

# Package ‘ferrn’

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**Title** Facilitate Exploration of touRR optimisation

**Version** 0.0.1

**Description** Diagnostic plots for optimisation, with a focus on projection pursuit. These show paths the optimiser takes in the high-dimensional space in multiple ways: by reducing the dimension using principal component analysis, and also using the tour to show the path on the high-dimensional space. Several botanical colour palettes are included, reflecting the name of the package.

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**BugReports** <https://github.com/huizezhang-sherry/ferrn/issues>

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---

add\_anchor *A ggproto for drawing anchor points*

---

### Description

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

### Usage

```
add_anchor(dt, anchor_size = 3, anchor_alpha = 0.5, anchor_color = NULL, ...)
```

### Arguments

<code>dt</code>	A data object from the running the optimisation algorithm in guided tour
<code>anchor_size</code>	numeric; the size of the anchor points
<code>anchor_alpha</code>	numeric; the alpha of the anchor points
<code>anchor_color</code>	the variable to be coloured by
<code>...</code>	other aesthetics inherent from <code>explore_space_pca()</code>

### Value

a wrapper for drawing anchor points in `explore_space_pca()`

### See Also

Other draw functions: [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)

---

add\_anno *A ggproto for annotating the symmetry of the starting points*

---

### Description

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

### Usage

```
add_anno(dt, anno_color = "black", anno_lty = "dashed", anno_alpha = 0.1, ...)
```

**Arguments**

dt	A data object from the running the optimisation algorithm in guided tour
anno_color	character; the colour of the annotation line
anno_lty	character; the linetype of the annotation line
anno_alpha	numeric; the alpha of the annotation line
...	other aesthetics inherent from <code>explore_space_pca()</code>

**Value**

a wrapper for annotating the symmetry of start points in `explore_space_pca()`

**See Also**

Other draw functions: [add\\_anchor\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)

---

add_dir_search	<i>A ggproto for drawing directional search points</i>
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---

**Description**

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

**Usage**

```
add_dir_search(dt, dir_size = 0.5, dir_alpha = 0.5, dir_color = NULL, ...)
```

**Arguments**

dt	A data object from the running the optimisation algorithm in guided tour
dir_size	numeric; the size of the directional search points in pseudo derivative search
dir_alpha	numeric; the alpha of the directional search points in pseudo derivative search
dir_color	the variable to be coloured by
...	other aesthetics inherent from <code>explore_space_pca()</code>

**Value**

a wrapper for drawing directional search points (used in pseudo derivative search) with buffer in `explore_space_pca()`

**See Also**

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)

---

add_end	<i>A ggproto for drawing start points</i>
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---

**Description**

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

**Usage**

```
add_end(dt, end_size = 5, end_alpha = 1, end_color = NULL, ...)
```

**Arguments**

<code>dt</code>	A data object from the running the optimisation algorithm in guided tour
<code>end_size</code>	numeric; the size of the end point
<code>end_alpha</code>	numeric; the alpha of the end point
<code>end_color</code>	the variable to be coloured by
<code>...</code>	other aesthetics inherent from <code>explore_space_pca()</code>

**Value**

a wrapper for drawing end points in `explore_space_pca()`

**See Also**

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)

---

add_interp	<i>A ggproto for drawing interpolation path</i>
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---

**Description**

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

**Usage**

```
add_interp(  
  dt,  
  interp_size = 1.5,  
  interp_alpha = NULL,  
  interp_color = NULL,  
  interp_group = NULL,  
  ...  
)
```

**Arguments**

dt	A data object from the running the optimisation algorithm in guided tour
interp_size	numeric; the size of the interpolation path
interp_alpha	numeric; the alpha of the interpolation path
interp_color	the variable to be coloured by
interp_group	the variable to label different interpolation path
...	other aesthetics inherent from explore_space_pca()

**Value**

a wrapper for drawing the interpolation points in explore\_space\_pca()

**See Also**

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)

---

add_interp_last	<i>A ggproto for drawing finish points</i>
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---

