Table S1. Parameters of different algorithms for solving HRC-DLBP

|  |  |  |  |
| --- | --- | --- | --- |
| Algorithm | Parameters |  |  |
|  | P10 | P25 | P55 |
| HLSGA |  |  |  |
| FPA |  |  |  |
| NSGA-II |  |  |  |
| GASA |  |  |  |
| MIPSO |  |  |  |
| GDCS |  |  |  |

The priority diagrams of P10, P25, and P55 are shown in Fig. S1, S2, and S3, respectively. Blue, orange, purple, and green represent general, hazardous, complex, and interactive disassembly tasks, respectively; numbers in brackets represent disassembly times.

|  |
| --- |
|  |
| Fig. S1 Priority diagrams of P10 |
|  |
| Fig. S2 Priority diagrams of P25 |
|  |
| Fig. S3 Priority diagrams of P55 |

Table S2. Solutions obtained by different algorithms for P10 of HRC-DLBP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Algorithm | No. |  |  |  | Algorithm | No. |  |  |  |
| HLSGA | **1** | 2 | 965 | 154 163.6 | FPA | **1** | 2 | 1053 | 154 109.2 |
|  | **2** | 2 | 857 | 154 326.8 |  | **2** | 2 | 1205 | 154 000.4 |
|  | **3** | 2 | 1205 | 154 000.4 |  | **3** | 2 | 965 | 154 163.6 |
|  | **4** | 2 | 1053 | 154 109.2 |  |  |  |  |  |
|  | **5** | 2 | 1117 | 154 054.8 |  |  |  |  |  |
|  | **6** | 2 | 945 | 154 272.4 |  |  |  |  |  |
| NSGA-II | **1** | 2 | 1205 | 154 000.4 | GASA | 1 | 2 | 1005 | 154 163.6 |
|  | **2** | 2 | 965 | 154 163.6 |  | 2 | 2 | 1109 | 154 109.2 |
|  | **3** | 2 | 1053 | 154 109.2 |  | 3 | 2 | 1425 | 154 054.8 |
|  | **4** | 2 | 945 | 154 272.4 |  |  |  |  |  |
|  | **5** | 2 | 1117 | 154 054.8 |  |  |  |  |  |
|  | 6 | 2 | 913 | 154 517.2 |  |  |  |  |  |
| MIPSO | **1** | 2 | 1053 | 154 109.2 | GDCS | **1** | 2 | 1117 | 154 054.8 |
|  | **2** | 2 | 1205 | 154 000.4 |  | **2** | 2 | 1205 | 154 000.4 |
|  | **3** | 2 | 965 | 154 163.6 |  | **3** | 2 | 1053 | 154 109.2 |
|  |  |  |  |  |  | **4** | 2 | 945 | 154 272.4 |
|  |  |  |  |  |  | 5 | 2 | 917 | 154 326.8 |
|  |  |  |  |  |  | **6** | 2 | 965 | 154163.6 |

Table S3. Solutions obtained by different algorithms for solving P25 of HRC-DLBP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Algorithm | No. |  |  |  | Algorithm | No. |  |  |  |
| HLSGA | **1** | 3 | 45 | 228 680.0 | FPA | **1** | 3 | 39 | 228 734.4 |
|  | **2** | 3 | 39 | 228 734.4 |  | 2 | 3 | 49 | 228 680.0 |
|  | **3** | 3 | 89 | 228 544.0 |  | 3 | 3 | 117 | 228 571.2 |
|  | **4** | 3 | 41 | 228 707.2 |  | 4 | 3 | 57 | 228 652.8 |
|  | **5** | 3 | 51 | 228 652.8 |  | 5 | 3 | 65 | 228 625.6 |
|  | **6** | 3 | 67 | 228 598.4 |  | **6** | 3 | 41 | 228 707.2 |
|  | **7** | 3 | 59 | 228 625.6 |  |  |  |  |  |
|  | **8** | 3 | 77 | 228 571.2 |  |  |  |  |  |
| NSGA-II | **1** | 3 | 67 | 228 598.4 | GASA | **1** | 3 | 41 | 228 707.2 |
|  | 2 | 3 | 47 | 228 680.0 |  | **2** | 3 | 51 | 228 652.8 |
|  | 3 | 3 | 61 | 228 625.6 |  | **3** | 3 | 67 | 228 598.4 |
|  | 4 | 3 | 39 | 228 761.6 |  | **4** | 3 | 59 | 228 625.6 |
|  | **5** | 3 | 77 | 228 571.2 |  | **5** | 3 | 45 | 228 680.0 |
|  | **6** | 3 | 51 | 228 652.8 |  | **6** | 3 | 39 | 228 734.4 |
|  | **7** | 3 | 41 | 228 707.2 |  | 7 | 3 | 79 | 228 571.2 |
| MIPSO | 1 | 3 | 47 | 228 680.0 | GDCS | 1 | 3 | 47 | 228 680.0 |
|  | 2 | 3 | 109 | 228 571.2 |  | **2** | 3 | 77 | 228 571.2 |
|  | 3 | 3 | 61 | 228 625.6 |  | **3** | 3 | 39 | 228 734.4 |
|  | 4 | 3 | 53 | 228 652.8 |  | 4 | 3 | 73 | 228 598.4 |
|  | **5** | 3 | 39 | 228 734.4 |  | 5 | 3 | 61 | 228 625.6 |
|  |  |  |  |  |  | **6** | 3 | 41 | 228 707.2 |
|  |  |  |  |  |  | **7** | 3 | 51 | 228 652.8 |

