|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Problem size | J | I | B | F | Time | | | | |
| MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid |
| Small | 8 | 2 | 1 | 1 |  |  |  | 17.3151 | 8.2399 |
|  | 3 | 2 | 1 |  |  |  | 14.5907 | 12.2438 |
| 10 | 3 | 1 | 1 |  |  |  | 14.9771 | 7.3456 |
|  | 3 | 2 | 1 |  |  |  | 14.7471 | 8.5845 |
|  | 4 | 2 | 2 |  |  |  | 15.0371 | 9.0437 |
| 12 | 3 | 1 | 1 |  |  |  |  | 8.0472 |
|  | 3 | 2 | 1 |  |  |  |  | 8.7451 |
|  | 4 | 2 | 2 |  |  |  |  | 11.3038 |
| Medium | 15 | 4 | 2 | 1 |  |  |  |  | 15.4937 |
|  | 6 | 3 | 2 |  |  |  |  | 13.7903 |
| 20 | 4 | 2 | 1 |  |  |  |  | 8.6386 |
|  | 6 | 3 | 2 |  |  |  |  | 8.2809 |
| 25 | 4 | 2 | 1 |  |  |  |  | 12.8359 |
|  | 6 | 3 | 2 |  |  |  |  | 12.6845 |
| 30 | 4 | 2 | 1 |  |  |  |  | 14.9096 |
|  | 6 | 3 | 2 |  |  |  |  | 15.1431 |
| Large | 40 | 8 | 3 | 2 |  |  |  |  | 20.2552 |
|  | 10 | 4 | 3 |  |  |  |  | 17.7729 |
| 50 | 10 | 3 | 2 |  |  |  |  | 21.2376 |
|  | 12 | 4 | 3 |  |  |  |  | 31.7191 |
| 60 | 12 | 3 | 2 |  |  |  |  | 33.7411 |
|  | 15 | 4 | 3 |  |  |  |  | 32.0186 |
| 80 | 15 | 3 | 2 |  |  |  |  | 56.5761 |
|  | 20 | 4 | 3 |  |  |  |  | 57.3463 |

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| Problem size | J | I | B | F | NPS | | | | |  | MID | | | | |  | DM | | | | |
| MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid | MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid | MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid |
| Small | 8 | 2 | 1 | 1 |  |  |  | 2 | 5 |  |  |  |  | 1.2071 | 1.2768 |  |  |  |  | 42.6465 | 11.4467 |
|  | 3 | 2 | 1 |  |  |  | 6 | 10 |  |  |  |  | 1.1808 | 1.0147 |  |  |  |  | 20.394 | 49.2291 |
| 10 | 3 | 1 | 1 |  |  |  | 5 | 8 |  |  |  |  | 0.88722 | 1.0015 |  |  |  |  | 27.3542 | 28.4317 |
|  | 3 | 2 | 1 |  |  |  | 5 | 10 |  |  |  |  | 1.0662 | 0.91347 |  |  |  |  | 29.5771 | 56.6637 |
|  | 4 | 2 | 2 |  |  |  | 8 | 7 |  |  |  |  | 1.1092 | 1.2913 |  |  |  |  | 39.4873 | 62.3476 |
| 12 | 3 | 1 | 1 |  |  |  |  | 11 |  |  |  |  |  | 1.0738 |  |  |  |  |  | 40.5446 |
|  | 3 | 2 | 1 |  |  |  |  | 25 |  |  |  |  |  | 0.95438 |  |  |  |  |  | 99.4901 |
|  | 4 | 2 | 2 |  |  |  |  | 6 |  |  |  |  |  | 1.1665 |  |  |  |  |  | 11.2472 |
| Medium | 15 | 4 | 2 | 1 |  |  |  |  | 5 |  |  |  |  |  | 0.8857 |  |  |  |  |  | 37.0345 |
|  | 6 | 3 | 2 |  |  |  |  | 10 |  |  |  |  |  | 1.1278 |  |  |  |  |  | 78.0877 |
| 20 | 4 | 2 | 1 |  |  |  |  | 21 |  |  |  |  |  | 1.0446 |  |  |  |  |  | 150.4566 |
|  | 6 | 3 | 2 |  |  |  |  | 35 |  |  |  |  |  | 1.0688 |  |  |  |  |  | 141.3404 |
| 25 | 4 | 2 | 1 |  |  |  |  | 28 |  |  |  |  |  | 1.1495 |  |  |  |  |  | 191.3738 |
|  | 6 | 3 | 2 |  |  |  |  | 50 |  |  |  |  |  | 1.1708 |  |  |  |  |  | 164.9684 |
| 30 | 4 | 2 | 1 |  |  |  |  | 33 |  |  |  |  |  | 1.1626 |  |  |  |  |  | 266.0303 |
|  | 6 | 3 | 2 |  |  |  |  | 26 |  |  |  |  |  | 1.0073 |  |  |  |  |  | 170.0448 |
| Large | 40 | 8 | 3 | 2 |  |  |  |  | 43 |  |  |  |  |  | 0.9603 |  |  |  |  |  | 737.7513 |
|  | 10 | 4 | 3 |  |  |  |  | 24 |  |  |  |  |  | 1.1472 |  |  |  |  |  | 124.4317 |
| 50 | 10 | 3 | 2 |  |  |  |  | 55 |  |  |  |  |  | 1.1836 |  |  |  |  |  | 494.6096 |
|  | 12 | 4 | 3 |  |  |  |  | 25 |  |  |  |  |  | 1.0515 |  |  |  |  |  | 437.9534 |
| 60 | 12 | 3 | 2 |  |  |  |  | 22 |  |  |  |  |  | 0.99932 |  |  |  |  |  | 284.2811 |
|  | 15 | 4 | 3 |  |  |  |  | 12 |  |  |  |  |  | 1.357 |  |  |  |  |  | 322.1378 |
| 80 | 15 | 3 | 2 |  |  |  |  | 36 |  |  |  |  |  | 1.045 |  |  |  |  |  | 344.4207 |
|  | 20 | 4 | 3 |  |  |  |  | 10 |  |  |  |  |  | 1.3779 |  |  |  |  |  | 444.1816 |

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| Problem size | J | I | B | F | SNS | | | | |  | RAS | | | | |  | QM | | | | |
| MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid | MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid | MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid |
| Small | 8 | 2 | 1 | 1 |  |  |  | 0.29289 | 0.16851 |  |  |  |  | 4.7609 | 5.3745 |  |  |  |  |  |  |
|  | 3 | 2 | 1 |  |  |  | 0.1251 | 0.23127 |  |  |  |  | 7.2852 | 6.5721 |  |  |  |  |  |  |
| 10 | 3 | 1 | 1 |  |  |  | 0.35343 | 0.17965 |  |  |  |  | 13.944 | 10.9233 |  |  |  |  |  |  |
|  | 3 | 2 | 1 |  |  |  | 0.33671 | 0.28985 |  |  |  |  | 8.3472 | 6.02 |  |  |  |  |  |  |
|  | 4 | 2 | 2 |  |  |  | 0.26669 | 0.13971 |  |  |  |  | 8.5519 | 7.0635 |  |  |  |  |  |  |
| 12 | 3 | 1 | 1 |  |  |  |  | 0.11876 |  |  |  |  |  | 8.878 |  |  |  |  |  |  |
|  | 3 | 2 | 1 |  |  |  |  | 0.12986 |  |  |  |  |  | 9.0445 |  |  |  |  |  |  |
|  | 4 | 2 | 2 |  |  |  |  | 0.16664 |  |  |  |  |  | 9.4166 |  |  |  |  |  |  |
| Medium | 15 | 4 | 2 | 1 |  |  |  |  | 0.31756 |  |  |  |  |  | 11.0827 |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  | 0.24957 |  |  |  |  |  | 13.1962 |  |  |  |  |  |  |
| 20 | 4 | 2 | 1 |  |  |  |  | 0.25791 |  |  |  |  |  | 14.9049 |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  | 0.087296 |  |  |  |  |  | 19.2584 |  |  |  |  |  |  |
| 25 | 4 | 2 | 1 |  |  |  |  | 0.1453 |  |  |  |  |  | 14.9199 |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  | 0.088658 |  |  |  |  |  | 13.7901 |  |  |  |  |  |  |
| 30 | 4 | 2 | 1 |  |  |  |  | 0.12632 |  |  |  |  |  | 16.1261 |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  | 0.22227 |  |  |  |  |  | 18.5044 |  |  |  |  |  |  |
| Large | 40 | 8 | 3 | 2 |  |  |  |  | 0.2302 |  |  |  |  |  | 21.0302 |  |  |  |  |  |  |
|  | 10 | 4 | 3 |  |  |  |  | 0.18247 |  |  |  |  |  | 19.7054 |  |  |  |  |  |  |
| 50 | 10 | 3 | 2 |  |  |  |  | 0.079507 |  |  |  |  |  | 25.1413 |  |  |  |  |  |  |
|  | 12 | 4 | 3 |  |  |  |  | 0.10347 |  |  |  |  |  | 25.1865 |  |  |  |  |  |  |
| 60 | 12 | 3 | 2 |  |  |  |  | 0.18724 |  |  |  |  |  | 26.5015 |  |  |  |  |  |  |
|  | 15 | 4 | 3 |  |  |  |  | 0.13086 |  |  |  |  |  | 28.1735 |  |  |  |  |  |  |
| 80 | 15 | 3 | 2 |  |  |  |  | 0.11212 |  |  |  |  |  | 36.2053 |  |  |  |  |  |  |
|  | 20 | 4 | 3 |  |  |  |  | 0.1747 |  |  |  |  |  | 42.9505 |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Problem size | J | I | B | F | NPS | | |  | MID | | |  | DM | | |  | SNS | | |  | RAS | | |  | QM | | |  | Time | | |
| NSGA-II | Hybrid | MOEA/D | NSGA-II | Hybrid | MOEA/D | NSGA-II | Hybrid | MOEA/D | NSGA-II | Hybrid | MOEA/D | NSGA-II | Hybrid | MOEA/D | NSGA-II | Hybrid | MOEA/D | NSGA-II | Hybrid | MOEA/D |
| Small | 8 | 2 | 1 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 3 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 | 3 | 1 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 3 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 4 | 2 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 12 | 3 | 1 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 3 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 4 | 2 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Medium | 15 | 4 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20 | 4 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 25 | 4 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 30 | 4 | 2 | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 6 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Large | 40 | 8 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 10 | 4 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 | 10 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 12 | 4 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 | 12 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 15 | 4 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 80 | 15 | 3 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 20 | 4 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |