**Table 14**

Unimodal benchmark functions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Funtion | Dim | Range | Shift position | fmin |
|  | 20 | [-100,100] | [-30,-30,..,-30] | 0 |
|  | 20 | [-10,10] | [-3,-3,..,-3] | 0 |
|  | 20 | [-100,100] | [-30,-30,..,-30] | 0 |
|  | 20 | [-100,100] | [-30,-30,..,-30] | 0 |
|  | 20 | [-30,30] | [-15,-15,..,-15] | 0 |
|  | 20 | [-100,100] | [-750,..,-750] | 0 |
|  | 20 | [-1.28,1.28] | [-0.25,..,-0.25] | 0 |

**Table 15** :

Multimodal benchmark functions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Funtion | Dim | Range | Shift position | fmin |
|  | 20 | [-500,500] | [-300,..,-300] |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Table 16:**

Composite benchmark functions.

|  |  |  |  |
| --- | --- | --- | --- |
| Funtion | Dim | Range | fmin |
|  | 10 | [-5,5] | 0 |
|  | 10 | [-5,5] | 0 |
|  | 10 | [-5,5] | 0 |
|  | 10 | [-5,5] | 0 |
|  | 10 | [-5,5] | 0 |
|  | 10 | [-5,5] | 0 |

**Appendix B. Multi-objective test problems utilised in this work**

ZDT1:

|  |  |
| --- | --- |
| Minimise: | (B.1) |
| Minimise: | (B.2) |
| Where: | (B.3) |
|  | (B.4) |

ZDT2:

|  |  |
| --- | --- |
| Minimise: | (B.5) |
| Minimise: | (B.6) |
| Where: | (B.7) |
|  | (B.8) |

|  |  |
| --- | --- |
| Name | Mathematical formulation |
| UF1 |  |
| UF2 |  |
| UF3 |  |
| UF4 |  |
| UF5 |  |
| UF6 |  |
| UF7 |  |

**Table 18:**

|  |  |
| --- | --- |
| Name | Mathematical formulation |
| UF8 |  |
| UF9 |  |
| UF10 |  |

**CDT3:**

|  |  |
| --- | --- |
| Minimise: | (B.9) |
| Minimise: | (B.10) |
| Where: | (B.11) |
|  | (B.12) |

ZDT1 with linear PF:

|  |  |
| --- | --- |
| Minimise: | (B.13) |
| Minimise: | (B.14) |
| Where: | (B.15) |
|  | (B.16) |

ZDT2 with three objectives:

|  |  |
| --- | --- |
| Minimise: | (B.17) |
| Minimise: | (B.18) |
| Minimise: | (B.19) |
| Where: | (B.20) |
|  | (B.21) |