**Description**

This is a wrapper function used by explore\_space\_pca() and should be called directly by the user

**Usage**

```
add_interp_last(
  dt,
  interp_last_size = 3,
  interp_last_alpha = 1,
  interp_last_color = NULL,
  ...
)
```

**Arguments**

dt	A data object from the running the optimisation algorithm in guided tour
interp_last_size	numeric; the size of the last interpolation points in each iteration
interp_last_alpha	numeric; the alpha of the last interpolation points in each iteration
interp_last_color	the variable to be coloured by
...	other aesthetics inherent from explore_space_pca()

**Value**

a wrapper for drawing the last interpolation points of each iteration in `explore_space_pca()`

**See Also**

Other draw functions: `add_anchor()`, `add_anno()`, `add_dir_search()`, `add_end()`, `add_interp()`, `add_interrupt()`, `add_search()`, `add_space()`, `add_start()`, `add_theo()`

---

add_interrupt	<i>A ggproto for annotating the interrupted path</i>
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---

**Description**

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

**Usage**

```
add_interrupt(
  dt,
  interrupt_size = 0.5,
  interrupt_alpha = NULL,
  interrupt_color = NULL,
  interrupt_group = NULL,
  interrupt_linetype = "dashed",
  ...
)
```

**Arguments**

<code>dt</code>	A data object from the running the optimisation algorithm in guided tour
<code>interrupt_size</code>	numeric; the size of the interruption path
<code>interrupt_alpha</code>	numeric; the alpha of the interruption path
<code>interrupt_color</code>	the variable to be coloured by
<code>interrupt_group</code>	the variable to label different interruption
<code>interrupt_linetype</code>	character; the linetype to annotate the interruption
<code>...</code>	other aesthetics inherent from <code>explore_space_pca()</code>

**Value**

a wrapper for annotating the interruption in `explore_space_pca()`

**See Also**

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)

---

add_search	<i>A ggproto for drawing search points</i>
------------	--

---

**Description**

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

**Usage**

```
add_search(dt, search_size = 0.5, search_alpha = 0.5, search_color = NULL, ...)
```

**Arguments**

dt	A data object from the running the optimisation algorithm in guided tour
search_size	numeric; the size of the search points
search_alpha	numeric; the alpha of the anchor points
search_color	the variable to be coloured by
...	other aesthetics inherent from <code>explore_space_pca()</code>

**Value**

a wrapper for drawing search points in `explore_space_pca()`

**See Also**

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)



---

`add_space`*A ggproto for drawing circle*

---

## Description

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

## Usage

```
add_space(  
  dt,  
  space_alpha = 0.5,  
  space_fill = "grey92",  
  space_color = "white",  
  cent_size = 1,  
  cent_alpha = 1,  
  cent_color = "black",  
  ...  
)
```

## Arguments

<code>dt</code>	A data object from the running the optimisation algorithm in guided tour
<code>space_alpha</code>	numeric; the alpha of the basis space
<code>space_fill</code>	character; the colour of the space filling
<code>space_color</code>	character; the colour of the space brim
<code>cent_size</code>	numeric; the size of the centre point
<code>cent_alpha</code>	numeric; an alpha of the centre point
<code>cent_color</code>	character; the colour of the centre point
<code>...</code>	other aesthetics inherent from <code>explore_space_pca()</code>

## Value

a wrapper for drawing the space in `explore_space_pca()`

## See Also

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_start\(\)](#), [add\\_theo\(\)](#)

**Examples**

```
library(ggplot2)
space <- tibble::tibble(x0 = 0, y0 = 0, r = 5)
ggplot() +
  add_space(space) +
  theme_void() +
  theme(aspect.ratio = 1)
```

