Package ‘TPMplt’

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Type Package

Title Tool-Kit for Dynamic Materials Model and Thermal Processing Maps

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Description Provides a simple approach for constructing dynamic materials modeling suggested by Prasad and Gegel <doi:10.1007/BF02664902>. It can easily generate various processing-maps based on this model as well. The calculation result in this package contains full materials constants, information about power dissipation efficiency factor, and rheological properties, can be exported completely also, through which further analysis and customized plots will be applicable as well.

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URL https://github.com/CubicZebra/TPMplt

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Imports VBTree, ggplot2, rgl, e1071, qpcR, grDevices, rowr

Depends R (>= 2.10)

Suggests testthat, knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation no

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R topics documented:

API4TMZ *Read multiple files exported from Thermec Master-Z tester*

Description

Read data from multiple files with structurized file names, then generate a summary table. It will also be available for the files from other tester apparatus by correct setting.

Usage

```
API4TMZ(Cdl, wd = getwd(), ftype = ".csv", Straincln = 7,
  Stresscln = 8, startrow = 29)
```

Arguments

Cdl	An handmade double list to determine selected conditions.
wd	Work directory. Default setting is getwd().
ftype	File type to be read. Defaust setting is ".csv".
Straincln	An integer to specify column for Strain in your data. Default value is 7 means the 7th column contains strain data, in the files exported from Thermec Master-Z tester.
Stresscln	An integer to specify column for Strain in your data. Default value is 8 means the 8th column contains stress data, in the files exported from Thermec Master-Z tester.
startrow	An integer to ignore the prefix rows for testing conditions. Default value is 29.

Value

A matrix-like summary table for all input files.

Examples

```
## Not run:
variable1 <- c("factor11", "factor12", "factor13")
variable2 <- c("factor21", "factor22")
variable3 <- c("factor31", "factor32", "factor33", "factor34")
conditions <- list(variable1, variable2, variable3)
SummaryTable <- API4TMZ(conditions, "/Your_Working_Directory/")
SummaryTable

## End(Not run)
```

`DMMprocess` *Dynamic material modeling from strain rate temperature table*

Description

Dynamic material modeling based on strain rate-temperature table returned from the function `epsExtract`. Material constants as well as power dissipation efficiency factors and rheological stability coefficients in current conditions will be returned.

Usage

```
DMMprocess(x, consfuncPRT = FALSE, lgbase = exp(1), rnd = 2)
```

Arguments

`x`	A strain rate-temperature table, returned from `epsExtract`.
`consfuncPRT`	A boolean value to control result printing for constructive function. The default value uses FALSE.
`lgbase`	A numeric value to determine the logarithm base in calculation. The default value is exp(1).
`rnd`	An integer to control the digit accuracy. Default setting is 2, means accurating to 0.01.

Value

Serial material constants, constructive function, eta table and xi table through dynamic material model developed by Gegel and Prasad.

See Also

`VBTree`, `epsExtract`

Examples

```
require(VBTree)
dl2vbt(chrvec2dl(colnames(TPMdata)))
epstable <- epsExtract(TPMdata, 0.7, 2, 3)
DMM <- DMMprocess(epstable)
DMM
```

epsExtract — *Auto output for strain rate vs. temperature table*

Description

Automatically output the strain rate vs. temperature table, by a specified strain condition.

Usage

```
epsExtract(data, eps, lyT, lySR, manual = NULL)
```

Arguments

`data`	A data frame with `VBTree` style. Pay attention, all factors in column names should be separated by "-" symbol, and factors for temperatures and strain rates should be saved in pure numeric style.
`eps`	A numeric value to specify strain condition.
`lyT`	An integer to specify the layer for temperature attribute in the vector binary tree.
`lySR`	An integer to specify the layer for strain rate attribute in the vector binary tree.
`manual`	An integer vector with the length of 3 where the 1st element denotes the layer for Stress and Strain, the 2nd and 3rd elements represent the levels for Strain and Stress, respectively. The default setting is NULL, which can call the function `lyIDdetector` for automatical completion this vector.

Value

A list consist of a matrix table arranged by rows for strain rates while columns for temperatures, and a numeric value as strain condition for this strain rate-temperature table.

See Also

`VBTree`, `lyIDdetector`

Examples

```
require(VBTree)
# Find locations for temperature and strain rate:
dl2vbt(chrvec2dl(colnames(TPMdata)))
epsExtract(TPMdata, eps = 0.7, lyT = 2, lySR = 3)
```

`lyIDdetector` *Detecting locations for Strain and Stress*

Description

Function for detecting the locations for Strain and Stress in data frame. It is an key component for automatic completion in the function of `epsExtract`.

Usage

```
lyIDdetector(data, patterns = "[Ss][Tt][Rr]")
```

Arguments

`data`	A data frame with `VBTree` style. Pay attention, all factors in column names should be separated by "-" symbol, and factors for temperatures and strain rates should be saved in pure numeric style.
`patterns`	A regex object to determine layer of Strain and Stress. The default pattern uses "[Ss][Tt][Rr]".

Value

A list consisted of the layer, and the levels in this layer for Strain and Stress respectively.

See Also

`VBTree`, `TPMplt`

Examples

```
require(VBTree)
chrvec2dl(colnames(TPMdata))
lyIDdetector(TPMdata)
```

`SVRModel` *Build support vector regression result*

Description

Return a table with continuous values for eta and xi, based on prediction built by support vector regression model (SVR). The kernel function in SVR is radial basis.

Usage

```
SVRModel(x, seqby = 80)
```

Arguments

`x`	The calculation result returned from the function `DMMprocess`.
`seqby`	A numeric value to specify the grid density. Default value is 80, namely the default mesh for original plot uses 80*80.

