

Package ‘spatialising’

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Title Ising Model for Spatial Data

Version 0.6.2

Description Performs simulations of binary spatial raster data using the Ising model (Ising (1925) <[doi:10.1007/BF02980577](https://doi.org/10.1007/BF02980577)>; Onsager (1944) <[doi:10.1103/PhysRev.65.117](https://doi.org/10.1103/PhysRev.65.117)>). It allows to set a few parameters that represent internal and external pressures, and the number of simulations (Stepinski and Nowosad (2023) <[doi:10.1098/rsos.231005](https://doi.org/10.1098/rsos.231005)>).

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Encoding UTF-8

RoxygenNote 7.3.3

Imports comat, Rcpp, terra

URL <https://jakubnowosad.com/spatialising/>

BugReports <https://github.com/Nowosad/spatialising/issues>

Suggests covr, knitr, rmarkdown, optimization, testthat (>= 3.0.0)

Config/testthat/edition 3

Depends R (>= 4.1.0)

LazyData false

LinkingTo Rcpp

VignetteBuilder knitr

NeedsCompilation yes

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composition_index	<i>Composition imbalance index</i>
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Description

Calculates composition imbalance index (also known as the m index) – a sum of cell’s values over the entire site divided by the number of cell in the site. m has a range from -1 (site completely dominated by the -1 values) to 1 (site completely dominated by the 1 values).

Usage

```
composition_index(x)
```

Arguments

x SpatRaster or matrix containing two values: -1 and 1

Value

A numeric vector

See Also

[kinetic_ising\(\)](#)

Examples

```
data(r_start, package = "spatialising")
composition_index(r_start)
ts1 = kinetic_ising(r_start, B = -0.3, J = 0.7)
composition_index(ts1)
ts2 = kinetic_ising(r_start, B = -0.3, J = 0.7, updates = 2)
composition_index(ts2)
```

```
library(terra)
r1 = rast(system.file("raster/r_start.tif", package = "spatialising"))
```

```
composition_index(r1)
r2 = kinetic_ising(r1, B = -0.3, J = 0.7)
composition_index(r2)
```

kinetic_ising *Ising model for spatial data*

Description

Performs simulations based on the given parameters of the Ising model

Usage

```
kinetic_ising(
  x,
  B,
  J,
  updates = 1,
  iter,
  rule = "glauber",
  inertia = 0,
  version = 1,
  progress = FALSE
)
```

Arguments

x	SpatRaster or matrix containing two values: -1 and 1
B	External pressure (positive or negative): it tries to align cells' values with its sign
J	Strength of the local autocorrelation tendency (always positive): it tries to align signs of neighboring cells
updates	Specifies how many sets of iterations are performed on the input object. The output of this function has as many layers as the updates value.
iter	Specifies how many iterations are performed on the input object. By default it equals to the number of values in the input object.
rule	IM temporal evolution rule: either "glauber" (default) or "metropolis"
inertia	Represents the modification of the algorithm aimed at suppressing the salt-and-pepper noise of the focus category present when simulating evolution of a coarse-textured pattern. With $Q > 0$, small patches of the focus category are not generated, thus eliminating the salt-and-pepper noise of the focus category
version	By default, 1, the x object is converted into a matrix (fast, but can be memory consuming); version = 2 has a lower RAM impact, but is much slower
progress	TRUE/FALSE

Value

Object of the same class as `x` with the number of layers specified by `updates`

References

- Ising, E., 1924. Beitrag zur theorie des ferro-und paramagnetismus. Ph.D. thesis, Grefe & Tiedemann.
- Onsager, L., 1944. Crystal statistics. I. A two-dimensional model with an order-disorder transition. *Physical Review* 65 (3-4), 117.
- Brush, S. G., 1967. History of the Lenz-Ising model. *Reviews of modern physics* 39 (4), 883.
- Cipra, B. A., 1987. An introduction to the Ising model. *The American Mathematical Monthly* 94 (10), 937–959.

Examples

```
data(r_start, package = "spatialising")
ts1 = kinetic_ising(r_start, B = -0.3, J = 0.7)
ts10 = kinetic_ising(r_start, B = -0.3, J = 0.7, updates = 10)

r1 = terra::rast(system.file("raster/r_start.tif", package = "spatialising"))
terra::plot(r1)
r2 = kinetic_ising(r1, B = -0.3, J = 0.7)
terra::plot(r2)

library(terra)
ri1 = kinetic_ising(r1, B = -0.3, J = 0.7, updates = 9)
plot(ri1)

ri2 = kinetic_ising(r1, B = 0.3, J = 0.7, updates = 9)
plot(ri2)

ri3 = kinetic_ising(r1, B = -0.3, J = 0.4, updates = 9)
plot(ri3)
```

kinetic_ising_ensemble

Ensemble of Ising models for spatial data

Description

Creates an ensemble of simulations based on the given parameters of the Ising model

Usage

```
kinetic_ising_ensemble(runs, ...)
```

Arguments

runs A number of simulations to perform
... Arguments for `kinetic_ising()`

Value

A list of objects of the same class as x

See Also

`kinetic_ising()`, `kinetic_ising_exemplar()`

Examples

```
data(r_start, package = "spatialising")  
l = kinetic_ising_ensemble(100, r_start, B = -0.3, J = 0.7)
```

```
library(terra)  
r1 = rast(system.file("raster/r_start.tif", package = "spatialising"))  
plot(r1)  
r2 = kinetic_ising_ensemble(100, r1, B = -0.3, J = 0.7)
```

kinetic_ising_exemplar

Exemplar of an Ising model for spatial data

Description

Creates an ensemble of simulations based on the given parameters of the Ising model and selects an exemplar (a model that is closest to the average of the ensemble)

Usage

```
kinetic_ising_exemplar(runs, ...)
```

Arguments

runs A number of simulations to perform
... Arguments for `kinetic_ising()`

Value

Object of the same class as x

See Also

[kinetic_ising\(\)](#), [kinetic_ising_ensemble\(\)](#)

Examples

```
data(r_start, package = "spatialising")
l = kinetic_ising_exemplar(100, r_start, B = -0.3, J = 0.7)

library(terra)
r1 = rast(system.file("raster/r_start.tif", package = "spatialising"))
plot(r1)
r2 = kinetic_ising_exemplar(100, r1, B = -0.3, J = 0.7)
plot(r2)
```

r_end	<i>An example matrix object</i>
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Description

A matrix has 50 columns and 50 rows. The matrix contains two values: -1 and 1. This object was created with `r_end = kinetic_ising(r_start, B = -0.3, J = 0.7)`

Usage

```
data(r_end)
```

Format

A matrix

r_start	<i>An example matrix object</i>
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Description

A matrix has 50 columns and 50 rows. The matrix contains two values: -1 and 1.

Usage

```
data(r_start)
```

Format

A matrix

r_start.tif	<i>An example binary raster</i>
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Description

A raster file covering an area of 50x50 cells. The raster file contains two values: -1 and 1.
`system.file("raster/r_start.tif", package = "spatialising")`

Format

A raster file

texture_index	<i>Texture index</i>
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Description

Calculates texture index – an average (over an array) of a product of the values of neighboring cells. The value of texture index is between 0 (fine texture), and 1 (coarse texture).

Usage

```
texture_index(x, ...)
```

Arguments

x	SpatRaster or matrix containing two values: -1 and 1
...	Arguments for <code>comat::get_coma()</code>

Value

A numeric vector

See Also

[kinetic_ising\(\)](#)

Examples

```
data(r_start, package = "spatialising")
texture_index(r_start)
ts1 = kinetic_ising(r_start, B = -0.3, J = 0.7)
texture_index(ts1)
ts2 = kinetic_ising(r_start, B = -0.3, J = 0.7, updates = 2)
texture_index(ts2)

library(terra)
r1 = rast(system.file("raster/r_start.tif", package = "spatialising"))
texture_index(r1)
r2 = kinetic_ising(r1, B = -0.3, J = 0.7)
texture_index(r2)
```

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