---

 add\_start

*A ggproto for drawing start points*


---

**Description**

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

**Usage**

```
add_start(dt, start_size = 5, start_alpha = 1, start_color = NULL, ...)
```

**Arguments**

<code>dt</code>	A data object from the running the optimisation algorithm in guided tour
<code>start_size</code>	numeric; the size of start point
<code>start_alpha</code>	numeric; the alpha of start point
<code>start_color</code>	the variable to be coloured by
<code>...</code>	other aesthetics inherent from <code>explore_space_pca()</code>

**Value**

a wrapper for drawing start points in `explore_space_pca()`

**See Also**

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_theo\(\)](#)

**Examples**

```
library(ggplot2)
# construct the space and start df for plotting
space <- tibble::tibble(x0 = 0, y0 = 0, r = 5)
start <- holes_1d_geo %>%
  compute_pca() %>%
  purrr::pluck("aug") %>%
  clean_method() %>%
  get_start()
```

```
ggplot() +  
  add_space(dt = space) +  
  add_start(dt = start, start_color = info) +  
  theme_void() +  
  theme(aspect.ratio = 1)
```

---

add\_theo

*A ggproto for drawing the theoretical basis, if applicable*

---

## Description

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

## Usage

```
add_theo(dt, theo_label = "*", theo_size = 25, theo_alpha = 0.8, ...)
```

## Arguments

<code>dt</code>	A data object from the running the optimisation algorithm in guided tour
<code>theo_label</code>	character; a symbol to label the theoretical point
<code>theo_size</code>	numeric; the size of the theoretical point
<code>theo_alpha</code>	numeric; the alpha of the theoretical point
<code>...</code>	other aesthetics inherent from <code>explore_space_pca()</code>

## Value

a wrapper for drawing theoretical points in `explore_space_pca()`

## See Also

Other draw functions: [add\\_anchor\(\)](#), [add\\_anno\(\)](#), [add\\_dir\\_search\(\)](#), [add\\_end\(\)](#), [add\\_interp\\_last\(\)](#), [add\\_interp\(\)](#), [add\\_interrupt\(\)](#), [add\\_search\(\)](#), [add\\_space\(\)](#), [add\\_start\(\)](#)

---

bind_random	<i>Bind random bases in the projection bases space</i>
-------------	--

---

**Description**

Given the orthonormality constraint, the projection bases live in a high dimensional hollow sphere. Generating random points on the sphere is useful to perceive the data object in the high dimensional space.

**Usage**

```
bind_random(dt, n = 500, seed = 1)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the tourr package
n	numeric; the number of random bases to generate in each dimension by geozoo
seed	numeric; a seed for generating reproducible random bases from geozoo

**Value**

a tibble object containing both the searched and random bases

**See Also**

Other bind: [bind\\_random\\_matrix\(\)](#), [bind\\_theoretical\(\)](#)

**Examples**

```
bind_random(holes_1d_better) %>% tail(5)
```

---

bind_random_matrix	<i>Bind random bases in the projection bases space as a matrix</i>
--------------------	--

---

**Description**

Bind random bases in the projection bases space as a matrix

**Usage**

```
bind_random_matrix(basis, n = 500, front = FALSE, seed = 1)
```

**Arguments**

basis	a matrix returned by <code>get_basis_matrix()</code>
n	numeric; the number of random bases to generate in each dimension by <code>geozoo</code>
front	logical; if the random bases should be bound before or after the original bases
seed	numeric; a seed for generating reproducible random bases from <code>geozoo</code>

**Value**

matrix  
a matrix containing both the searched and random bases

**See Also**

Other bind: [bind\\_random\(\)](#), [bind\\_theoretical\(\)](#)

**Examples**

```
data <- get_basis_matrix(holes_1d_geo)
bind_random_matrix(data) %>% tail(5)
```

---

bind_theoretical	<i>Bind the theoretical best record</i>
------------------	---

---

**Description**

The theoretical best basis is usually known for a simulated problem. Augment this information into the data object allows for evaluating the performance of optimisation against the theory.

**Usage**

```
bind_theoretical(dt, matrix, index, raw_data)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the <code>tourr</code> package
matrix	a matrix of the theoretical basis
index	the index function used to calculate the index value
raw_data	a tibble of the original data used to calculate the index value

