Considered ELA Features

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Meta-Model Features:

- fits linear and quadratic models (with and without pairwise interaction effects) to the data
- extracts information from these models, such as ...
  - ... the adjusted R^2 of these models
  - ... summary statistics of the estimated parameter coefficients
- helpful to ...
  - ... detect simple problems such as 'sphere' or 'linear slope'
  - ... distinguish between problems with an underlying global structure (e.g., funnel) and random landscapes

Mersmann, O., Bischl, B., Trautmann, H., Preuss, M., Weihs, C. & Rudolph, G. (2011). *Exploratory Landscape Analysis*. In: Proceedings of GECCO 2011 (pp. 829 – 836)

Considered ELA Features

y-Distribution Features:

- focusses on distribution of objective values ($= y$-values)
- measures skewness, kurtosis and (estimated) number of peaks of the distribution of the y-values
- helpful to detect, whether landscape possesses many points at a certain height
  $\rightsquigarrow$ possible plateaus, mainly flat areas, spiky peaks, ...?

Mersmann, O., Bischl, B., Trautmann, H., Preuss, M., Weihs, C. & Rudolph, G. (2011). *Exploratory Landscape Analysis*. In: Proceedings of GECCO 2011 (pp. 829 – 836)

Considered ELA Features

Dispersion Features:

- splits data based on a quantile of the objective values (default: best 2, 5, 10 and 25% vs. corresponding worst)
- computes average distance (mean and median) within group of worst and best observations $\rightsquigarrow$ aggregate via ratio or difference
- helpful to distinguish highly multimodal problems (with random global structure) from funnel-like (or other simpler) landscapes

Lunacek, M. & Whitley, D. (2006). *The Dispersion Metric and the CMA Evolution Strategy*. In: Proceedings of GECCO 2006 (pp. 477 - 484).

Considered ELA Features

Nearest Better Clustering Features:

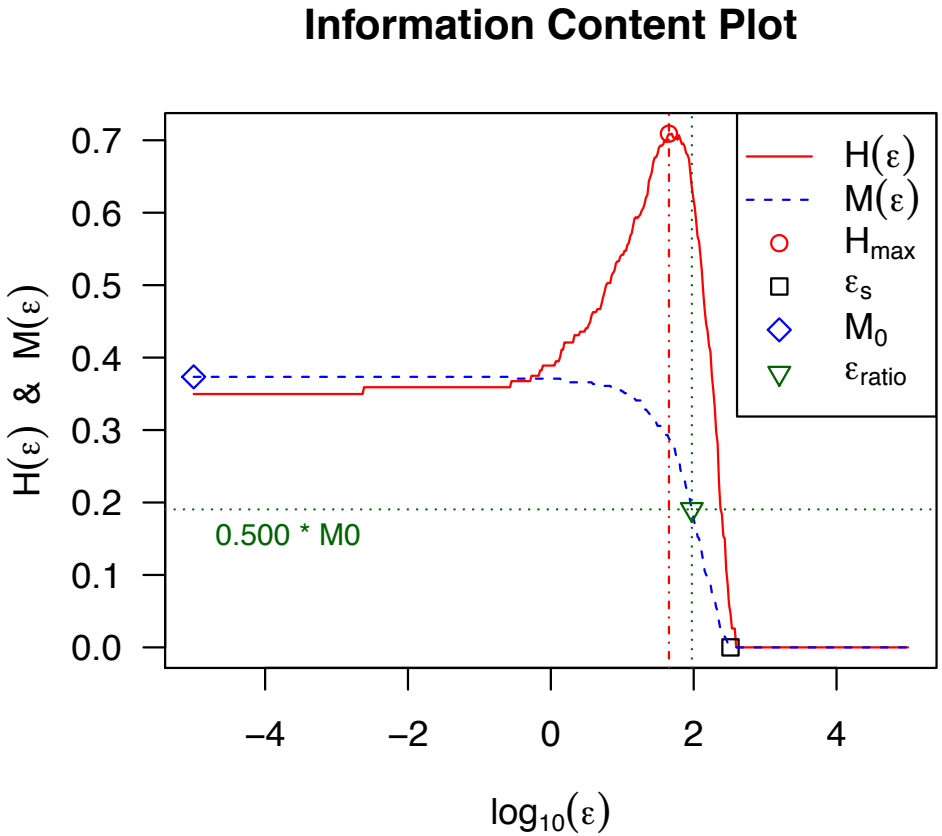
- computes for each observation the nearest neighbor and nearest better neighbor (= closest neighbor among all observation with better y-value)
- analyze the two distance sets (set of nearest neighbor distances and set of nearest better neighbor distances)
- proved to be helpful for detecting funnel landscapes

Kerschke, P., Preuss, M., Wessing, S. & Trautmann H. (2015). *Detecting Funnel Structures by Means of Exploratory Landscape Analysis*. In: Proceedings of GECCO 2015 (pp. 265 - 272).

Considered ELA Features

Information Content Features:

- based on a random walk along the sample's points
- aggregates information of changes (decrease, increase) for consecutive points along that walk
- helpful to 'measure' smoothness, ruggedness, or neutrality of a landscape



Muñoz, M. A., Kirley, M., Halgamuge, S. K. (2015). *Exploratory Landscape Analysis of Continuous Space Optimization Problems using Information Content*. In: IEEE Transactions on Evolutionary Computation (pp. 74 - 87).

Considered ELA Features

Basic Features:

- straight-forward information from the problem setup, such as number of input parameters, observations, boundaries, etc.

Principal Component Analysis Features:

- information based on applying PCA ($\rightsquigarrow$ dimensionality reduction) on the landscape, e.g., percentage of variance that is explained by the first principal component

Kerschke, P. (2017). *Comprehensive Feature-Based Landscape Analysis of Continuous and Constrained Optimization Problems Using the R-Package flacco*.
In: `https://arxiv.org/abs/1708.05258`.