# Package ‘toolmaRk’

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**Type** Package  
**Title** Tests for Same-Source of Toolmarks  
**Version** 0.0.1  
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**Description**  
Implements two tests for same-source of toolmarks. The chumbley_non_random() test follows the paper "An Improved Version of a Tool Mark Comparison Algorithm" by Hadler and Morris (2017) <doi:10.1111/1556-4029.13640>. This is an extension of the Chumbley score as previously described in "Validation of Tool Mark Comparisons Obtained Using a Quantitative, Comparative, Statistical Algorithm" by Chumbley et al (2010) <doi:10.1111/j.1556-4029.2010.01424.x>. fixed_width_no_modeling() is based on correlation measures in a diamond shaped area of the toolmark as described in Hadler (2017).  
**Depends** R (>= 3.3), plyr (>= 1.8.4), dplyr (>= 0.7.2), reshape2 (>= 1.4.2)  
**Imports** ggplot2 (>= 2.2.1)  
**License** GPL-3  
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**RoxygenNote** 6.0.1  
**NeedsCompilation** no  
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**R topics documented:**

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Description

Data set of toolmarks (profiles) created by screwdrivers under different angles. Toolmark data included here were produced by Prof. Scott Chumbley, Mr. Stephen Davis, Ms. Taylor Grieve, Mr. Ryan Spotts, and Dr. Jeremy Hadler. These data were produced as part of research performed at the Ames Laboratory, located on the Iowa State University campus. Ames Laboratory is operated for the U.S. Department of Energy by Iowa State University under Contract No. DE-Ac02-07CH11358.

Usage

ameslab

Format

The dataset consists of a sample of 16 toolmark profiles and descriptors. Toolmarks with the same toolmark identifier are known matches, all other profiles are known non-matches.

- **ID**: toolmark identifier. Factor variable.
- **side**: A or B, indicates the side of the screwdriver used to create the toolmark. Factor variable.
- **angle**: degree under which the toolmark was created.
- **rep**: replicate number for a toolmark, side, angle composition. Note that the data here provided is not complete. For a more complete data set or more information please contact the references given below.
- **profile**: list of data sets with one profile each. Measurements are taken at equispaced intervals across the toolmark.

References

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Examples

data(ameslab)
plot(ameslab$profile[[1]]$v1)
chumbley_non_random(ameslab$profile[[1]], ameslab$profile[[2]])
res14 <- fixed_width_no_modeling(ameslab$profile[[1]], ameslab$profile[[4]])
res14$dist_pval
chumbley_non_random  

Chumbley Non-Random

Description
This function computes the Chumbley U-Statistic on systemically chosen pairs of windows rather than the original method which selects randomly chosen pairs of windows.

Usage
chumbley_non_random(data1, data2, window_opt = 500, window_val = 50, coarse = 0.25)

Arguments
- data1: The first tool mark as a 1-column matrix
- data2: The second tool mark as a 1-column matrix
- window_opt: Size of the window to be used in the optimization step
- window_val: Size of the window to be used in the validation step
- coarse: Smoothing parameter for the normalization smooth

Value
- list with
  - same_shift_n: Number of same shift offsets used
  - diff_shift_n: Number of different shift offsets used
  - U: Observed U statistic
  - p_value: Corresponding p-value

fixed_width_no_modeling  

Distance/threshold test for toolmarks

Description
Compute all possible correlations for windows of length n between the class components. Determine the location of the maximized correlation. Given this location, create a diamond around it in the individual matrix of correlations. For each offset in this diamond, compute the maximized correlation. (1) Determine the distance between the offset for the class and individual components. (2) Compute the Threshold test statistics.
fixed_width_no_modeling

Usage

fixed_width_no_modeling(dat1, dat2, coarse = 0.25, fine = 0.01, window.size = 0.6, M = 500)

Arguments

dat1 a one column matrix representing a digitized tool mark
dat2 a one column matrix representing a second digitized tool mark
coarse normalization smoothing parameter
fine decomposition smoothing parameter
window.size desired window size for the correlations to compute
M search area restriction

Value

list with

• "max_corr" maximized individual component correlation
• "Smooth_offset" optimal Class offset
• "Resid_offset" optimal individual offset
• "dist_pval" distance p-value
• "thresh_pval" threshold p-value
• "Above" Number of offsets with correlation bigger than threshold
• "total_thresh" 2*M+1
• "mark1_decomposition" plot of decomposition d1
• "mark2_decomposition" plot of decomposition d2
• "class_correlations" plot of class correlation
• "individual_correlations" plot of individual correlation
• "distance_plot" distance_plot
• "threshold_plot" threshold_plot
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