Maximum Number Of Element In The Ring (), Retention Rate (), Number of Elements (N), Ring Radii(), And Number of Elements in the Rings ()

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Method | PSLL(dB) | N  N | n | 1 | 2 | 3 | 4 | 5 | 6 |
| Opt.&[11] | -27.82 | 142 |  | 0.76 | 1.36 | 2.09 | 2.99 | 3.78 | 4.70 |
|  | 9 | 17 | 25 | 31 | 26 | 33 |
| Maximum\_element\_number | | |  | 9.55 | 17.09 | 26 | 37 | 47 | 59 |
| Retention\_rate () | | |  | 9/9.55 | 17/17.09 | 25/26.26 | 31/37.57 | 26/47.50 | 33/59.06 |

Table Ⅱ

Optimization Method (Method), Peak Sidelobe Level (PSLL),Maximum Number Of Element In The Ring (), Retention Rate (), Number of Elements (N), Ring Radii(), And Number of Elements in the Rings ()

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| methmeem Method | PSLL(dB) | N | n | 1 | 2 | 3 | 4 | 5 | 6 |
| Opt. by MPSO[18] | -27.89 | 132 |  | 0.89 | 1.48 | 2.11 | 2.92 | 3.66 | 4.70 |
|  | 10 | 16 | 23 | 27 | 25 | 31 |
| Maximum\_element\_number | | |  | 11.18 | 18.60 | 26.52 | 36.69 | 45.99 | 59 |
| Retention\_rate () | | |  | 10/11.18 | 16/18.60 | 23/26.52 | 27/36.69 | 25/45.99 | 31/59.06 |

Table Ⅲ

Coefficient and Goodness of Fit(CGF) Fitting Function Model(FFM)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| FFM  CGF | a | b | c | d | SSE | R-square |
| Linear model:  f(x) = a(sin(x-π))+b((x-10)^2) + c | -0.1414 | 0.004213 | 0.5523 |  | 0.01107 | 0.9533 |
| Linear model Poly1:  f(x) = a·x + b | -0.1027 | 1.06 |  |  | 0.04334 | 0.8044 |
| General model Sin1:  f(x) =a·sin(bx+c) | 0.9866 | 0.236 | 1.493 |  | 0.02588 | 0.8832 |
| General model Gauss1:  f(x)=a·exp(-((x-b)/c)) | 0.9883 | 0.6489 | 4.979 |  | 0.0237 | 0.893 |
| General model Fourier1:  f(x) =a + b·cos(x·d) + c·sin(x·d) | 0.7543 | 0.1981 | 0.1444 | 0.7073 | 0.02126 | 0.904 |

Table Ⅳ

Peak Sidelobe Level (PSLL), Modified Real Genetic Algorithm and Fitting Function(MGA&F(R)), Number of Elements(N), Run Time(RT), Ring Radii(), and Number of Elements in the Rings ()

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| method | PSLL(dB) | RT | N | n | 1 | 2 | 3 | 4 | 5 | 6 |
| Opt.&[1] | -27.82 | 57 min | 142 |  | 0.76 | 1.36 | 2.09 | 2.99 | 3.78 | 4.70 |
|  | 9 | 17 | 25 | 31 | 26 | 33 |
| Opt.by MGA&F(R) | -28.18 | 45 min | 142 |  | 0.83 | 1.36 | 2.11 | 2.94 | 3.78 | 4.70 |
|  | 10 | 17 | 25 | 29 | 29 | 31 |

Table Ⅴ

Peak Sidelobe Level (PSLL), Modified Real Genetic Algorithm and Fitting Function(MGA&F(R)), Number of Elements(N), Run Time(RT), Ring Radii(), and Number of Elements in the Rings ()

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| method | PSLL(dB) | RT | N | n | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Opt.&[1] | -27.82 | 57min | 142 |  | 0.76 | 1.36 | 2.09 | 2.99 | 3.78 | 4.70 | -- |
|  | 9 | 17 | 25 | 31 | 26 | 33 | -- |
| Opt.by MGA&F(R) | -29.39 | 56min | 159 |  | 0.53 | 1.08 | 1.58 | 2.20 | 3.01 | 3.77 | 4.70 |
|  | 6 | 13 | 19 | 27 | 31 | 31 | 31 |



Fig. 9. Cross section of radiation pattern

in and in simulation B



Fig. 5. Cross section of radiation

pattern in and



Radiation pattern(dB)

Radiation pattern(dB)





x(λ)

Fig. 4. The layout of the best sparse concentric ring array





generation

Fig.3.Convergence characteristics

PSLL(dB)



generation

Fig. 7. Convergence characteristics of simulation B.

PSLL(dB)



x(λ)

Fig.8. The layout of the best sparse array in simulation B



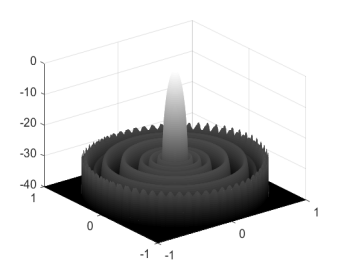


Fig. 2.Radiation pattern of the

best optimal result.

Radiation pattern(dB)





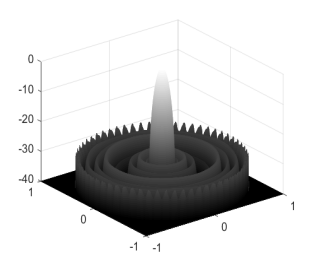


Fig. 6. Radiation pattern of the best optimal result in simulation B

Radiation pattern(dB)