**Value**

a tibble object containing both the searched and theoretical best bases

**See Also**

Other bind: `bind_random_matrix()`, `bind_random()`

**Examples**

```
best <- matrix(c(0, 1, 0, 0, 0), nrow = 5)
tail(holes_1d_better %>% bind_theoretical(best, tourr::holes(), raw_data = boa5), 1)
```

---

botanical\_palettes      *A customised colour palette based on Australian botanies*

---

**Description**

Available colours in the palettes

**Usage**

```
botanical_palettes
botanical_pal(palette = "fern", reverse = FALSE)
```

**Arguments**

palette	Colour palette from the botanical_palette
reverse	logical, if the colour should be reversed

**Format**

An object of class `list` of length 5.

**Value**

a function for interpolating colour in the botanical palette

---

clean_method	<i>Clean method names</i>
--------------	---------------------------

---

**Description**

Clean method names

**Usage**

```
clean_method(dt)
```

**Arguments**

dt                    a data object

**Value**

a tibble with method cleaned

**Examples**

```
head(clean_method(holes_1d_better), 5)
```

---

explore_space_pca	<i>Plot the PCA projection of the projection bases space</i>
-------------------	--

---

**Description**

The set of functions returns a primary ggplot object that plots the data object in a space reduced by PCA. `compute_pca()` computes the PCA and `explore_space_pca()` plots the bases in the PCA-projected space

**Usage**

```
explore_space_pca(  
  dt,  
  details = FALSE,  
  pca = TRUE,  
  group = NULL,  
  color = NULL,  
  ...,  
  animate = FALSE  
)
```

```
flip_sign(dt, group = NULL, ...)
```

```
compute_pca(dt, group = NULL, random = TRUE, flip = TRUE, ...)
```

**Arguments**

<code>dt</code>	a data object collected by the projection pursuit guided tour optimisation in <code>tourr</code>
<code>details</code>	logical; if components other than start, end and interpolation need to be shown
<code>pca</code>	logical; if PCA coordinates need to be computed for the data
<code>group</code>	the variable to label different runs of the optimiser(s)
<code>color</code>	the variable to be coloured by
<code>...</code>	other arguments received from <code>explore_space_pca()</code>
<code>animate</code>	logical; if the interpolation path needs to be animated
<code>random</code>	logical; if random bases from the basis space need to be added to the data
<code>flip</code>	logical; if the sign flipping need to be performed

**Value**

`explore_space_pca()` a ggplot object for diagnosing the optimisers in the PCA-projected basis space

`flip_sign()` a list containing

- a matrix of all the bases
- a logical value whether a flip of sign is performed
- a dataframe of the original dataset

`compute_pca()` a list containing

- the PCA summary
- a dataframe with PC coordinates augmented

**See Also**

Other main plot functions: [explore\\_space\\_tour\(\)](#), [explore\\_trace\\_interp\(\)](#), [explore\\_trace\\_search\(\)](#)

**Examples**

```
dplyr::bind_rows(holes_1d_geo, holes_1d_better) %>%
  bind_theoretical(matrix(c(0, 1, 0, 0, 0), nrow = 5),
    index = tourr::holes(), raw_data = boa5
  ) %>%
  explore_space_pca(group = method, details = TRUE) +
  scale_color_discrete_botanical()
dplyr::bind_rows(holes_1d_geo, holes_1d_better) %>%
  flip_sign(group = method) %>%
  str(max = 1)
dplyr::bind_rows(holes_1d_geo, holes_1d_better) %>% compute_pca(group = method)
```



---

explore\_space\_tour      *Plot the grand tour animation of the bases space in high dimension*

---

### Description

Plot the grand tour animation of the bases space in high dimension

### Usage

```
explore_space_tour(...)

prep_space_tour(
  dt,
  group = NULL,
  flip = FALSE,
  color = NULL,
  rand_size = 1,
  point_size = 1.5,
  end_size = 5,
  theo_size = 3,
  theo_shape = 17,
  theo_color = "black",
  palette = botanical_palettes$fern,
  ...
)
```

