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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Problem size | J | I | B | F | Time | | | | |
| MOEA/D | NSGA-II | PESA-II | SPEA-II | Hybrid |
| Small | 8 | 2 | 1 | 1 | 32.6474 | 5.0467 | 88.6577 | 15.1166 | 8.2399 |
|  | 3 | 2 | 1 | 29.9591 | 4.9302 | 92.1496 | 14.5907 | 12.2438 |
| 10 | 3 | 1 | 1 | 30.2709 | 5.1587 | 92.4004 | 14.9771 | 7.3456 |
|  | 3 | 2 | 1 | 31.2294 | 5.1483 | 86.283 | 14.7471 | 8.5845 |
|  | 4 | 2 | 2 | 30.5542 | 5.1294 | 92.9171 | 15.0371 | 9.0437 |
| 12 | 3 | 1 | 1 | 31.4158 | 5.2105 | 73.9626 | 15.0546 | 8.0472 |
|  | 3 | 2 | 1 | 31.6741 | 5.08 | 74.8597 | 14.5348 | 8.7451 |
|  | 4 | 2 | 2 | 31.4583 | 5.2893 | 95.6354 | 14.7744 | 11.3038 |
| Medium | 15 | 4 | 2 | 1 | 32.0432 | 5.2581 | 82.8064 | 15.4054 | 15.4937 |
|  | 6 | 3 | 2 | 29.3238 | 5.5068 | 83.941 | 16.1566 | 13.7903 |
| 20 | 4 | 2 | 1 | 32.1144 | 5.5774 | 67.4338 | 16.0538 | 8.6386 |
|  | 6 | 3 | 2 | 30.2584 | 5.4306 | 72.5659 | 15.9565 | 8.2809 |
| 25 | 4 | 2 | 1 | 32.2252 | 6.2183 | 73.4431 | 18.7302 | 12.8359 |
|  | 6 | 3 | 2 | 31.2682 | 6.278 | 64.2536 | 18.7325 | 12.6845 |
| 30 | 4 | 2 | 1 | 35.5775 | 6.8787 | 35.0823 | 20.3039 | 14.9096 |
|  | 6 | 3 | 2 | 34.417 | 6.9693 | 40.4226 | 21.2672 | 15.1431 |
| Large | 40 | 8 | 3 | 2 | 34.5126 | 7.3399 | 31.6192 | 22.626 | 20.2552 |
|  | 10 | 4 | 3 | 34.881 | 6.6231 | 34.8256 | 22.0326 | 17.7729 |
| 50 | 10 | 3 | 2 | 37.1943 | 8.5183 | 29.5127 | 25.5885 | 21.2376 |
|  | 12 | 4 | 3 | 38.9901 | 10.4129 | 32.7741 | 31.9129 | 31.7191 |
| 60 | 12 | 3 | 2 | 37.8278 | 10.3384 | 33.2987 | 32.1423 | 33.7411 |
|  | 15 | 4 | 3 | 38.8251 | 10.4378 | 34.6028 | 32.4666 | 32.0186 |
| 80 | 15 | 3 | 2 | 48.0306 | 15.771 | 38.0899 | 51.9088 | 56.5761 |
|  | 20 | 4 | 3 | 47.2628 | 16.1258 | 40.2692 | 52.5774 | 57.3463 |

Run at Company, Run at Home

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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 | 2 | 2 | 2 | 2 |  | 1.2071 | 1.2071 | 1.2071 | 1.2071 | 1.2071 |  | 48.0607 | 42.6465 | 42.6465 | 42.6465 | 0.66667 |
|  | 3 | 2 | 1 | 2 | 6 | 6 | 6 | 10 |  | 1.2071 | 1.1795 | 1.1616 | 1.1808 | 1.0147 |  | 18.0408 | 20.394 | 21.8308 | 20.394 | 49.2291 |
| 10 | 3 | 1 | 1 | 2 | 5 | 4 | 5 | 8 |  | 1.2071 | 0.88722 | 0.88682 | 0.88722 | 1.0015 |  | 25.6786 | 27.3542 | 27.3542 | 27.3542 | 28.4317 |