Value

A data frame including continuous values for eta and xi, calculated based on the discrete values for eta and xi returned from `DMMprocess`. The strain condition in current calculation is also included.

See Also

`DMMprocess`

Examples

```
epstable <- epsExtract(TPMdata, 0.7, 2, 3)
DMM <- DMMprocess(epstable)
PLTbd <- SVRModel(DMM)
PLTbd
```

`TMZdatainput` *Read multiple files exported from Thermec Master-Z tester*

Description

Read data from multiple files with structurized file names, then generate a summary data frame. It will also be available for the files from other tester apparatus by correct setting.

Usage

```
TMZdatainput(makeidx = FALSE, ...)
```

Arguments

`makeidx`	A boolean value to control the index column, inserted in the first column. Default setting is FALSE.
`...`	Arguments to be passed to `API4TMZ`.

Value

A summary data frame for all input files.

Examples

```
## Not run:
variable1 <- c("factor11", "factor12", "factor13")
variable2 <- c("factor21", "factor22")
variable3 <- c("factor31", "factor32", "factor33", "factor34")
conditions <- list(variable1, variable2, variable3)
SummaryTable <- TMZdatainput(Cdl=conditions, wd="/Your_Working_Directory/")
SummaryTable

## End(Not run)
```

TPM2dplt — *Plot 2d thermal process maps*

Description

Plot a 2d thermal process maps: logarithm strain rate as y axis while celsius temperature as x axis. Contours denotes the power dissipation efficiency factor, while the background with gradual colors represents rheological stability.

Usage

```
TPM2dplt(x, xloc = 0.09, yloc = 0.03, lowclr = "red",
  mdclr = "white", highclr = "green")
```

Arguments

`x`	Regression results from modeling functions such as `SVRModel`.
`xloc`	Location for annotatin in x axis. The default value is 0.09.
`yloc`	Location for annotatin in y axis. The default value is 0.03.
`lowclr`	Colour for low rheological stability region. The default setting is "red".
`mdclr`	Colour between low and high rheological stability regions. The default setting uses "white".
`highclr`	Colour for high rheological stability region. The default setting is "green".

Value

A 2d thermal processing-map with logarithm strain rate as its y axis while celsius temperature as its x axis. Strain conditon is showed in top-left in the figure. Power dissipation efficiency factor eta is denoted by gradient blue contours, and the rheological stability coefficient are represented by gradient background.

Examples

```
epstable <- epsExtract(TPMdata, 0.7, 2, 3)
DMM <- DMMprocess(epstable)
PLTbd <- SVRModel(DMM)
TPM2dplt(PLTbd)
```

TPM3dplt — *Plot 3d thermal processing-maps*

Description

Return a 3d thermal process result consisted of 3d surfaces for power dissipation efficiency eta and rheological stability coefficient xi respectively.

Usage

```
TPM3dplt(x, dvs = 5, etaclr = "heat", xiclr = "cm")
```

Arguments

- `x` Regression results from modeling functions such as `SVRModel`.
- `dvs` A positive integer to set the divisions for x, y and z labels in two 3d surface plots. The default value is 5.
- `etaclr` Colour control for eta. Optional value are "rainbow", "heat", "terrain", "topo" and "cm". "heat" is default value.
- `xiclr` Colour control for xi. Optional value are "rainbow", "heat", "terrain", "topo" and "cm". "cm" is default value.

Value

Two 3d surface plots: the left one denotes power dissipation efficiency factor eta, while the right one is for rheological stability xi. A zero plane, z=0, for xi value is added in the right plots for determining unstable region.

Examples

```
epstable <- epsExtract(TPMdata, 0.7, 2, 3)
DMM <- DMMprocess(epstable)
PLTbd <- SVRModel(DMM)
TPM3dplt(PLTbd)
```

`TPMplt` *Tool-Kit for Dynamic Materials Model and Thermal Processing Maps*

Description

Provides a simple approach for constructing dynamic materials modeling (DMM) suggested by Prasad and Gegel. It can easily generate various processing-maps based on this model as well. The calculation result in this package contains full materials constants, information about power dissipation efficiency factor, and rheological properties, can be exported completely also, through which further analysis and customized plots will be applicable as well.

Details

Input data should be of the data frame with "VBTree" style. Full calculation result returned from the function DMMprocess builds the dynamic material model. 2D and 3D thermal processing-maps can be generated based on this model. 2D plots are built using ggplot2 while 3D plots are constructed by rgl. Especially, 3D plots will separately generate two 3D surfaces, for power dissipation efficiency eta, and rheological stability coefficient xi, respectively.

Author(s)

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References

Prasad, YVRK, Gegel, HL, Doraivelu, SM, Malas, JC, Morgan, JT, Lark, KA & Barker, DR (1984). Modeling of dynamic material behavior in hot deformation: forging of Ti-6242. Metallurgical Transactions A, 15, 1883-1892.

Prasad, YVRK, Rao, KP & Sasidhar, S (2015). Hot working guide: a compendium of processing maps. ASM international

See Also

VBTree, ggplot2, rgl

Examples

```
## Not run:
# Check the factors in column names of input data:
# Note: Temperature in layer2, Strain Rate in layer3.
require(VBTree)
vbt <- dl2vbt(chrvec2dl(colnames(TPMdata)))
vbt

# Export Strain Rate-Temperature table based on
# given strain condition (epsilon):
epstable <- epsExtract(TPMdata, 0.7, 2, 3)

# Build dynamic materials model (DMM) from Strain
# Rate-Temperature table:
DMM <- DMMprocess(epstable)

# Choose regression method for plots:
PLTbd <- SVRModel(DMM)

# 2D processing-map through selected regression method:
TPM2dplt(PLTbd)

# 3D processing-map through selected regression method:
TPM3dplt(PLTbd)

## End(Not run)
```

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