Porovnání optimalizačních algoritmů

Souhrn jednokriteriálních algoritmů

- S jedním řešením v daném čase:
  - Gradientní metody
  - Horolezecké algoritmy
  - Simulované žíhání
  - TABU search
  - (1+1)-ES

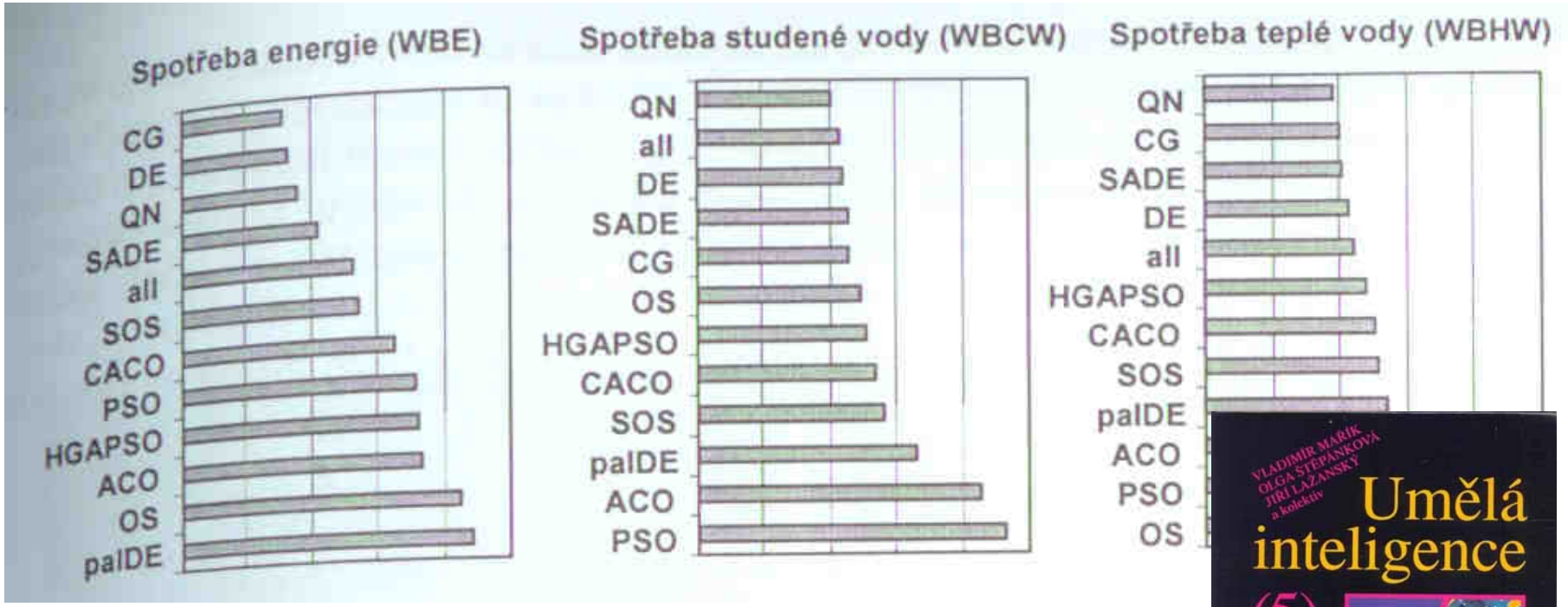
- Výhody: malý počet vyhodnocení, rychlá konvergence

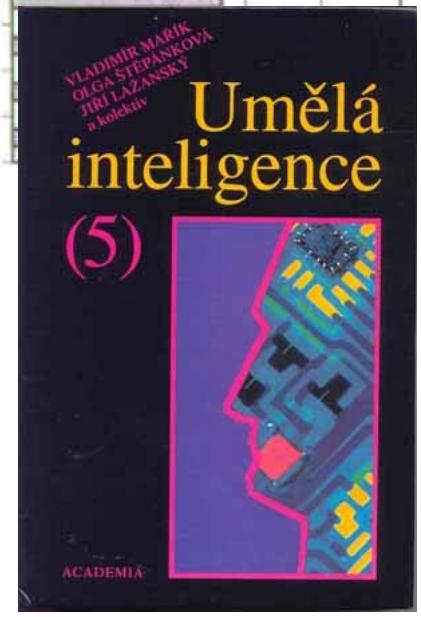
Souhrn jednokriteriálních algoritmů

- S množinou řešení v daném čase:
  - Binární genetické algoritmy
  - Evoluční strategie
  - Diferenciální evoluce
  - SADE/GRADE + CERAF