|  | 3 | 2 | 1 | 3 | 4 | 3 | 5 | 10 |  | 1.3136 | 1.1379 | 1.2215 | 1.0662 | 0.91347 |  | 22.0259 | 23.8374 | 18.9451 | 29.5771 | 56.6637 |
|  | 4 | 2 | 2 | 7 | 6 | 8 | 8 | 7 |  | 0.96517 | 1.1447 | 1.1074 | 1.1092 | 1.2913 |  | 46.8488 | 39.4873 | 39.4873 | 39.4873 | 62.3476 |
| 12 | 3 | 1 | 1 | 4 | 15 | 15 | 17 | 11 |  | 1.1713 | 0.88265 | 0.88168 | 0.87407 | 1.0738 |  | 97.1798 | 97.4709 | 94.8112 | 96.8442 | 40.5446 |
|  | 3 | 2 | 1 | 4 | 20 | 26 | 27 | 25 |  | 1.0241 | 0.97476 | 0.8711 | 0.88426 | 0.95438 |  | 55.887 | 67.2881 | 77.4498 | 75.598 | 99.4901 |
|  | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 6 |  | 1.2071 | 1.2071 | 1.2071 | 1.2071 | 1.1665 |  | 16.9607 | 15.308 | 12.659 | 15.308 | 11.2472 |
| Medium | 15 | 4 | 2 | 1 | 2 | 6 | 6 | 7 | 5 |  | 1.2071 | 1.1612 | 1.1471 | 1.1509 | 0.8857 |  | 37.677 | 30.4485 | 32.755 | 32.8921 | 37.0345 |
|  | 6 | 3 | 2 | 4 | 14 | 15 | 18 | 10 |  | 0.98597 | 0.80768 | 0.83844 | 0.78606 | 1.1278 |  | 36.6523 | 57.793 | 64.1825 | 57.793 | 78.0877 |
| 20 | 4 | 2 | 1 | 4 | 28 | 35 | 59 | 21 |  | 1.0052 | 0.89508 | 0.85143 | 0.82995 | 1.0446 |  | 142.6322 | 140.7745 | 142.3899 | 157.3448 | 150.4566 |
|  | 6 | 3 | 2 | 3 | 23 | 51 | 32 | 35 |  | 0.89697 | 0.88062 | 0.84974 | 0.90486 | 1.0688 |  | 90.4969 | 109.0681 | 94.8081 | 87.4814 | 141.3404 |
| 25 | 4 | 2 | 1 | 4 | 18 | 32 | 16 | 28 |  | 0.9985 | 0.77852 | 0.79432 | 0.84737 | 1.1495 |  | 212.6787 | 198.7338 | 161.6318 | 130.6256 | 191.3738 |
|  | 6 | 3 | 2 | 6 | 20 | 31 | 39 | 50 |  | 0.94105 | 0.97209 | 1.0235 | 0.88597 | 1.1708 |  | 185.699 | 235.0913 | 184.3406 | 274.9976 | 164.9684 |
| 30 | 4 | 2 | 1 | 2 | 18 | 22 | 29 | 33 |  | 1.2071 | 0.6593 | 1.0293 | 0.97069 | 1.1626 |  | 45.2309 | 145.426 | 120.2896 | 122.1123 | 266.0303 |
|  | 6 | 3 | 2 | 4 | 12 | 10 | 8 | 26 |  | 0.98524 | 0.82263 | 1.0329 | 0.99644 | 1.0073 |  | 93.2531 | 81.5818 | 33.3542 | 46.3132 | 170.0448 |
| Large | 40 | 8 | 3 | 2 | 3 | 22 | 38 | 25 | 43 |  | 0.87408 | 0.85045 | 0.88173 | 0.99636 | 0.9603 |  | 159.8308 | 412.8383 | 277.5052 | 216.6345 | 737.7513 |
|  | 10 | 4 | 3 | 2 | 8 | 18 | 15 | 24 |  | 1.2071 | 0.82466 | 0.85412 | 0.69092 | 1.1472 |  | 18.4572 | 70.6403 | 89.5796 | 248.8079 | 124.4317 |
| 50 | 10 | 3 | 2 | 2 | 15 | 13 | 18 | 55 |  | 1.2071 | 0.70698 | 1.02 | 0.74572 | 1.1836 |  | 159.4249 | 193.1025 | 140.781 | 115.8795 | 494.6096 |
