Protokol EV

Výběr funkcí

Pro výběr funkcí jsem se poradil s Chat GPT. Kladl jsem důraz na zadané požadavky:

* Multimodální
* Spojitá na celém rozsahu
* Ohodnotitelná v reálném čase
* Nemá fraktální charakter, či jiné „patologie“

I když použití CHAT-GPT hodně pomohlo, bylo potřeba dohledat zdroje a ověřit fakta. Celou historii chatu si lze prohlédnout zde: <https://chat.openai.com/share/1ee8ec28-67a5-44c5-beb7-ec8868512922>

Vizualizace funkcí

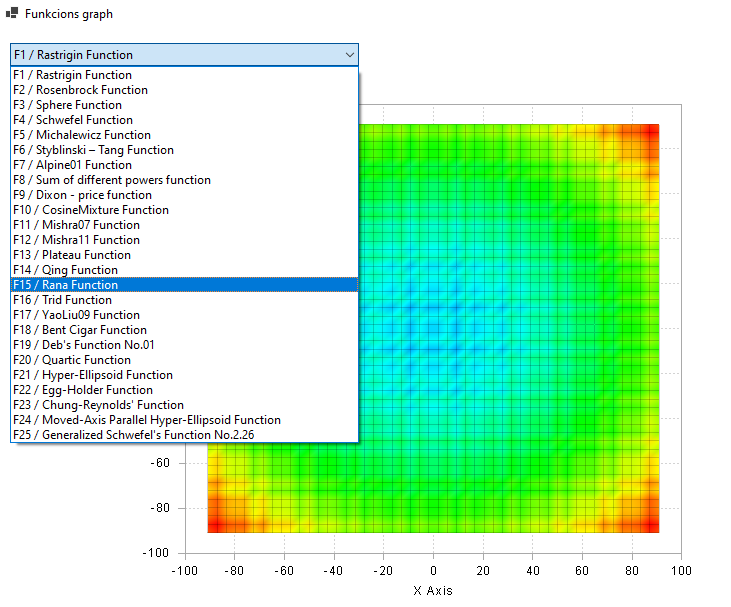
Pro zobrazení funkcí v **2D** a **3D**, jsem vytvořil pomocný program, ve kterém je možné interaktivně zobrazovat zvolené funkce.

Program podporuje posouvání jednotlivých os a manipulaci s prostorem. Ve výchozím stavu zobrazuje funkci ve 2D (heat mapu).

Obsah obrázku diagram, snímek obrazovky, Barevnost, text

Popis byl vytvořen automatickyPři zobrazení funkcí pracuji se zadaným rozsahem: -100, +100.

V pomocném programu se nachází výběrový seznam, který obsahuje seznam funkcí, které lze dynamicky prohlížet. Kompletní seznam funkcí, včetně vzorce a zdroje je detailně popsán níže.



Seznam vybraných funkcí

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| F1/ Rastrigin function | |
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| <https://en.wikipedia.org/wiki/Rastrigin_function>  *Poznámka:* ***a = 10*** | |

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| F2 / Rosenbrock function | | |
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| <https://en.wikipedia.org/wiki/Rosenbrock_function> | | |
| F3 / Sphere function | | |
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| <https://www.sfu.ca/~ssurjano/spheref.html> | | |

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| F4 / Schwefel function | |
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| <https://www.sfu.ca/~ssurjano/schwef.html> | |

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| F5 / Michalewicz function | |
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| <https://www.sfu.ca/~ssurjano/michal.html>  *Poznámka:* ***m=10*** | |

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| F6 / Styblinski – Tang function | |
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| <https://www.sfu.ca/~ssurjano/stybtang.html> | |

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| F7 / Alpine01 | |
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| f_{\text{Alpine01}}(\mathbf{x}) = \sum_{i=1}^{n} \lvert {x_i \sin \left( x_i \right) + 0.1 x_i} \rvert | |
| <https://infinity77.net/global_optimization/test_functions_nd_A.html#go_benchmark.Alpine01> | |

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| F8 / Sum of different powers function | |
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| <https://www.sfu.ca/~ssurjano/sumpow.html> | |