- Výhody: robustnost

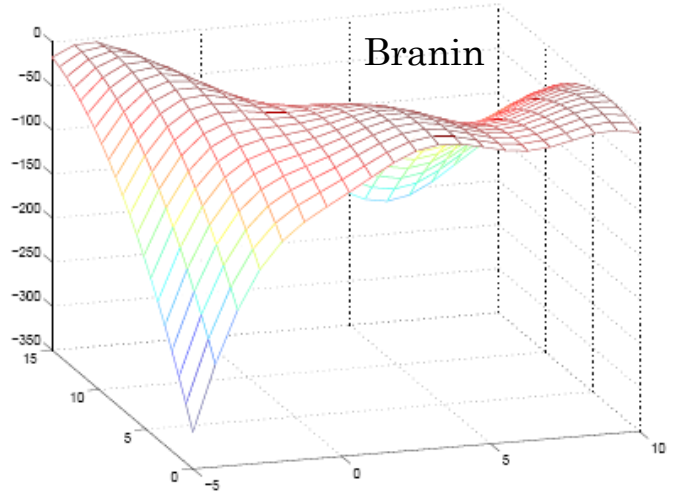
Příklad porovnání

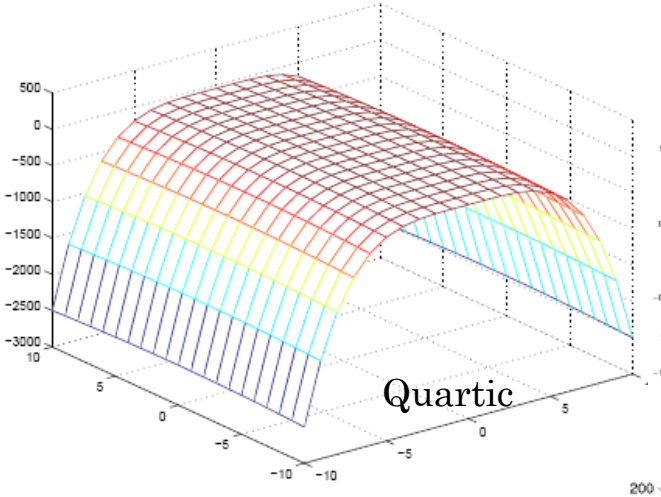


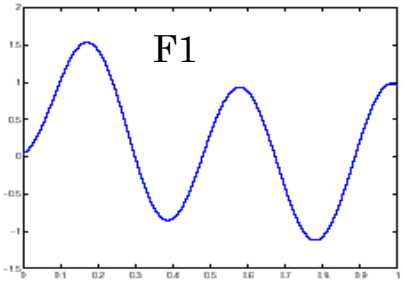


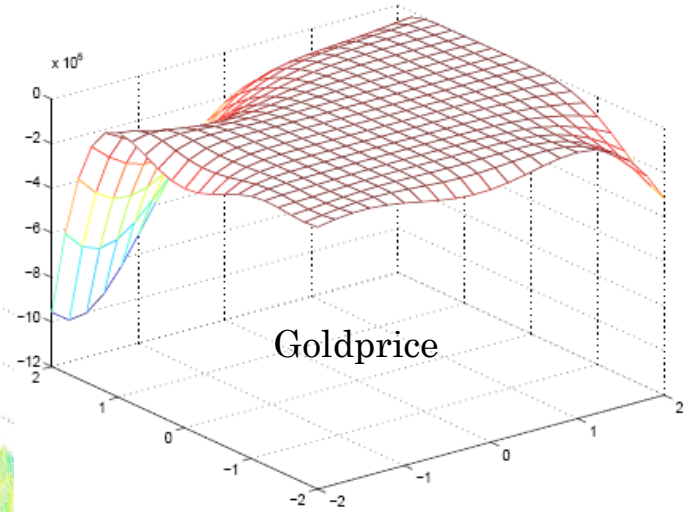
Benchmarks

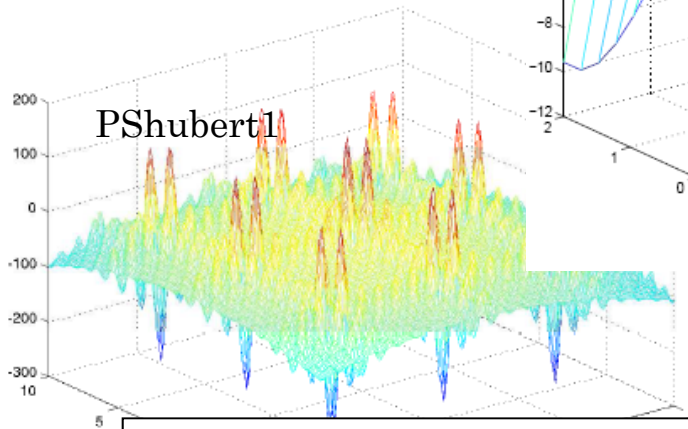
- 20 mathematical functions from 1 to 20 variables
- In Matlab and C++