|  | 12 | 4 | 3 | 3 | 17 | 34 | 38 | 25 |  | 1.0998 | 0.8317 | 0.7571 | 0.80655 | 1.0515 |  | 171.2526 | 147.2321 | 216.8398 | 364.9533 | 437.9534 |
| 60 | 12 | 3 | 2 | 5 | 24 | 24 | 43 | 22 |  | 0.9984 | 0.79522 | 0.7106 | 0.77285 | 0.99932 |  | 217.5051 | 202.3475 | 154.1489 | 165.4826 | 284.2811 |
|  | 15 | 4 | 3 | 5 | 20 | 17 | 23 | 12 |  | 1.0074 | 0.95341 | 0.83715 | 0.69773 | 1.357 |  | 123.3942 | 110.8981 | 103.6223 | 224.6829 | 322.1378 |
| 80 | 15 | 3 | 2 | 3 | 15 | 10 | 52 | 36 |  | 1.1115 | 0.56782 | 0.90543 | 0.88638 | 1.045 |  | 151.2244 | 153.4713 | 113.3816 | 249.3265 | 344.4207 |
|  | 20 | 4 | 3 | 3 | 21 | 10 | 48 | 10 |  | 0.97791 | 0.68327 | 0.89175 | 0.5452 | 1.3779 |  | 95.9609 | 260.9722 | 108.6341 | 357.8739 | 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 | 0.29289 | 0.29289 | 0.29289 | 0.29289 |  | 4.9315 | 4.7609 | 4.7609 | 4.7609 | 5.3316 |  | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |
|  | 3 | 2 | 1 | 0.29289 | 0.12356 | 0.10765 | 0.1251 | 0.23127 |  | 7.7756 | 7.2837 | 7.3047 | 7.2852 | 6.5721 |  | 0.0 | 1.0 | 0.8333 | 0.8333 | 0.0 |
| 10 | 3 | 1 | 1 | 0.29289 | 0.35343 | 0.4081 | 0.35343 | 0.17965 |  | 11.8886 | 13.944 | 13.7244 | 13.944 | 10.9233 |  | 0.5000 | 1.0 | 1.0 | 1.0 | 0.0 |
|  | 3 | 2 | 1 | 0.27729 | 0.31368 | 0.20859 | 0.33671 | 0.28985 |  | 7.8497 | 7.8912 | 7.8969 | 8.3472 | 6.02 |  | 0.0 | 1.0 | 1.0 | 1.0 | 0.0 |
|  | 4 | 2 | 2 | 0.28683 | 0.24985 | 0.26967 | 0.26669 | 0.13971 |  | 8.0667 | 8.4464 | 8.5405 | 8.5519 | 7.0635 |  | 0.0 | 1.0 | 1.0 | 0.7500 | 0.0 |
| 12 | 3 | 1 | 1 | 0.26208 | 0.20799 | 0.20869 | 0.19702 | 0.11876 |  | 8.1349 | 8.8581 | 8.8508 | 8.865 | 8.878 |  | 0.0 | 0.6000 | 0.9333 | 0.4118 | 0.0 |
|  | 3 | 2 | 1 | 0.27174 | 0.15733 | 0.10581 | 0.10374 | 0.12986 |  | 11.4614 | 12.2236 | 12.4218 | 12.4564 | 9.0445 |  | 0.0 | 0.7500 | 0.7308 | 0.5556 | 0.0 |
|  | 4 | 2 | 2 | 0.29289 | 0.29289 | 0.29289 | 0.29289 | 0.16664 |  | 12.7865 | 12.4833 | 12.6146 | 12.4833 | 9.4166 |  | 0.0 | 1.0 | 0.5000 | 1.0 | 0.0 |
| Medium | 15 | 4 | 2 | 1 | 0.29289 | 0.13985 | 0.13101 | 0.12044 | 0.31756 |  | 9.4903 | 12.9045 | 12.9252 | 13.2953 | 11.0827 |  | 0.0 | 0.8333 | 0.5000 | 0.7143 | 0.0 |
|  | 6 | 3 | 2 | 0.4021 | 0.29527 | 0.28955 | 0.28727 | 0.24957 |  | 16.6567 | 17.0317 | 17.3215 | 17.3294 | 13.1962 |  | 0.5000 | 0.9286 | 0.4667 | 0.7222 | 0.0 |