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| F9 / Dixon-price function | |
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| <https://www.sfu.ca/~ssurjano/dixonpr.html> | |

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| F10 / CosineMixture Function | |
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| f_{\text{CosineMixture}}(\mathbf{x}) = -0.1 \sum_{i=1}^n \cos(5 \pi x_i) - \sum_{i=1}^n x_i^2 | |
| <https://infinity77.net/global_optimization/test_functions_nd_C.html> | |

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| F11 / Mishra07 Function | |
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| f_{\text{Mishra07}}(\mathbf{x}) = \left [\prod_{i=1}^{n} x_i - n! \right]^2 | |
| <https://infinity77.net/global_optimization/test_functions_nd_M.html> | |

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| F12 / Mishra11 Function | |
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| f_{\text{Mishra11}}(\mathbf{x}) = \left [ \frac{1}{n} \sum_{i=1}^{n} \lvert x_i \rvert - \left(\prod_{i=1}^{n} \lvert x_i \rvert \right )^{\frac{1}{n}} \right]^2 | |
| <https://infinity77.net/global_optimization/test_functions_nd_M.html> | |

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| F13 / Plateau Function | |
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| f_{\text{Plateau}}(\mathbf{x}) = 30 + \sum_{i=1}^n \lfloor x_i \rfloor | |
| <https://infinity77.net/global_optimization/test_functions_nd_P.html> | |

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| F14 / Qing Function | |
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| <https://infinity77.net/global_optimization/test_functions_nd_Q.html> | |

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| F15 / Rana Function | |
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| f_{\text{Rana}}(\mathbf{x}) = \sum_{i=1}^{n} \left[x_{i} \sin\left(\sqrt{\lvert{x_{1} - x_{i} + 1}\rvert}\right) \cos\left(\sqrt{\lvert{x_{1} + x_{i} + 1}\rvert}\right) + \left(x_{1} + 1\right) \sin\left(\sqrt{\lvert{x_{1} + x_{i} + 1}\rvert}\right) \cos\left(\sqrt{\lvert{x_{1} - x_{i} + 1}\rvert}\right)\right] | |
| <https://infinity77.net/global_optimization/test_functions_nd_R.html> | |

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| F16 / Trid Function | |
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| <https://infinity77.net/global_optimization/test_functions_nd_T.html> | |

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| F17 / YaoLiu09 Function | |
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| f_{\text{YaoLiu09}}(\mathbf{x}) = \sum_{i=1}^n \left [ x_i^2 - 10 \cos(2 \pi x_i ) + 10 \right ] | |
| <https://infinity77.net/global_optimization/test_functions_nd_Y.html> | |

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| F18 / Bent Cigar Function | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/164-bent-cigar-function> | |

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| F19 / Deb's Function No.01 | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/231-deb-s-function-no-01> | |

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| F20 / Quartic Function | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/161-quartic-or-modified-4th-de-jong-s-function> | |

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| F21 / Hyper-Ellipsoid Function | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/177-hyper-elipsoid-function> | |

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| F22 / Egg-Holder Function | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/187-egg-holder-function> | |

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| F23 / Chung-Reynolds' Function | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/165-chung-reynolds-function> | |

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| F24 / Moved-Axis Parallel Hyper-Ellipsoid Function | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/230-moved-axis-parallel-hyper-ellipsoid-function> | |

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| F25 / Generalized Schwefel's Function No.2.26 | |
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| <https://al-roomi.org/benchmarks/unconstrained/n-dimensions/176-generalized-schwefel-s-problem-2-26> | |