### Arguments

...	other argument passed to <code>tourr::animate_xy()</code> and <code>prep_space_tour()</code>
dt	a data object collected by the projection pursuit guided tour optimisation in <code>tourr</code>
group	the variable to label different runs of the optimiser(s)
flip	logical; if the sign flipping need to be performed
color	the variable to be coloured by
rand_size	numeric; the size of random points
point_size	numeric; the size of points searched by the optimiser(s)
end_size	numeric; the size of end points
theo_size	numeric; the size of theoretical point(s)
theo_shape	numeric; the shape symbol in the basic plot
theo_color	character; the color of theoretical point(s)
palette	the colour palette to be used

**Value**

explore\_space\_tour() an animation of the search path in the high-dimensional sphere  
 prep\_space\_tour() a list containing various components needed for producing the animation

**See Also**

Other main plot functions: [explore\\_space\\_pca\(\)](#), [explore\\_trace\\_interp\(\)](#), [explore\\_trace\\_search\(\)](#)

**Examples**

```
explore_space_tour(dplyr::bind_rows(holes_1d_better, holes_1d_geo),
  group = method, palette = botanical_palettes$fern[c(1, 6)]
)
```

---

explore\_trace\_interp *Plot the trace the search progression*

---

**Description**

Trace the index value of search/ interpolation points in guided tour optimisation

**Usage**

```
explore_trace_interp(
  dt,
  iter = NULL,
  color = NULL,
  group = NULL,
  cutoff = 50,
  target_size = 3,
  interp_size = 1,
  accuracy_x = 5,
  accuracy_y = 0.01
)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in tourr
iter	the variable to be plotted on the x-axis
color	the variable to be coloured by
group	the variable to label different runs of the optimiser(s)
cutoff	numeric; if the number of interpolating points is smaller than cutoff, all the interpolation points will be plotted as dots
target_size	numeric; the size of target points in the interpolation

interp_size	numeric; the size of interpolation points
accuracy_x	numeric; If the difference of two neighbour x-labels is smaller than accuracy_x, only one of them will be displayed. Used for better axis label
accuracy_y	numeric; the precision of y-axis label

**Value**

a ggplot object for diagnosing how the index value progresses during the interpolation

**See Also**

Other main plot functions: [explore\\_space\\_pca\(\)](#), [explore\\_space\\_tour\(\)](#), [explore\\_trace\\_search\(\)](#)

**Examples**

```
# Compare the trace of interpolated points in two algorithms
holes_1d_better %>%
  explore_trace_interp(interp_size = 2) +
  scale_color_continuous_botanical(palette = "fern")
```

---

explore\_trace\_search *Plot the count in each iteration*

---

**Description**

Plot the count in each iteration

**Usage**

```
explore_trace_search(
  dt,
  iter = NULL,
  color = NULL,
  cutoff = 15,
  extend_lower = 0.95,
  ...
)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in <code>tourr</code>
iter	the variable to be plotted on the x-axis
color	the variable to be coloured by
cutoff	numeric; if the number of searches in one iteration is smaller than cutoff, a point geom, rather than boxplot geom, will be used.
extend_lower	a numeric for extending the y-axis to display text labels
...	arguments passed into <code>geom_label_repel()</code> for displaying text labels

**Value**

a ggplot object for diagnosing how many points the optimiser(s) have searched

**See Also**

Other main plot functions: [explore\\_space\\_pca\(\)](#), [explore\\_space\\_tour\(\)](#), [explore\\_trace\\_interp\(\)](#)

**Examples**

```
# Summary plots for search points in two algorithms
library(patchwork)
library(dplyr)
library(ggplot2)
p1 <- holes_1d_better %>% explore_trace_search() +
  scale_color_continuous_botanical(palette = "fern")
p2 <- holes_2d_better_max_tries %>% explore_trace_search() +
  scale_color_continuous_botanical(palette = "daisy")
p1 / p2
```

---

format\_label

*Better label formatting to avoid overlapping*


---

**Description**

Better label formatting to avoid overlapping

**Usage**

```
format_label(labels, accuracy)
```

**Arguments**

labels	a numerical vector of labels
accuracy	the accuracy of the label

**Value**

a vector of adjusted labels

**Examples**

```
format_label(c(0.87, 0.87, 0.9, 0.93, 0.95), 0.01)
format_label(c(0.87, 0.87, 0.9, 0.93, 0.95, 0.96, 0.96), 0.01)
```

---

get_anchor	<i>Extract the anchor points on the geodesic path</i>
------------	---

---

**Description**

Extract the anchor points on the geodesic path

**Usage**

```
get_anchor(dt, group = NULL)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the tourr package
group	the variable to label different runs of the optimiser(s)

**Value**

a tibble object containing the target bases in each iteration

**See Also**

Other get functions: [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
holes_1d_better %>% get_anchor()  
holes_1d_geo %>% get_anchor()
```

---

get_basis_matrix	<i>Extract all the bases as a matrix</i>
------------------	--

---

**Description**

Extract all the bases as a matrix

**Usage**

```
get_basis_matrix(dt)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the tourr package
----	---

**Value**

a matrix that flattens each basis into a row

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
head(get_basis_matrix(holes_1d_better), 5)
```

---

get\_best

*Extract the record with the largest index value*

---

**Description**

Extract the record with the largest index value

**Usage**

```
get_best(dt, group = NULL)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the tourr package
group	the variable to label different runs of the optimiser(s)

**Value**

a tibble object containing the best basis found by the optimiser(s)

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
dplyr::bind_rows(holes_1d_better, holes_1d_geo) %>% get_best(group = method)
```

---

get_dir_search	<i>Extract directional search points during the optimisation</i>
----------------	--

---

**Description**

Extract directional search points during the optimisation

**Usage**

```
get_dir_search(dt, ratio = 5, ...)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the tourr package
ratio	numeric; a buffer value to deviate directional search points from the anchor points
...	arguments passed to compute_pca()

**Value**

a tibble object containing the directional search bases in pseudo derivative search

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
holes_1d_geo %>%  
  compute_pca() %>%  
  purrr::pluck("aug") %>%  
  get_dir_search()
```

---

get_interp	<i>Extract interpolated records</i>
------------	-------------------------------------

---

**Description**

Extract interpolated records

**Usage**

```
get_interp(dt, group = NULL)
```

**Arguments**

dt                    a data object collected by the projection pursuit guided tour optimisation in the tourr package

group                the variable to label different runs of the optimiser(s)

**Value**

a tibble object containing the interpolating bases

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
holes_1d_better %>%
  get_interp() %>%
  head()
get_interp(dplyr::bind_rows(holes_1d_better, holes_1d_geo), group = method) %>% head()
```

---

get\_interp\_last            *Extract the end point at each interpolation*

---

**Description**

Extract the end point at each interpolation

**Usage**

```
get_interp_last(dt, group = NULL)
```

**Arguments**

dt                    a data object collected by the projection pursuit guided tour optimisation in the tourr package

group                the variable to label different runs of the optimiser(s)

**Value**

a tibble object containing the last interpolating basis in each iteration

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)



**Examples**

```
holes_1d_better %>% get_interp_last()
get_interp_last(dplyr::bind_rows(holes_1d_better, holes_1d_geo), group = method)
```

---

get_interrupt	<i>Extract the end point of the interpolation and the target point in the iteration when an interruption happens</i>
---------------	--

---

**Description**

The optimiser can find better basis on the interpolation path, an interruption is implemented to stop further interpolation from the highest point to the target point. This discrepancy is highlighted in the PCA plot. You should not use geodesic search on this function.

**Usage**

```
get_interrupt(dt, group = NULL, precision = 0.001)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the <code>tourr</code> package
group	the variable to label different runs of the optimiser(s)
precision	numeric; if the index value of the last interpolating point and the anchor point differ by precision, an interruption is registered