| 20 | 4 | 2 | 1 | 0.29815 | 0.15107 | 0.15848 | 0.1193 | 0.25791 |  | 12.9088 | 13.2044 | 13.4456 | 13.7233 | 14.9049 |  | 0.0 | 0.1786 | 0.6571 | 0.5085 | 0.0 |
|  | 6 | 3 | 2 | 0.57571 | 0.22976 | 0.17937 | 0.18503 | 0.087296 |  | 16.942 | 23.2244 | 21.3212 | 22.4472 | 19.2584 |  | 0.0 | 0.3043 | 0.5294 | 0.6562 | 0.0 |
| 25 | 4 | 2 | 1 | 0.29554 | 0.24595 | 0.21313 | 0.21988 | 0.1453 |  | 14.1398 | 13.9753 | 13.9942 | 13.361 | 14.9199 |  | 0.0 | 0.2778 | 0.5938 | 0.5000 | 0.0 |
|  | 6 | 3 | 2 | 0.36833 | 0.20167 | 0.25925 | 0.21858 | 0.088658 |  | 15.7656 | 16.4195 | 16.4263 | 16.5954 | 13.7901 |  | 0.0 | 0.4000 | 0.0645 | 0.9744 | 0.0 |
| 30 | 4 | 2 | 1 | 0.29289 | 0.30539 | 0.15448 | 0.14701 | 0.12632 |  | 16.2685 | 18.028 | 18.2142 | 18.316 | 16.1261 |  | 0.0 | 0.6667 | 0.6818 | 0.5172 | 0.0 |
|  | 6 | 3 | 2 | 0.36732 | 0.32 | 0.22382 | 0.31918 | 0.22227 |  | 18.7009 | 20.007 | 20.7232 | 20.4422 | 18.5044 |  | 0.0 | 0.3333 | 1.0 | 0.5000 | 0.0 |
| Large | 40 | 8 | 3 | 2 | 0.61287 | 0.23895 | 0.1927 | 0.25151 | 0.2302 |  | 28.7453 | 25.4443 | 25.2427 | 25.7747 | 21.0302 |  | 0.0 | 0.3636 | 0.2632 | 0.7200 | 0.0 |
|  | 10 | 4 | 3 | 0.29289 | 0.38664 | 0.32234 | 0.32154 | 0.18247 |  | 19.823 | 22.5447 | 22.8494 | 22.383 | 19.7054 |  | 0.0 | 1.0 | 0.1111 | 0.8000 | 0.0 |
| 50 | 10 | 3 | 2 | 0.29289 | 0.45658 | 0.39357 | 0.38846 | 0.079507 |  | 26.5352 | 26.4226 | 24.6703 | 28.2417 | 25.1413 |  | 0.0 | 0.3333 | 0.2308 | 0.7778 | 0.0 |
|  | 12 | 4 | 3 | 0.27826 | 0.21841 | 0.27305 | 0.34886 | 0.10347 |  | 26.4504 | 27.3506 | 27.1325 | 26.4048 | 25.1865 |  | 0.0 | 0.5882 | 0.1471 | 0.9211 | 0.0 |
| 60 | 12 | 3 | 2 | 0.24062 | 0.20824 | 0.21696 | 0.2401 | 0.18724 |  | 26.3033 | 25.8608 | 26.053 | 24.8018 | 26.5015 |  | 0.0 | 0.3333 | 0.1667 | 1.0 | 0.0 |
|  | 15 | 4 | 3 | 0.23404 | 0.1463 | 0.20753 | 0.28557 | 0.13086 |  | 33.0493 | 33.8469 | 33.1035 | 32.5136 | 28.1735 |  | 0.0 | 0.1500 | 0.6471 | 0.7826 | 0.0 |
| 80 | 15 | 3 | 2 | 0.26514 | 0.33141 | 0.3139 | 0.19734 | 0.11212 |  | 34.7639 | 43.0671 | 44.0787 | 43.3951 | 36.2053 |  | 0.0 | 0.5333 | 0.0 | 0.9808 | 0.0 |
|  | 20 | 4 | 3 | 0.44776 | 0.28591 | 0.2825 | 0.28457 | 0.1747 |  | 46.2629 | 49.1783 | 47.9256 | 49.8598 | 42.9505 |  | 0.0 | 0.1429 | 1.0 | 0.5625 | 0.0 |

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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 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |