

Package ‘infocausality’

May 8, 2026

Title Information-Theoretic Measure of Causality

Version 1.1

Description Methods for quantifying temporal and spatial causality through information flow, and decomposing it into unique, redundant, and synergistic components, following the framework described in Martinez-Sanchez et al. (2024) <[doi:10.1038/s41467-024-53373-4](https://doi.org/10.1038/s41467-024-53373-4)>.

License GPL-3

Encoding UTF-8

RoxygenNote 7.3.3

URL <https://stscl.github.io/infocausality/>,
<https://github.com/stscl/infocausality>

BugReports <https://github.com/stscl/infocausality/issues>

Depends R (>= 4.1.0)

LinkingTo Rcpp

Imports methods, reticulate (>= 1.41.0), sdsfun, sf, terra

Suggests gdverse, ggplot2, infoxtr, knitr, Rcpp, rmarkdown, spEDM,
tEDM

VignetteBuilder knitr

NeedsCompilation yes

Author Wenbo Lyu [aut, cre, cph] (ORCID:
<<https://orcid.org/0009-0002-6003-3800>>)

Maintainer Wenbo Lyu <lyu.geosocial@gmail.com>

Repository CRAN

Date/Publication 2026-03-20 13:30:08 UTC

Contents

surd	2
Index	4

surd

synergistic-unique-redundant decomposition of causality

Description

synergistic-unique-redundant decomposition of causality

Usage

```
## S4 method for signature 'data.frame'
surd(
  data,
  target,
  agents,
  lag = 1,
  bin = 5,
  max.combs = NULL,
  cores = 1,
  backend = "threading"
)

## S4 method for signature 'sf'
surd(
  data,
  target,
  agents,
  lag = 1,
  bin = 5,
  max.combs = NULL,
  cores = 1,
  backend = "threading",
  nb = NULL
)

## S4 method for signature 'SpatRaster'
surd(
  data,
  target,
  agents,
  lag = 1,
  bin = 5,
  max.combs = NULL,
  cores = 1,
  backend = "threading"
)
```

Arguments

<code>data</code>	observation data.
<code>target</code>	name of the target variable.
<code>agents</code>	names of agent variables.
<code>lag</code>	(optional) lag order.
<code>bin</code>	(optional) number of discretization bins.
<code>max.combs</code>	(optional) maximum combination order. If NULL, the standard SURD decomposition is applied.
<code>cores</code>	(optional) number of cores for parallel computation.
<code>backend</code>	(optional) Joblib backend: loky, threading, or multiprocessing.
<code>nb</code>	(optional) neighbours list.

Value

A list.

unique Unique information contributions per variable.

synergistic Synergistic information components by agent combinations.

redundant Redundant information shared by agent subsets.

mutual_info Mutual information measures for each combination.

info_leak Information leak ratio.

References

Martinez-Sanchez, A., Arranz, G. & Lozano-Duran, A. Decomposing causality into its synergistic, unique, and redundant components. *Nat Commun* 15, 9296 (2024).

Examples

```
columbus = sf::read_sf(system.file("case/columbus.gpkg", package="spEDM"))

tryCatch(
  surd(columbus, "hoval", c("inc", "crime")),
  error = \(e) message("Skipping Python-dependent example: ", e$message)
)
```

Index

[surd](#), [2](#)
[surd](#), `data.frame`-method ([surd](#)), [2](#)
[surd](#), `sf`-method ([surd](#)), [2](#)
[surd](#), `SpatRaster`-method ([surd](#)), [2](#)