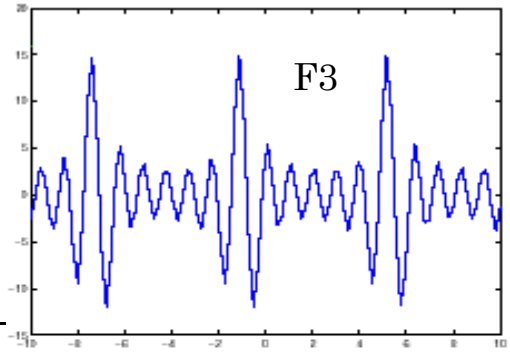






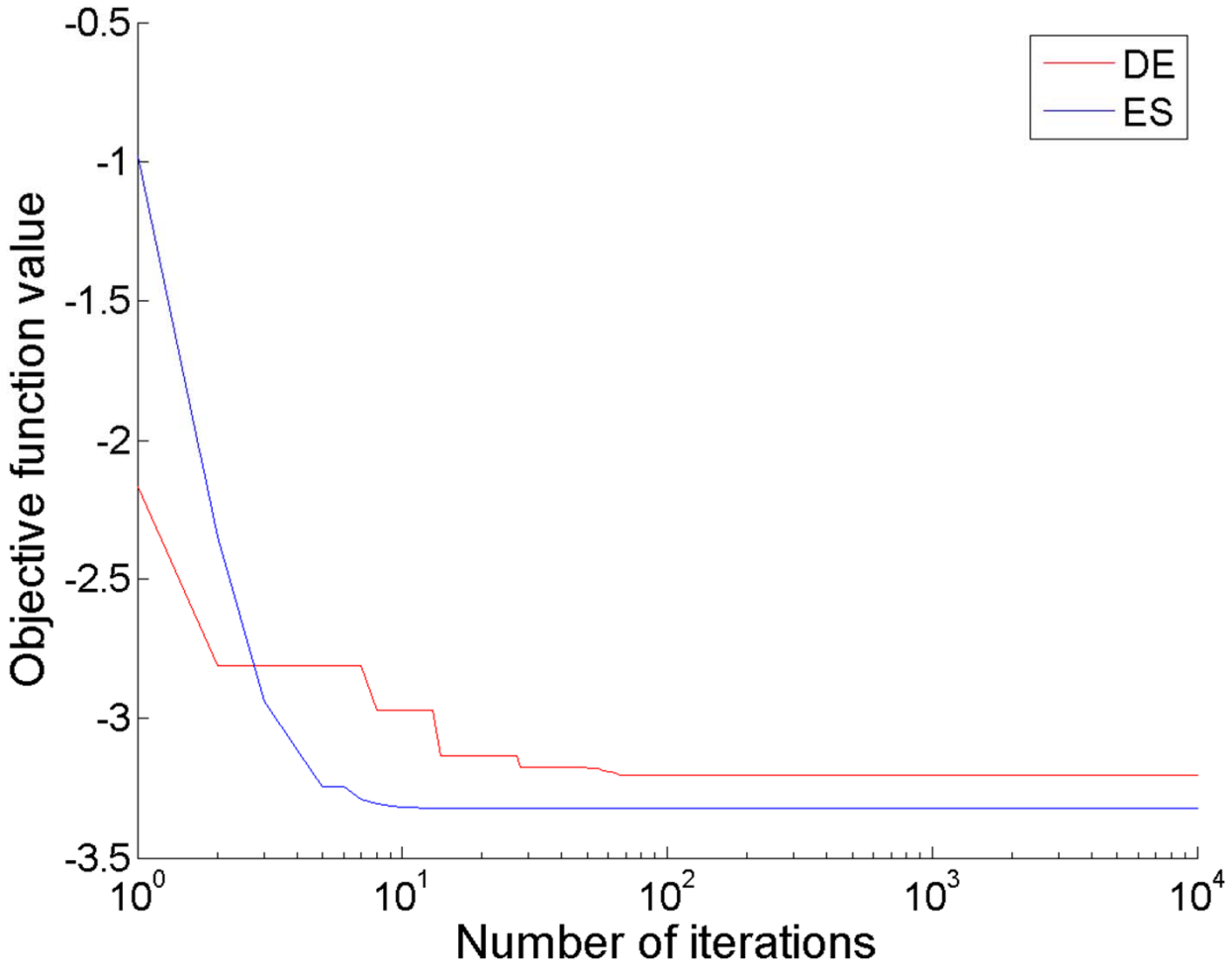




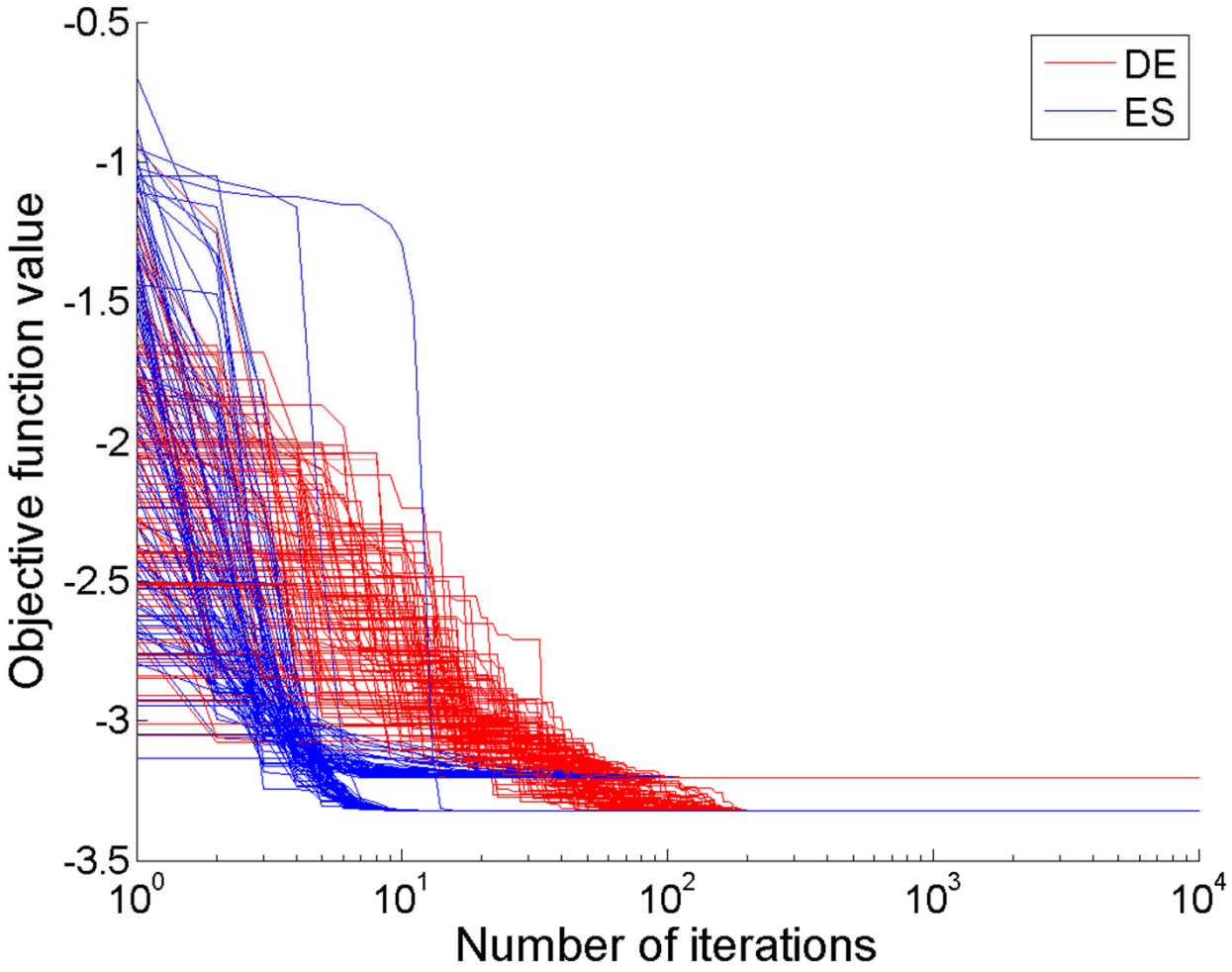


http://klobouk.fsv.cvut.cz/~anicka/testfunc/testfunc.html

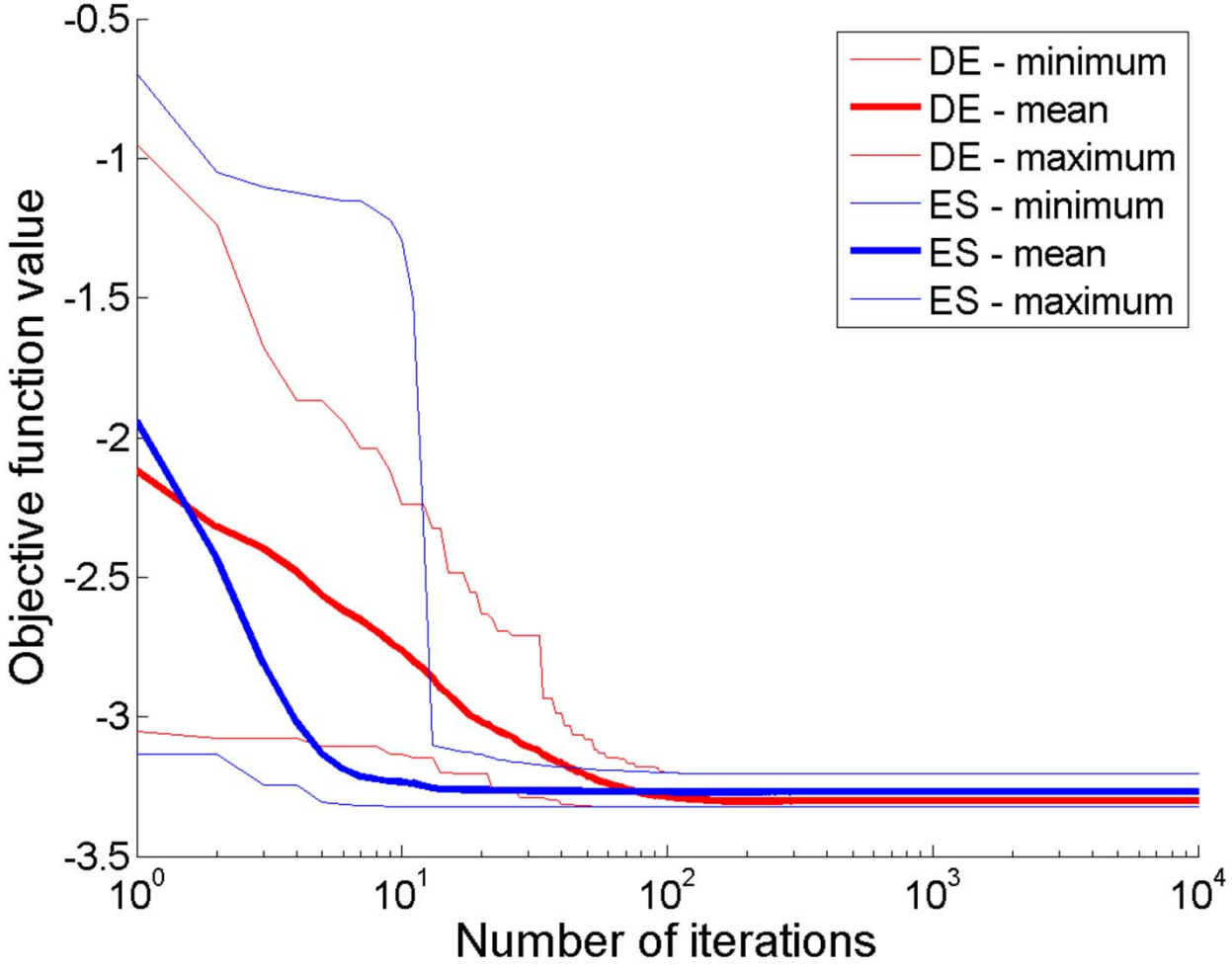
One run comparison: "Progress plots"