Výkonnost algoritmů

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| **D2** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 5.10499 | 0.00011 | 439.96329 | 37.56791 | 934.58595 |
| F2 | 1.04798 | 0.03313 | 754475.85764 | 2624.43259 | 11501.15901 |
| F3 | 0.00798 | 1.05E-18 | 0.58890 | 67.35834 | 619.82922 |
| F4 | 441.99961 | 710.69584 | 757.38693 | 734.60592 | 752.72985 |
| F5 | -1.92734 | -1.85146 | -0.85063 | -1.51783 | -1.73317 |
| F6 | -75.88305 | -78.33233 | 42803.61156 | 8882.75714 | 92.28626 |
| F7 | 0.01964 | 2.37E-05 | 1.64004 | 1.45208 | 5.84538 |
| F8 | 0.04851 | 2.17E-13 | 5313.94613 | 151.00540 | 623.74021 |
| F9 | 0.09043 | 3.93E-13 | 53305.89747 | 232.73424 | 1638.09992 |
| F10 | -121076.58724 | -19250.34552 | -15056.07603 | -18514.96740 | -17469.99015 |
| F11 | 0.00077 | 0 | 220.71148 | 0.10146 | 37.04600 |
| F12 | 2.63E-20 | 0 | 0.00790 | 5.31E-08 | 8.91E-08 |
| F13 | 30.22046 | 30 | 35.72549 | 49.49137 | 45.58325 |
| F14 | 0.18138 | 1.61E-22 | 281774.87560 | 31568.22893 | 62563.14761 |
| F15 | -421.11678 | -180.292 | -90.91300 | -140.25166 | -92.72711 |
| F16 | -1.95542 | -2 | 1068.99284 | 163.81973 | 358.75464 |
| F17 | 4.02214 | 0.00027 | 303.64137 | 64.10757 | 105.72650 |
| F18 | 1.54E-06 | 6.65E-159 | 50.48377 | 4.04079 | 13.41171 |
| F19 | 1.23E-05 | 1.12E-06 | 0.00113 | 0.00874 | 0.00362 |
| F20 | 0.00144 | 5.32E-52 | 119141.41918 | 65754.07972 | 10357.69405 |
| F21 | 0.42417 | 1.26E-23 | 451.63477 | 504.94781 | 495.96390 |
| F22 | -393.11544 | -199.68403 | -125.97661 | -110.40750 | -120.92315 |
| F23 | 0.01178 | 1.31E-49 | 48254.24256 | 26352.06893 | 2182434.42509 |
| F24 | 2.92E-09 | 0 | 15.88628 | 1.50621 | 0.26467 |
| F25 | -382.10855 | -127.26996 | -93.28772 | -84.17066 | -106.69759 |

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| **D10** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 3092.49691 | 35.91955 | 10587.59974 | 13178.05193 | 12718.54770 |
| F2 | 136170881.05350 | 14071.35010 | 5356949625.63218 | 2488005843.5554 | 2350489822.56355 |
| F3 | 1945.65171 | 61.08770 | 11698.95763 | 12829.90848 | 15368.60540 |
| F4 | 3445.25351 | 3741.18801 | 4011.47729 | 3848.61876 | 3857.93014 |
| F5 | -4.97345 | -4.09196 | -3.26070 | -2.95892 | -2.68004 |
| F6 | 493554.55468 | -268.15271 | 21557775.49210 | 18489176.90937 | 14834365.23885 |
| F7 | 37.45389 | 4.08058 | 161.23707 | 139.92353 | 72.40820 |
| F8 | 1487598646.89094 | 80185.52967 | 15938242187109.8 | 54040256486129.6 | 4.87505E+15 |
| F9 | 68488835.38806 | 2571.74175 | 2971542652.32211 | 1744528616.42272 | 1983854121.07814 |
| F10 | -261585.40097 | -68033.41475 | -50536.42403 | -57431.91465 | -51448.35550 |
| F11 | 4785657785296.75 | 0 | 2.87926E+26 | 5.34460E+22 | 3.40929E+19 |
| F12 | 0.15848 | 0.00017 | 9.92708 | 7.85963 | 4.32743 |
| F13 | 150.28968 | 40.46836 | 316.11860 | 271.77868 | 354.64150 |
| F14 | 928136.49778 | 123.46525 | 71685848.02000 | 21264604.94842 | 92797114.56907 |
| F15 | -1167.49736 | -910.62955 | -222.32432 | -606.67692 | -634.16009 |
| F16 | 1200.86224 | -177.25260 | 6113.41694 | 9841.34292 | 7374.57993 |
| F17 | 2149.84467 | 69.62447 | 13881.01979 | 8984.23465 | 11936.50010 |
| F18 | 1311455667.41084 | 10822749.53324 | 15148979604.1896 | 7319781836.06107 | 3266363875.70407 |
| F19 | 0.56414 | 1.01433 | 1.83126 | 1.79547 | 0.76916 |
| F20 | 4494098.11677 | 427.85832 | 168546260.66823 | 147457986.77282 | 231685465.81444 |
| F21 | 2254.05027 | 34.91895 | 15609.66421 | 7640.11630 | 17501.36625 |
| F22 | -979.67387 | -662.88915 | -303.86712 | -356.24242 | -473.98366 |
| F23 | 8228542.22386 | 215.05079 | 227253457.43412 | 86842997.70977 | 134988967.08905 |
| F24 | 46890.52059 | 1616.66145 | 276563.98148 | 173677.67371 | 253243.72497 |
| F25 | -762.93157 | -483.31243 | -390.17314 | -328.00327 | -201.35106 |

