Package ‘NetIndices’

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Version 1.4.4.1

Title Estimating Network Indices, Including Trophic Structure of Foodwebs in R

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Depends R (>= 2.01), MASS

Suggests LIM

Description Given a network (e.g. a food web), estimates several network indices. These include: Ascendency network indices, Direct and indirect dependencies, Effective measures, Environ network indices, General network indices, Pathway analysis, Network uncertainty indices and constraint efficiencies and the trophic level and omnivory indices of food webs.

License GPL (>= 2)

LazyData yes

NeedsCompilation no

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R topics documented:

`NetIndices-package` *Estimates network indices, including trophic structure of foodwebs*

Description

Given a network (e.g. a food web), estimates several network indices.

These include:

- ascendency network indices,
- direct and indirect dependencies,
- effective measures,
- environ network indices,
- general network indices,
- pathway analysis,
- network uncertainty indices and constraint efficiencies
- the trophic level and omnivory indices of food webs.

Details

Package:	NetIndices
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Date:	2010-11-01
License:	GNU Public License 2 or above

Author(s)

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References

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
## Not run:
## show examples (see respective help pages for details)
example(AscInd)
```

```
example(TrophInd)
example(Takapoto)

## open the directory with script used to write the Kones et al. (2009) article
browseURL(paste(system.file(package="NetIndices"), "/EcologicalModelling", sep=""))

## open the directory with documents
browseURL(paste(system.file(package="NetIndices"), "/doc", sep=""))

## the vignette
vignette("NetIndices")

## End(Not run)
```

AscInd *Ascendency network indices*

Description

Calculates measures of system growth and development: Ascendency, Overhead and Capacity for several (sub)networks.

Usage

```
AscInd(Flow = NULL, Tij = t(Flow), Import = NULL,
       Export = NULL, Dissipation = NULL)
```

Arguments

`Flow`	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.
`Tij`	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
`Import`	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).
`Export`	vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).
`Dissipation`	vector with either the *indices* or the *names* to *external* compartments that dissipate flows (e.g. respiration); the indices point to the **row** positions in `Tij` (and the column positions in Flow).

Details

The mathematical formulation of these indices can be found in the package vignette - *vignette("NetIndices")*.

The PDF can be found in the subdirectory 'doc' of the NetIndices package.

Value

A matrix with ascendency values (columns) for several subnetworks (rows).

The subnetworks (rows) are:

`total`	network
`internal`	network (excluding flows from and to external)
`import`	flows
`export`	flows; this includes the usuable and unusable flows (i.e. +dissipation)
`dissipation`	flows

The ascendency indices comprise (columns:)

`asc`	the ascendency of the network, a measure of growth and development.
`overh`	the overhead of the network.
`cap`	the development capacity of the network, an upper bound on ascendency.
`ACratio`	the ratio of ascendency and capacity.

Author(s)

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References

Latham LG. 2006. Network flow analysis algorithms. Ecological Modelling 192: 586-600.

Ulanowicz RE. 2000. Ascendency: a measure of ecosystem performacne. Jorgensen SE, Muller F, editors. Handbook of Ecosystem Theories and Management. Lewis Publishers, Boca Raton, p303-315.

Ulanowicz RE, Norden JS. 1990. Symmetrical overhead in flow networks. International Journal of System Science 21: 429-437.

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
# The takapoto atoll network
AscInd(Takapoto, Import = "CO2",
       Export = c("CO2", "Sedimentation", "Grazing"),
       Dissipation = "CO2")

# Conesprings is the example set 1a from Latham 2006.
as.data.frame(
```

```
AscInd(Tij = Conesprings, Import = "Inflows",
Export = c("Export","Dissipation"),
Dissipation = "Dissipation")
)
```

`Conesprings` *Cone Spring ecosystem.*

Description

Cone spring ecosystem (Tilly, 1968) adapted for input - output analysis by Williams & Crouthamel (1972) in Szyrmer & Ulanowicz (1987, Fig. 1, p. 129) and Ulanowicz & Norden (1990, Fig. 1, p. 435).

This is example 1a from Latham (2006).