One hundred runs comparison



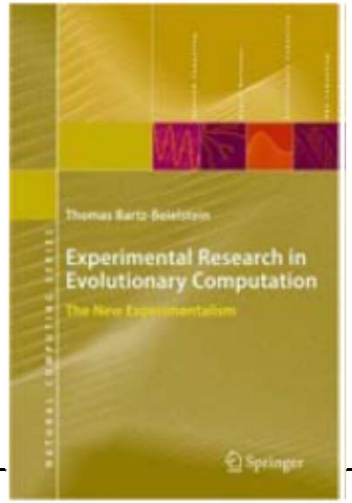
One hundred runs comparison



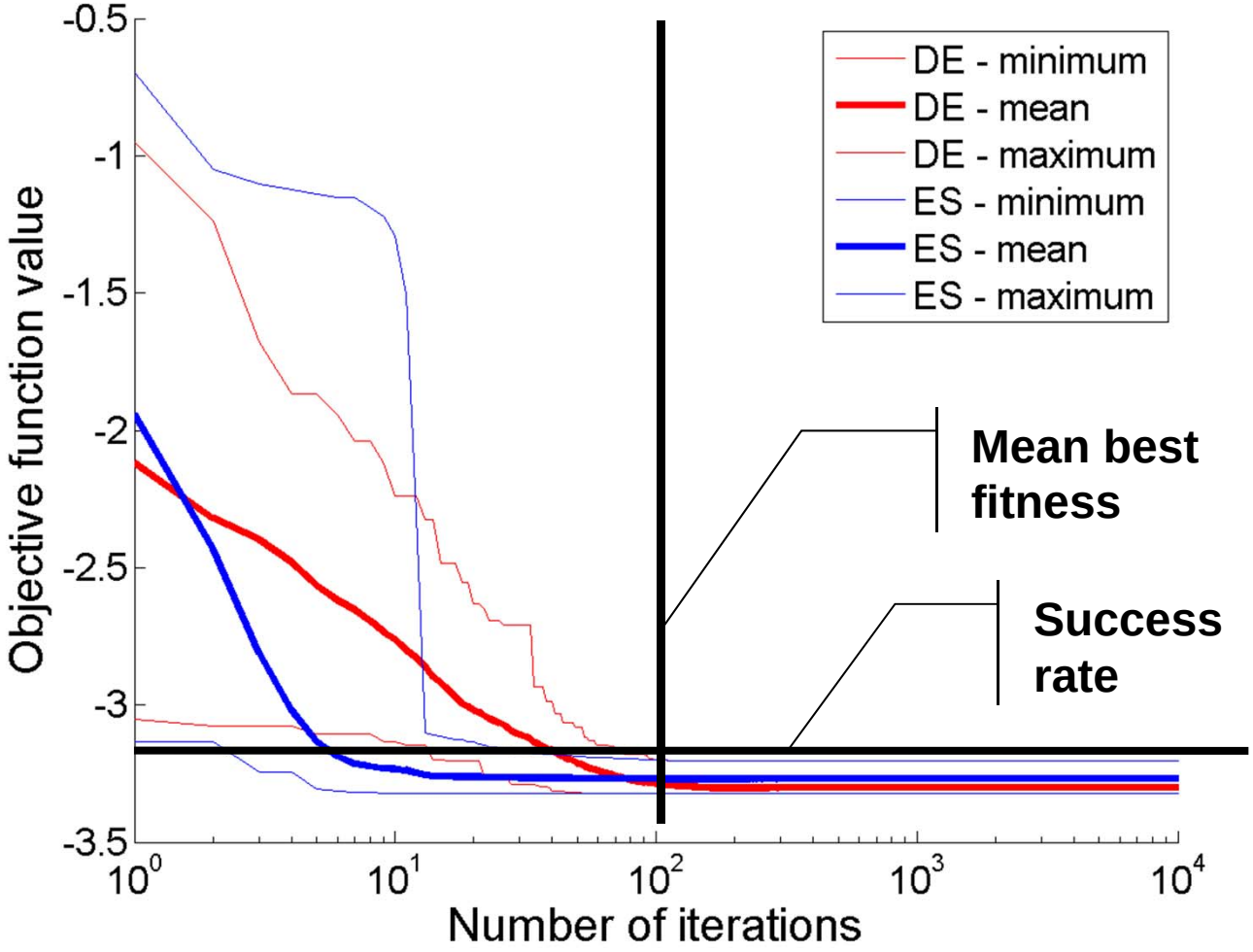
Traditional measures

- A.E. Eiben, J.E. Smith: Introduction to Evolutionary Computing, Springer (2008).
- A.E. Eiben, M. Jelasity: A critical note on experimental research methodology in EC, Proceedings of the 2002 Congress on Evolutionary Computation, 2002. CEC '02.
- Thomas Bartz-Beielstein: Experimental Research in Evolutionary Computation - The New Experimentalism. Springer, Berlin, 2006.
- Thomas Bartz-Beielstein web-page:

  http://ls11-www.informatik.uni-dortmund.de/people/tom/



Traditional measures



Comparison on reliability

Function	Dim	Fmincon	GRADE	GRADE+CERAF
F1	1	100	100	100
F3	1	100	100	100
Branin	2	100	100	100
Camelback	2	100	100	100
Goldprice	2	100	100	100
PShubert1	2	100	100	100
PShubert2	2	100	100	100
Quartic	2	100	100	100
Shubert	2	100	100	100
Hartman1	3	100	100	100
Shekel1	4	100	100	100
Shekel2	4	100	100	100
Shekel3	4	100	100	100
Hartman2	6	100	59	100
Hosc45	10	100	100	100
Brown1	20	100	100	100
Brown3	20	100	100	100
F5n	20	100	100	100
F10n	20	0	78	100
F15n	20	1	100	100

Comparison on convergence speed

Function	Dim	Fmincon	GRADE	GRADE+CERAF
F1	1	27	55	55
F3	1	57	95	95
Branin	2	24	348	348
Camelback	2	40	198	198
Goldprice	2	63	337	337
PShubert1	2	2097	3879	1402
PShubert2	2	1615	2333	896
Quartic	2	56	320	331
Shubert	2	375	606	603
Hartman1	3	63	284	292
Shekel1	4	335	47577	4078
Shekel2	4	255	15356	2686
Shekel3	4	284	7310	2496
Hartman2	6	200	123727	9881
Hosc45	10	264	2147	2096
Brown1	20	286979	176628	182390
Brown3	20	5660	36568	36090
F5n	20	15838	6734	7284
F10n	20	------	89715	226374
F15n	20	374110	22378	25528

Summary

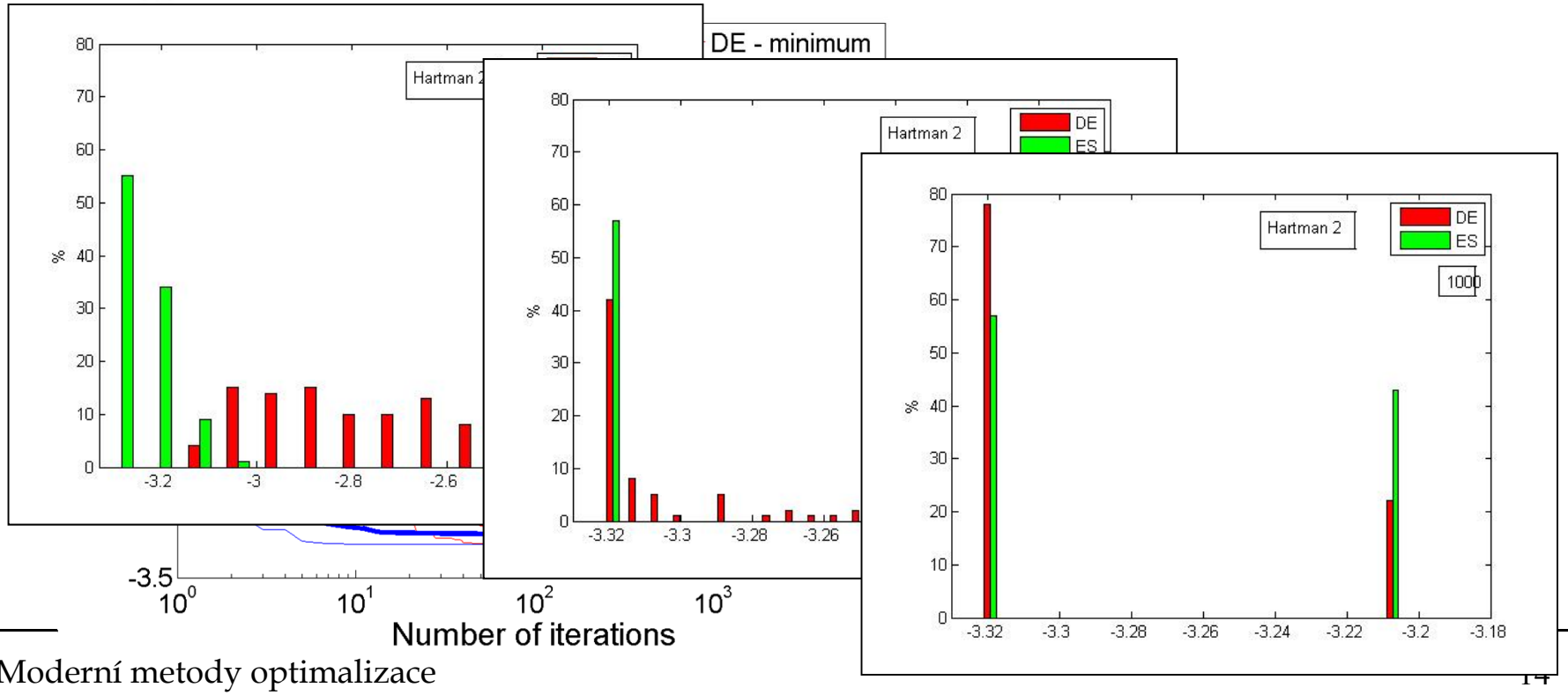
- Disadvantages of traditional measures:
  - Unpractical setting of functions calls limit for MBF type of measures
  - Need of optimum value knowledge for SR based measures