**Value**

a tibble object containing the target and anchor bases for the iteration when an interruption happens

**See Also**

Other `get` functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
holes_1d_better %>% get_interrupt()
holes_1d_geo %>% get_interrupt()
```

---

get_search	<i>Extract search points during the optimisation</i>
------------	--

---

**Description**

Extract search points during the optimisation

**Usage**

```
get_search(dt)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the <code>tourr</code> package
----	--

**Value**

a tibble object containing the search bases

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
holes_1d_better %>% get_search()
holes_1d_geo %>% get_search()
```

---

get_search_count	<i>Extract the count in each iteration</i>
------------------	--

---

**Description**

Extract the count in each iteration

**Usage**

```
get_search_count(dt, iter = NULL, group = NULL)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the <code>tourr</code> package
iter	the variable to be counted by
group	the variable to label different runs of the optimiser(s)

**Value**

a tibble object of the number of searches conducted by the optimiser(s) in each iteration

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
get_search_count(holes_1d_better)
get_search_count(dplyr::bind_rows(holes_1d_better, holes_1d_geo), group = method)
```

---

get_space_param	<i>Estimate the radius of the background circle based on the randomly generated points</i>
-----------------	--

---

**Description**

The space of projected bases is a circle when reduced to 2D. A radius is estimated using the largest distance from the bases in the data object to the centre point.

**Usage**

```
get_space_param(dt, ...)
```

**Arguments**

dt	a data object collected by the projection pursuit guided tour optimisation in the tourr package
...	other arguments passed to <code>compute_pca()</code>

**Details**

This is a wrapper function used by `explore_space_pca()` and should be called directly by the user

**Value**

a tibble object of the centre and radius of the basis space

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_start\(\)](#), [get\\_theo\(\)](#)

---

get_start	<i>Extract the starting records</i>
-----------	-------------------------------------

---

**Description**

Extract the starting records

**Usage**

```
get_start(dt)
```

**Arguments**

dt                    a data object collected by the projection pursuit guided tour optimisation in the tourr package

**Value**

a tibble object containing the start basis

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_theo\(\)](#)

**Examples**

```
holes_1d_better %>% get_start()
```

---

get_theo	<i>Extract the theoretical best basis, if applicable</i>
----------	--

---

**Description**

Extract the theoretical best basis, if applicable

**Usage**

```
get_theo(dt)
```

**Arguments**

dt                    a data object collected by the projection pursuit guided tour optimisation in the tourr package

**Value**

a tibble object containing the theoretical bases

**See Also**

Other get functions: [get\\_anchor\(\)](#), [get\\_basis\\_matrix\(\)](#), [get\\_best\(\)](#), [get\\_dir\\_search\(\)](#), [get\\_interp\\_last\(\)](#), [get\\_interp\(\)](#), [get\\_interrupt\(\)](#), [get\\_search\\_count\(\)](#), [get\\_search\(\)](#), [get\\_space\\_param\(\)](#), [get\\_start\(\)](#)

**Examples**

```
best <- matrix(c(0, 1, 0, 0, 0), nrow = 5)
holes_1d_better %>%
  bind_theoretical(best, tourr::holes(), raw_data = boa5) %>%
  get_theo()
```

---

holes_1d_geo	<i>Simulated data</i>
--------------	-----------------------

---

**Description**

The boa data is simulated using different Gaussian mixtures with varied centres and weights (see section format for the simulation code). These data are simulated for demonstrating the usage of four diagnostic plots in the package, users can create their own guided tour data objects and diagnose with the visualisation designed in this package.

**Usage**

```
holes_1d_geo
holes_1d_better
holes_2d_better
holes_2d_better_max_tries
boa
boa5
boa6
```

**Format**

The code for simulating each data object is as follows:

```

set.seed(123456);
holes_1d_geo <-
  animate_dist(boa5, tour_path = guided_tour(holes(), d = 1,
                                             search_f = search_geodesic),
              rescale = FALSE)

set.seed(123456)
holes_1d_better <-
  animate_dist(boa5, tour_path = guided_tour(holes(), d = 1,
                                             search_f = search_better),
              rescale = FALSE)

set.seed(123456)
holes_2d_better <-
  animate_xy(boa6, tour_path = guided_tour(holes(), d = 2,
                                           search_f = search_better),
            rescale = FALSE)

set.seed(123456)
holes_2d_better_max_tries <-
  animate_xy(boa6, tour_path = guided_tour(holes(), d = 2,
                                           search_f = search_better,
                                           max.tries = 500),
            rescale = FALSE)

library(tidyverse)
set.seed(1234)
x1 <- rnorm(1000, 0, 1)
x2 <- sample(c(rnorm(500, -3, 1), rnorm(500, 3, 1)), size = 1000)
x3 <- sample(c(rep(-1, 500), rep(1, 500)), size = 1000)
x4 <- sample(c(rnorm(250, -3, 1), rnorm(750, 3, 1)), size = 1000)
x5 <- sample(c(rnorm(330, -5, 1), rnorm(340, 0, 1), rnorm(330, 5, 1)), size = 1000)
x6 <- sample(c(rnorm(450, -5, 1), rnorm(100, 0, 1), rnorm(450, 5, 1)), size = 1000)
x7 <- sample(c(rnorm(500, -5, 1), rnorm(500, 5, 1)), size = 1000)
x8 <- rnorm(1000, 0, 1)
x9 <- rnorm(1000, 0, 1)
x10 <- rnorm(1000, 0, 1)

boa <- tibble(x1 = x1, x2 = x2, x3 = x3, x4 = x4, x5 = x5,
             x6 = x6, x7 = x7, x8 = x8, x9 = x9, x10 = x10)
boa <- as_tibble(scale(boa))
boa5 <- select(boa, x1, x2, x8: x10)
boa6 <- select(boa, x1, x2, x7: x10)

```

## Details

The prefix `holes_*` indicates the use of holes index in the guided tour. The suffix `*_better/geo` indicates the optimiser used: `search_better` and `search_geodesic`.

The name `boa` comes from the fact that the density plot of each variable in the data looks like boa constrictors swallowing multiple French baguettes, rather than elephants, as in the novella *the little prince*.

## Examples

```
library(ggplot2)
library(tidyr)
library(dplyr)
boa %>%
  pivot_longer(cols = x1:x10, names_to = "var", values_to = "value") %>%
  mutate(var = forcats::fct_relevel(as.factor(var), paste0("x", 1:10))) %>%
  ggplot(aes(x = value)) +
  geom_density() +
  facet_wrap(vars(var))
```

---

scale\_color\_continuous\_botanical  
*continuous scale colour function*

---

## Description

continuous scale colour function  
 Discrete scale colour function  
 continuous scale fill function  
 discrete scale fill function

## Usage

```
scale_color_continuous_botanical(palette = "fern", reverse = FALSE, ...)
scale_color_discrete_botanical(palette = "fern", reverse = FALSE, ...)
scale_fill_continuous_botanical(palette = "fern", reverse = FALSE, ...)
scale_fill_discrete_botanical(palette = "fern", reverse = FALSE, ...)
```

## Arguments

<code>palette</code>	colour palette from the <code>botanical_palette</code>
<code>reverse</code>	logical; if the colour should be reversed
<code>...</code>	other arguments passed into <code>scale_color_gradientn</code>

**Value**

a wrapper for continuous scales in the botanical palette  
a wrapper for discrete scales in the botanical palette  
a wrapper for continuous fill in the botanical palette  
a wrapper for discrete fill in the botanical palette

---

theme_fern	<i>A specific theme for trace plots</i>
------------	---

---

**Description**

A specific theme for trace plots

**Usage**

```
theme_fern()
```

**Value**

a ggplot2 theme for explore\_trace\_interp()



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