Table S4. Solutions obtained by different algorithms for solving P55 of HRC-DLBP

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Algorithm | No. |  |  |  | Algorithm | No. |  |  |  |
| HLSGA | **1** | 7 | 343 | 543 109.6 | FPA | 1 | 7 | 1061 | 542 348.0 |
|  | **2** | 7 | 673 | 542 239.2 |  | **2** | 7 | 347 | 543 082.4 |
|  | **3** | 7 | 653 | 542 266.4 |  | 3 | 7 | 607 | 542 375.2 |
|  | **4** | 7 | 617 | 542 320.8 |  | 4 | 7 | 579 | 542 402.4 |
|  | **5** | 7 | 635 | 542 293.6 |  | **5** | 7 | 529 | 542 484.0 |
|  | **6** | 7 | 599 | 542 348.0 |  | **6** | 7 | 349 | 543 028.0 |
|  | **7** | 7 | 583 | 542 375.2 |  | **7** | 7 | 511 | 542 511.2 |
|  | **8** | 7 | 551 | 542 429.6 |  | 8 | 7 | 547 | 542 456.8 |
|  | **9** | 7 | 567 | 542 402.4 |  | 9 | 7 | 563 | 542 429.6 |
|  | **10** | 7 | 535 | 542 456.8 |  | **10** | 7 | 469 | 542 592.8 |
| NSGA-II | **1** | 7 | 347 | 543 082.4 | GASA | **1** | 7 | 401 | 542 837.6 |
|  | 2 | 7 | 679 | 542 320.8 |  | **2** | 7 | 451 | 542 674.4 |
|  | 3 | 7 | 629 | 542 348.0 |  | 3 | 7 | 513 | 542 538.4 |
|  | 4 | 7 | 611 | 542 375.2 |  | 4 | 7 | 489 | 542 592.8 |
|  | 5 | 7 | 591 | 542 402.4 |  | **5** | 7 | 389 | 542 892.0 |
|  | 6 | 7 | 573 | 542 429.6 |  | **6** | 7 | 463 | 542 647.2 |
|  | 7 | 7 | 511 | 542 538.4 |  | **7** | 7 | 439 | 542 701.6 |
|  | 8 | 7 | 555 | 542 456.8 |  | **8** | 7 | 423 | 542 756.0 |
|  | **9** | 7 | 493 | 542 565.6 |  | 9 | 7 | 475 | 542 620.0 |
|  | 10 | 7 | 525 | 542 511.2 |  | **10** | 7 | 373 | 543 000.8 |
| MIPSO | 1 | 7 | 683 | 542 647.2 | GDCS | 1 | 7 | 351 | 543 082.4 |
|  | 2 | 7 | 389 | 543 028.0 |  | 2 | 7 | 671 | 542 429.6 |
|  | 3 | 7 | 495 | 542 674.4 |  | 3 | 7 | 637 | 542 456.8 |
|  | 4 | 7 | 465 | 542 810.4 |  | 4 | 7 | 595 | 542 484.0 |
|  | 5 | 7 | 487 | 542 728.8 |  | 5 | 7 | 543 | 542 565.6 |
|  | 6 | 7 | 431 | 542 864.8 |  | 6 | 7 | 563 | 542 538.4 |
|  | 7 | 7 | 405 | 542 973.6 |  | 7 | 7 | 495 | 542 647.2 |
|  | 8 | 7 | 391 | 543 000.8 |  | 8 | 7 | 577 | 542 511.2 |
|  | 9 | 7 | 417 | 542 892.0 |  | 9 | 7 | 513 | 542 620.0 |
|  | 10 | 7 | 409 | 542 946.4 |  | 10 | 7 | 527 | 542 592.8 |

Table S5. Disassembly schemes obtained by HLSGA for solving P55 of DLBP.

