`runTPLS` *runTPLS*

Description

This function implements the *Multi-Stratum Two-Phase Local Search* (MS-TPLS) algorithm described in Borrotti, Sambo, Mylona and Gilmour (2017). The MS-TPLS algorithm is useful to obtain exact optimal multi-stratum designs using a multi-criteria approach. The number of iterations of the MS-TPLS algorithm must be set by the user. The resulting experimental designs can minimize up to six criteria simultaneously from the following: I, D, A, Id, Ds and As. The `runTPLS` function is able to provide the set of solutions that build the approximate Pareto front for the specified optimization problem.

Usage

```
runTPLS(facts, units, criteria, model, iters, ...)
```

Arguments

`facts`	A list of vectors representing the distribution of factors across strata. Each item in the list represents a stratum and the first item is the highest stratum of the multi-stratum structure of the experiment. Within the vectors, experimental factors are indicated by progressive integer from 1 (the first factor of the highest stratum) to the total number of experimental factors (the last factor of the lowest stratum). Blocking factors are differently denoted by empty vectors.
`units`	A list whose i-th element, n_i, is the number of experimental units within each unit at the previous stratum $(i-1)$. The first item in the list, n_1, represents the number of experimental units in the stratum 0. The latter is defined as the entire experiment, such that $n_0 = 1$.
`criteria`	A list specifying the criteria to be optimized. It can contain any combination of: • "I" : I-optimality • "Id" : Id-optimality • "D" : D-optimality • "A" : Ds-optimality • "Ds" : A-optimality • "As" : As-optimality These criteria are well explained in Borrotti, Sambo, Mylona and Gilmour (2017). More detailed information on the available criteria is also given in `MSOpt`.
`model`	A string which indicates the type of model, among "main", "interaction" and "quadratic".
`iters`	An integer indicating the number of iterations of the MS-TPLS algorithm.
`...`	optional arguments (see below).

Details

Additional arguments can be specified as follows:

- `'Restarts',restarts`: A string and an integer, used in pair. `r` defines the number of times the MS-Opt procedure is altogether called within each iteration of the MS-TPLS algorithm. The default value is `r=100`.
- `'Levels',levels`: A string and a vector, used in pair. `levels` is a vector containing the number of available levels for each experimental factor in the argument `facts` (blocking factors are excluded). If all experimental factors share the number of levels one integer is sufficient.
- `'Etas',etas`: A string and a list, used in pair. In `etas` the user must specify the ratios of error variance between subsequent strata, starting from the highest strata. It follows that `length(etas)` must be equal to `length(facts)-1`.
- `'RestInit',restInit`: A string and an integer, used in pair. Through these parameters, it is possible to determine how many of the `r` iterations of MS-Opt should be used for each criterion in the first step of the MS-TPLS algorithm (lines 3-6 of the pseudo-code of MS-TPLS, see Borrotti, Sambo, Mylona and Gilmour (2017)). The default value is `restInit=50`. Let n be the number of criteria under consideration. One can calculate accordingly as $r - (n * restInit)$ the number of times MS-Opt is called in the second step (lines 7-11 of the pseudo-code of MS-TPLS) of each iteration of MS-TPLS.

Value

`runTPLS` returns a list, whose elements are:

- `ar`: A list of length equal to `iters`. The i-th element is a list whose elements are:
  - `nsols`: Number of designs produced during the i-th iteration.
  - `dim`: The criteria space dimension.
  - `scores`: A matrix of `nsols` rows and `dim` columns. Every row contains the value of the criteria for each solution of the i-th iteration.
  - `solutions`: A list of length equal to `nsols` containing the design matrices produced during the i-th iteration. The values of the criteria corresponding at the first element of `solutions` are placed in the first row of the `scores` matrix and so on.
- `stats`: A list of length equal to `iters`. Every element is a vector of size $r - (n * restInit) + 1$, where n is the number of the considered criteria. The first element represents the number of function evaluations during the first step of the MS-TPLS algorithm; the i-th element (excluding the first one) is the sum of the number of evaluations for the i-th scalarization and the maximum value in the `stats`.
- `megaAR`: A list whose elements are:
  - `nsols`: The number of the Pareto front solutions.
  - `dim`: The criteria space dimension.
  - `scores`: A matrix of `nsols` rows and `dim` columns. Every row contains the criteria values for each Pareto front design.
  - `solutions`: A list of length equal to `nsols` containing the design matrices for the Pareto front designs. The values of the criteria corresponding at the first element of `solutions` are placed in the first row of the `scores` matrix and so on.

References

M. Borrotti and F. Sambo and K. Mylona and S. Gilmour. A multi-objective coordinate-exchange two-phase local search algorithm for multi-stratum experiments. Statistics & Computing, 2017.