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| **D30** | | | | | |
|  | **DE rand/1/bin** | **DE rand/1/bin** | **PSO** | **SOMA all-to-one** | **SOMA all-to-all** |
| F1 | 33190.99826 | 1830.52780 | 58906.23861 | 57127.52298 | 72182.02526 |
| F2 | 9751248165.58860 | 20318746.48014 | 28322545052.42540 | 30546141834.87400 | 34433365644.84870 |
| F3 | 31952.79206 | 1592.23671 | 66118.55963 | 69349.36425 | 75462.24759 |
| F4 | 11365.50872 | 11735.40090 | 12218.79251 | 12075.92629 | 12305.46255 |
| F5 | -7.06547 | -7.44789 | -6.31840 | -6.59490 | -4.67331 |
| F6 | 27314585.25368 | 92271.79812 | 127423825.31453 | 133738556.77518 | 151724243.99448 |
| F7 | 364.79095 | 54.89980 | 607.22099 | 482.57560 | 565.64447 |
| F8 | 4.60925E+34 | 7.15529E+22 | 5.55101E+45 | 4.75622E+48 | 4.97750E+49 |
| F9 | 53993931824.55770 | 136543015.03358 | 324763739138.39700 | 221066209829.28100 | 232897494081.26200 |
| F10 | -474188.77448 | -157798.97092 | -145476.66688 | -138617.63574 | -130144.73037 |
| F11 | 1.77825E+58 | 0 | 1.64963E+84 | 3.50349E+78 | 4.28709E+84 |
| F12 | 6.02592 | 0.20251 | 51.90654 | 39.53759 | 49.32805 |
| F13 | 791.69923 | 189.86238 | 1265.33523 | 1180.65954 | 1221.28511 |
| F14 | 106880268.74010 | 119075.36516 | 351010988.82717 | 217443284.73263 | 276734445.61221 |
| F15 | -1587.31913 | -1088.09986 | -487.27182 | -588.73719 | -576.84209 |
| F16 | 19783.84727 | 1060.44486 | 57509.58248 | 51740.28332 | 43293.61067 |
| F17 | 29125.05185 | 1462.52726 | 68606.37740 | 60772.43677 | 68174.57458 |
| F18 | 30764341427.04540 | 1501066319.30036 | 67024336044.21860 | 59731344414.55880 | 73632474769.86400 |
| F19 | 5.55713 | 6.73824 | 9.06382 | 8.76917 | 7.36981 |
| F20 | 1044873391.31101 | 973267.54054 | 4470915905.39053 | 4735750857.31344 | 3960678371.11058 |
| F21 | 27701.59567 | 1169.74561 | 65470.17593 | 66312.76945 | 73844.48937 |
| F22 | -1761.32450 | -1415.15037 | -432.08684 | -315.76247 | -458.43129 |
| F23 | 986537838.34587 | 2751255.06944 | 4542754677.81263 | 4166003251.36463 | 4872658864.42770 |
| F24 | 50299371.36464 | 50204009.28362 | 72583145.04290 | 89317368.68520 | 76864374.05322 |
| F25 | -1174.51181 | -771.75083 | -428.08629 | -516.73602 | -357.73157 |