|  |  |
| --- | --- |
| No. | Disassembly scheme |
| 1 | {27,41,13,10,8}→{11,9,18,19,33,20,45,12}→{6,30,14,25,28,24,7,15,23}→{26,31,16,4}→{39,2,35,21}→{22,36,32,17,34,38,42,37,29,40}→{1,54,48,3,43,46,47,49,50,44,5,52,51,55,53} |
| 2 | {8,9,20,12,27}→{10,1,28,25,24,18,2,13,21,15}→{11,7,45,39,35}→{22,40,6,30,49,48,52}→{33,43,31,41}→{47,19,50,51,14,46,54,32,16}→{23,38,44,34,42,4,26,53,36,3,29,17,37,5,55} |
| 3 | {8,10,18,19,6,9}→{27,21,4,20}→{11,12,28,15,14,23,7,25,24,22,1}→{39,40,26,2,54}→{16,30,31,43,49,45,46,48,52}→{35,41,29,33,17,34,47,44}→{50,55,5,13,51,3,42,32,36,53,37,38} |
| 4 | {6,18,19,10,8,9}→{20,25,26,21,12,24,15,28}→{41,11,7,39}→{23,2,40,22,52,1,49,30,4,14,48}→{45,31,16,35,3}→{54,47,13,17,50,36,32,38,43,55,33,37,46}→{51,27,29,5,42,44,53,34} |
| 5 | {3,8,6,9,4}→{21,25,12,28,20,18,15,24,10}→{11,22,7,39,54,14}→{33,40,23,48,5,27,1,55,49}→{41,35,43,16,52}→{31,30,32,38,2,42,34,17,19,13,36,26}→{47,45,50,46,44,37,51,29,53} |

Table S6. Algorithm parameters for Tesla power battery module case

|  |  |
| --- | --- |
| Algorithm | Parameters |
| HLSGA |  |
| FPA | = 150,  = 0.8 |
| NSGA-II | = 220,  = 0.92,  = 0.1 |
| GASA | = 110,  = 80,  = 100,  = 0.9,  = 0.01 |
| MIPSO |  |
| GDCS |  |



Fig. S4. Three-dimensional drawing of Tesla power battery module

Table S7. Disassembly information of Tesla power battery module

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Part |  |  |  |  | Precedence task |
| 1 | Top cover 1 | 15 | No | No | No | - |
| 2 | Top cover 2 | 15 | No | No | No | - |
| 3 | Plastic bolt 1 | 10 | No | No | No | 1, 2 |
| 4 | Plastic bolt 2 | 10 | No | No | No | 1, 2 |
| 5 | Plastic bolt 3 | 10 | No | No | No | 1, 2 |
| 6 | Plastic bolt 4 | 10 | No | No | No | 1, 2 |
| 7 | PCB | 45 | No | Yes | No | 3, 4, 5, 6 |
| 8 | Temperature Sensor | 30 | No | Yes | No | 3, 4, 5, 6 |
| 9 | Routing 1 | 60 | No | No | Yes | 7 |
| 10 | Routing 2 | 60 | No | No | Yes | 7 |
| 11 | Confluence plate 1 | 100 | No | No | No | 9 |
| 12 | Confluence plate 2 | 100 | No | No | No | 9 |
| 13 | Confluence plate 3 | 100 | No | No | No | 9 |
| 14 | Confluence plate 4 | 100 | No | No | No | 9 |
| 15 | Confluence plate 5 | 100 | No | No | No | 10 |
| 16 | Confluence plate 6 | 100 | No | No | No | 10 |
| 17 | Confluence plate 7 | 100 | No | No | No | 10 |
| 18 | Support frame 1 | 30 | No | No | No | 15, 16, 17 |
| 19 | Support frame 2 | 30 | No | No | No | 11, 12, 13, 14 |
| 20 | Side panel 1 | 20 | No | No | No | 18 |
| 21 | Side panel 2 | 20 | No | No | No | 19 |
| 22 | Cooling pipe | 10 | Yes | No | No | 18,19 |
| 23 | Thermal pad 1 | 5 | No | No | No | 18,19 |
| 24 | Thermal pad 2 | 5 | No | No | No | 18,19 |
| 25 | Thermal pad 3 | 5 | No | No | No | 18,19 |
| 26 | Thermal pad 4 | 5 | No | No | No | 18,19 |
| 27 | Thermal pad 5 | 5 | No | No | No | 18,19 |
| 28 | Thermal pad 6 | 5 | No | No | No | 18,19 |
| 29 | Thermal pad 7 | 5 | No | No | No | 18,19 |
| 30 | Thermal pad 8 | 5 | No | No | No | 18,19 |
| 31 | Insulating cushion 1 | 15 | No | No | No | 18,19 |
| 32 | Insulating cushion 2 | 15 | No | No | No | 18,19 |
| 33 | Insulating cushion 3 | 15 | No | No | No | 18,19 |
| 34 | Insulating cushion 4 | 15 | No | No | No | 18,19 |
| 35 | Insulating cushion 5 | 15 | No | No | No | 18,19 |
| 36 | Insulating cushion 6 | 15 | No | No | No | 18,19 |
| 37 | Insulating cushion 7 | 15 | No | No | No | 18,19 |
| 38 | Cell group 1 | 86 | Yes | No | No | 22 |
| 39 | Cell group 2 | 92 | Yes | No | No | 22 |
| 40 | Cell group 3 | 92 | Yes | No | No | 22 |
| 41 | Cell group 4 | 95 | Yes | No | No | 22 |
| 42 | Cell group 5 | 95 | Yes | No | No | 22 |
| 43 | Cell group 6 | 89 | Yes | No | No | 22 |
| 44 | Cell group 7 | 83 | Yes | No | No | 22 |