- Result:
  - Whole progress plot is of importance

- Disadvantage:
  - Too much data need to be stored

Proposed solution for two methods

- Store only 10 × Dim results (like generations)
- Use statistical test to judge the result of comparison (Mann-Whitney-Wilcoxon test)

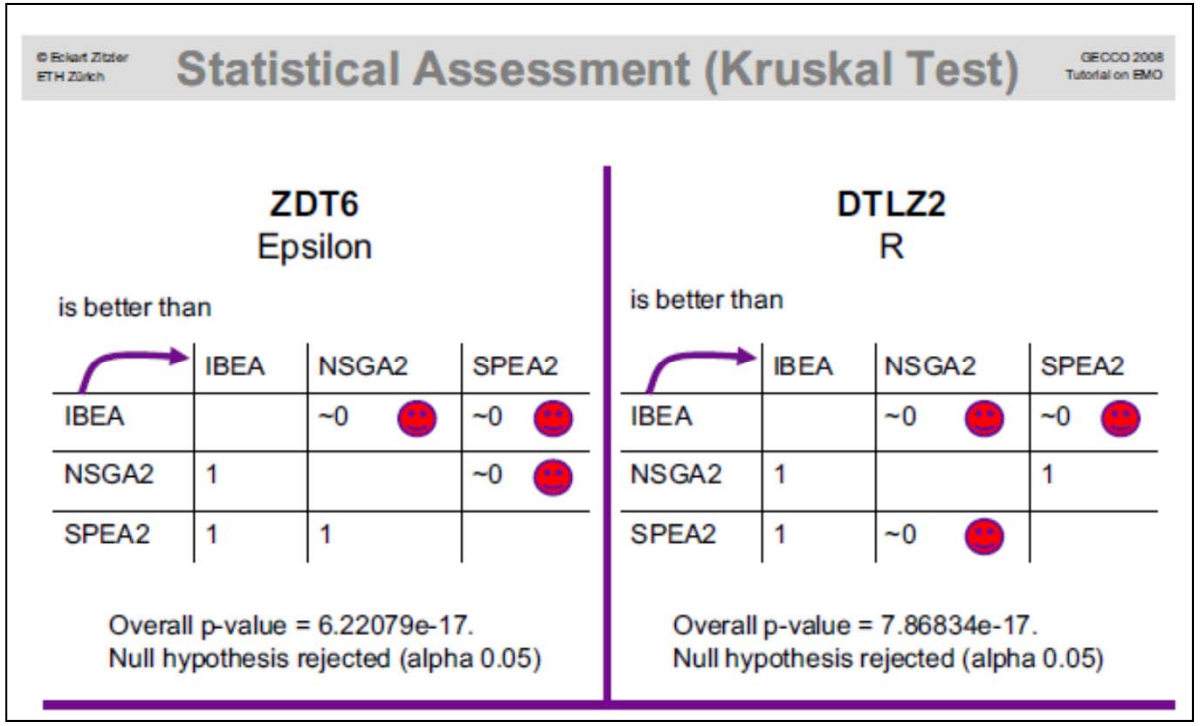


Proposed solution cont.

	10	20	30	40	50	60	70	80	90	100	200	300	400	500	600	700	800	900	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
F1	1	1	1	1	1	1	0	0	0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
F3	1	1	1	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Branin	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Camelback	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Goldprice	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pshubert 1	-1	-1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Pshubert 2	-1	-1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
Quartic	-1	0	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Shubert	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hartman 1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Shekel 1	-1	-1	-1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Shekel 2	-1	-1	-1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Shekel 3	-1	-1	-1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hartman 2	-1	-1	-1	-1	-1	-1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hosc 45	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0
Brown 1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	1	1	1
Brown 3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-1	-1	-1	-1	-1	-1	0	1	1	1	1	1	1	1	1	1
F5n	-1	-1	-1	-1	-1	-1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
F10n	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
F15n	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

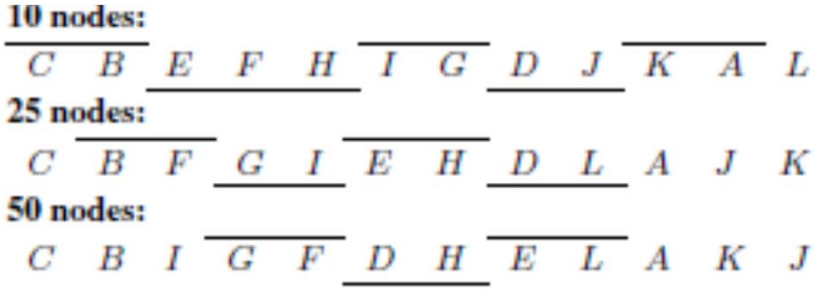
Proposed solution for more methods

- How to graphically compare more than two methods?
  - From multi-objective domain: Pair-vise comparison table



Proposed solution for more methods

- How to graphically compare more than two methods?
  - From single-objective domain: Partial ordering?



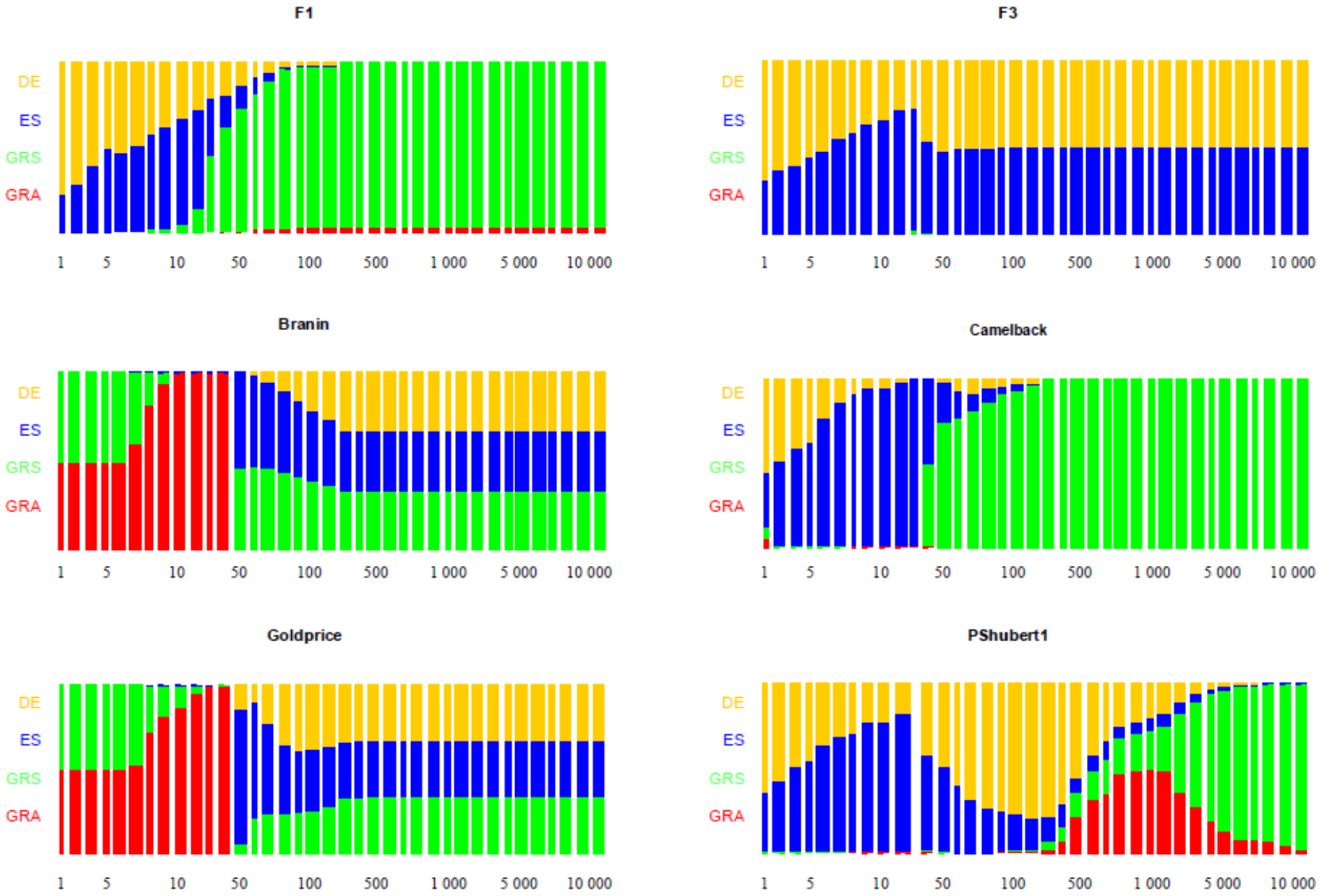
[Carrano et. al.: GECCO'08]

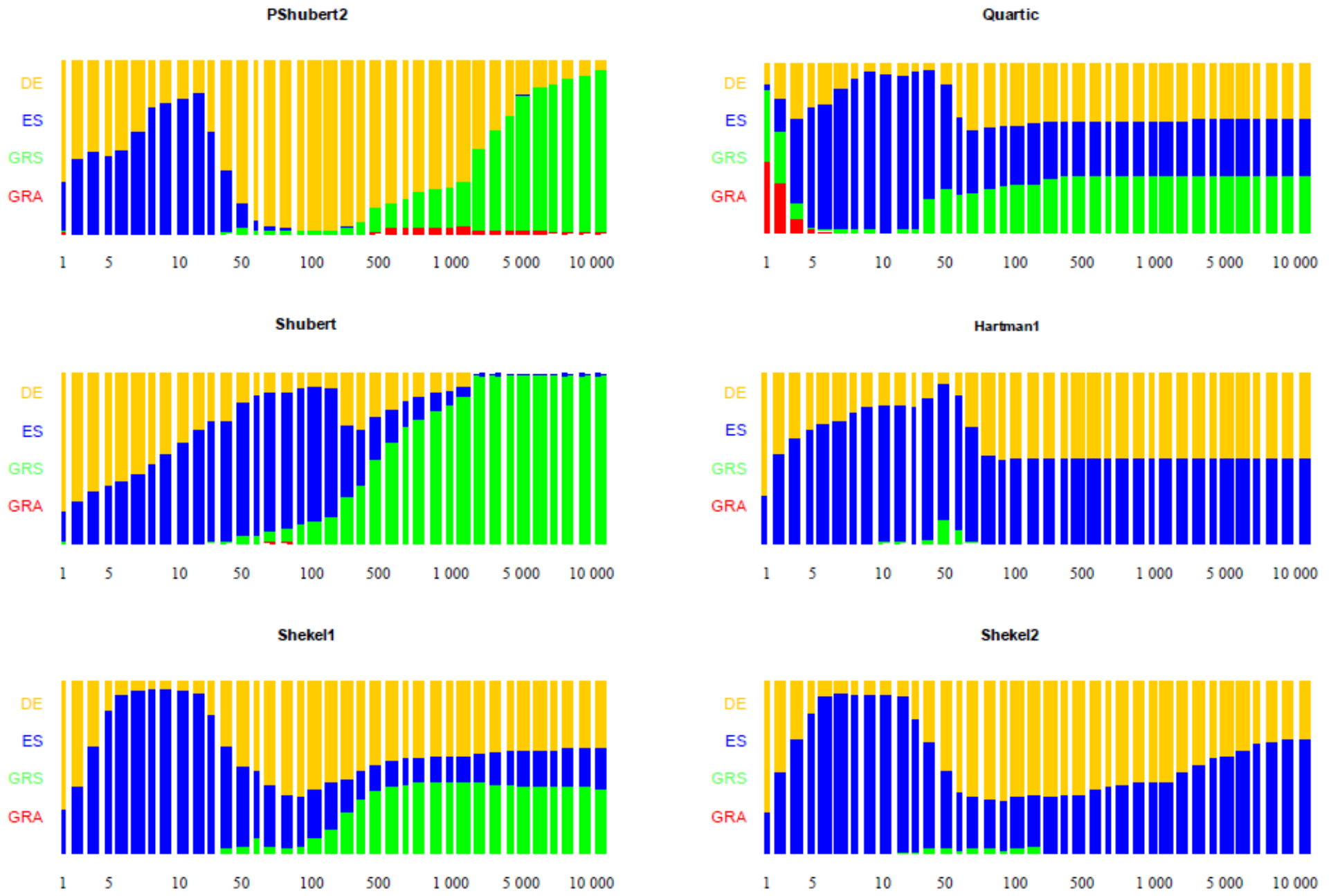
Proposed solution for more methods

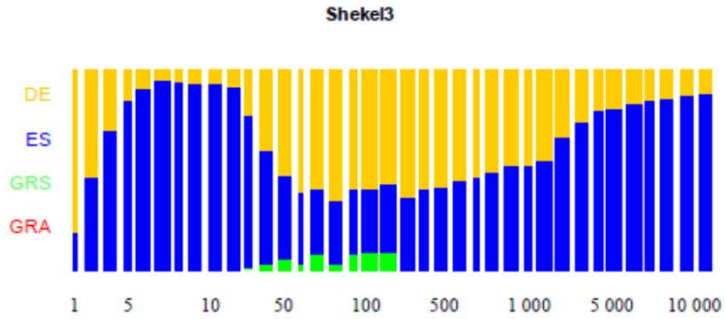
- Relative Winning Score

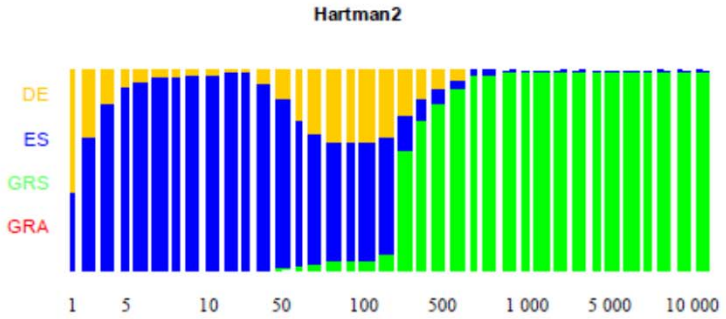
$$RWS_i = \frac{\sum No.\ cases\ i\ is\ winner}{\sum of\ \ scores}$$

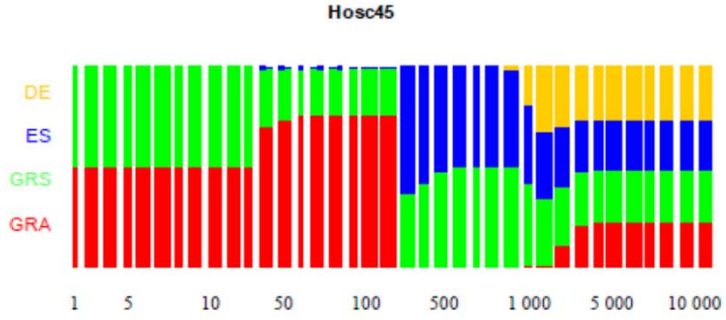
$$RWS_i \in <0,1> \quad \sum RWS_i = 1$$

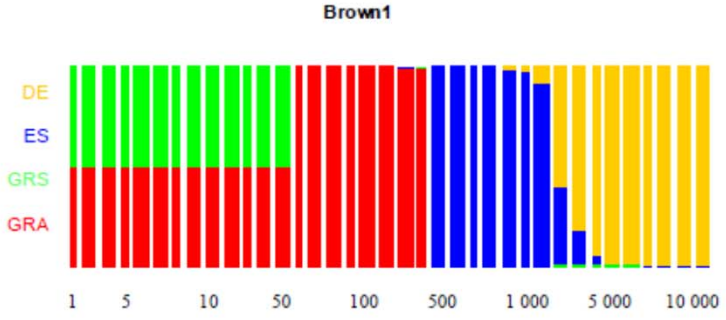

F1
F3
Branin
Camelback
Goldprice
PShubert1
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

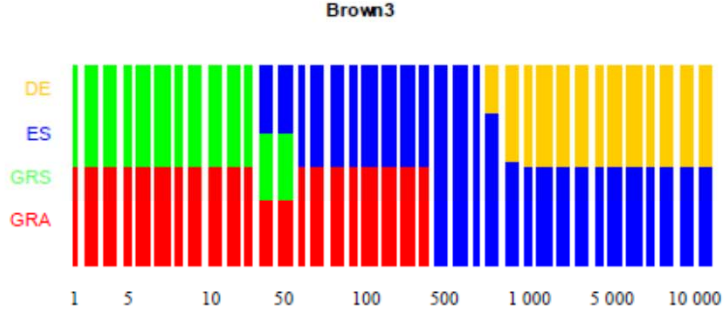

PShubert2
Quartic
Shubert
Hartman1
Shekel1
Shekel2
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

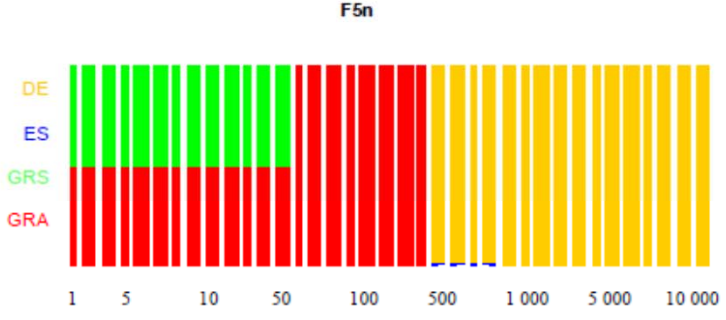

Shekel3
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

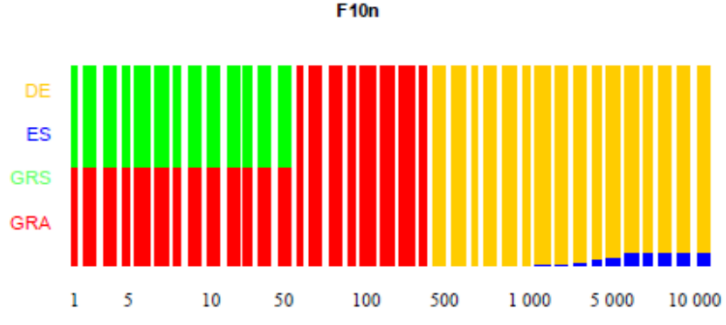

Hartman2
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

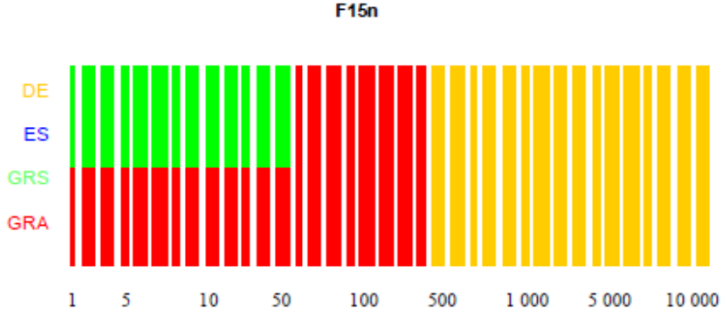

Hosc45
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000


Brown1
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

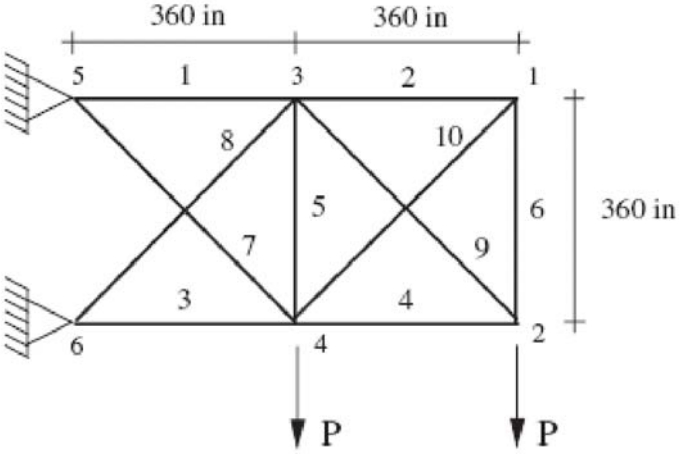

Brown3
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

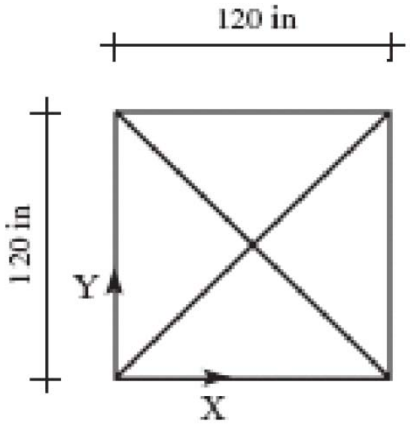

F5n
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

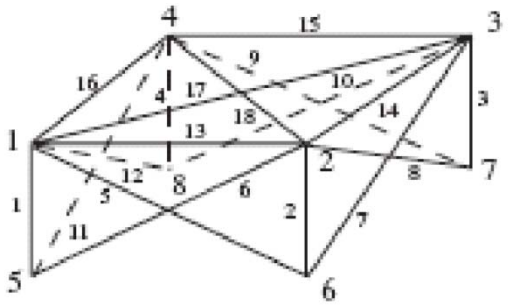

F10n
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

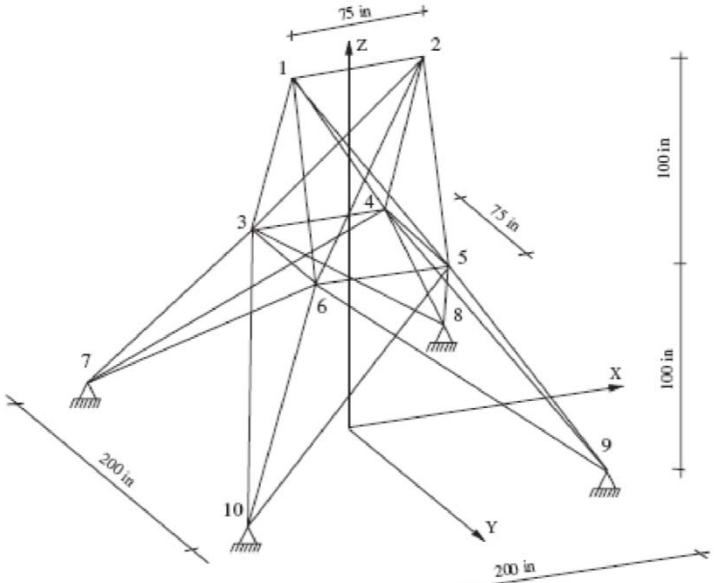

F15n
DE
ES
GRS
GRA
1
5
10
50
100
500
1 000
5 000
10 000

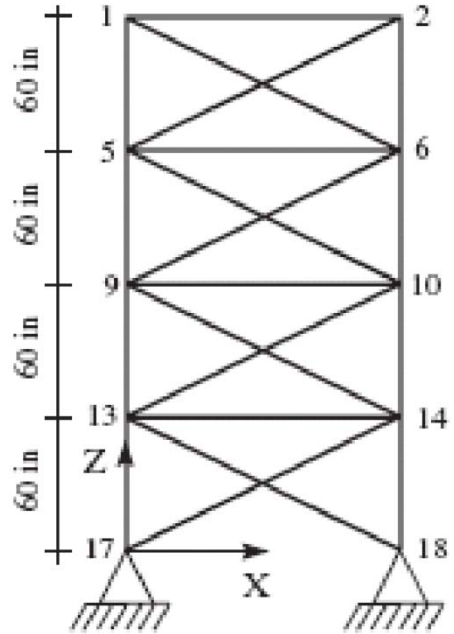
Traditional sizing problems



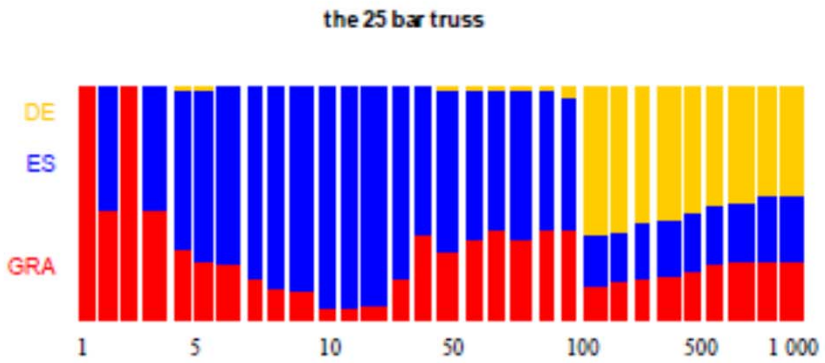


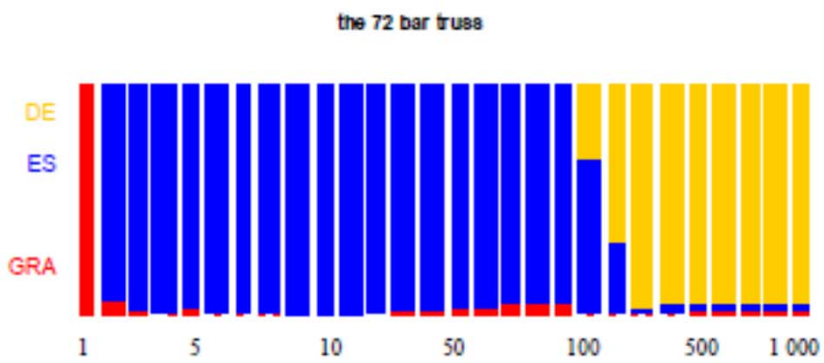


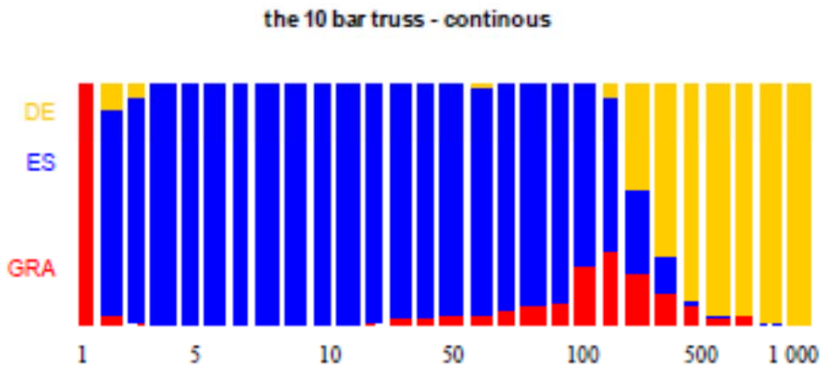


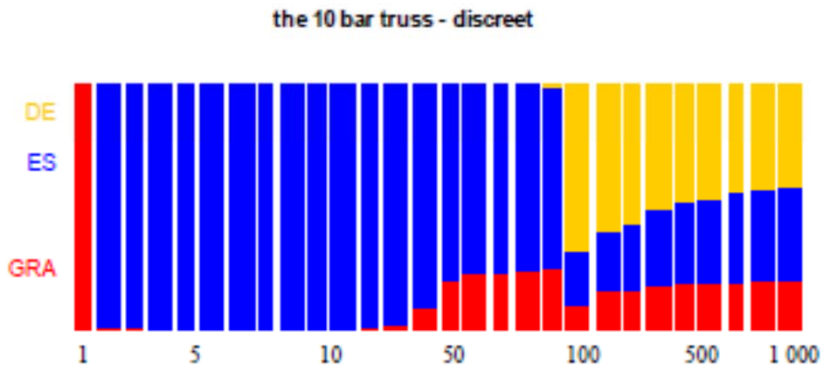


Proposed solution for more methods









Prosba. V případě, že v textu objevíte nějakou chybu nebo budete mít námět na jeho vylepšení, ozvěte se prosím na **matej.leps@fsv.cvut.cz**.

Datum poslední revize: 8.11.2009
Verze: 002