The food web comprises 5 functional compartments:

- Plants
- Detritus
- Bacteria
- Detritus feeders
- Carnivores

and two export compartments

- usable export
- dissipation

and one import compartment

- Inflows

Usage

```
Conesprings
```

Format

matrix with Tij values, where element (i,j) denotes flow from compartment j to i

rownames and columnames are the components.

Author(s)

Karline Soetaert <karline.soetaert@nioz.nl>

References

Latham LG. 2006. Network flow analysis algorithms. Ecological Modelling 192: 586-600.

Szyrmer, J., & Ulanowicz, R. E. (1987). Total flows in ecosystems. Ecol. Model. 35, 123..136.

Tilly, L. J. (1968). The structure and dynamics of Cone Spring. Ecol. Monogr. 38, 169..197.

Ulanowicz, R. E., & Norden, J. S. (1990). Symmetrical overhead in flow networks. Int. J. Systems Sci. 21, 429..437.

Williams, M., & Crouthamel, D. (1972). Systems analysis of Cone Spring. Unpublished manuscript. University of Georgia, Athens, Georgia.

Examples

```
GenInd(Tij = Conesprings, Import = "Inflows",
       Export = c("Export", "Dissipation"))

AscInd(Tij = Conesprings, Import = "Inflows",
       Export = c("Export", "Dissipation"),
       Dissipation = "Dissipation")

UncInd(Tij = Conesprings,Import="Inflows",
       Export = c("Export", "Dissipation"))

EffInd(Tij = Conesprings, Import = "Inflows",
       Export = c("Export", "Dissipation"))

EnvInd(Tij = Conesprings, Import = "Inflows",
       Export = c("Export", "Dissipation"),
       full = TRUE)
```

Dependency *Direct and indirect dependency analysis*

Description

Calculates for each component in a flow network the direct+indirect dependency on the other components.

Usage

```
Dependency(Flow = NULL, Tij = t(Flow),
           Import = NULL, Export = NULL)
```

Arguments

`Flow`	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.

`Tij`	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
`Import`	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).
`Export`	vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).

Value

A matrix with dependency of component i on component j

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References

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
# The takapoto atoll network
Dependency(Takapoto, Import = "CO2",
           Export = c("CO2", "Sedimentation", "Grazing"))

# making "Bacteria" a "primary food source"
TAK <- Takapoto
TAK[,"Bacteria"] <- c(0, 0, 0, 0, 0, 0, 1, 0)

# first two columns
DD <- Dependency(TAK, Import = c("CO2", "DOC"),
                 Export = c("CO2", "DOC", "Sedimentation", "Grazing"))
DD

barplot(t (DD[3:nrow(DD), 1:2]), beside = TRUE, ylab = "-",
       legend = c("Phytoplankton","Bacteria"),
       main = "dependency on (primary) food sources")
```

`EffInd` *Effective measures (or roles) suite: weighted measures for networks*

Description

Calculates effective connectivity, effective flows, effective nodes and effective roles of a network.

Usage

```
EffInd(Flow = NULL, Tij = t(Flow),
       Import = NULL, Export = NULL)
```

Arguments

`Flow`	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.
`Tij`	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
`Import`	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).
`Export`	vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).

Details

The mathematical formulation of these indices can be found in the package vignette - *vignette("NetIndices")*.

The PDF can be found in the subdirectory 'doc' of the NetIndices package.

Value

a list with the following items:

`CZ`	Effective connectance
`FZ`	Effective Flows
`NZ`	Effective nodes
`RZ`	Effective roles

Author(s)

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References

Latham LG. 2006. Network flow analysis algorithms. Ecological Modelling 192: 586-600.

Zorach and Ulanowicz, 2003. Quantifying the complexity of flow networks: how many roles are there?. Complexity 8,68-76.

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
# The takapoto atoll network
EffInd(Takapoto, Import = "CO2",
       Export = c("CO2", "Sedimentation", "Grazing"))

# Conesprings is the example set 1a from Latham 2006.
as.data.frame(
  EffInd(Tij = Conesprings, Import = "Inflows",
         Export = c("Export", "Dissipation"))
)
```

EnvInd *Environ network indices*

Description

Calculates the indices of homogenization, synergism index, dominance of indirect effects,... of a network.

Usage

```
EnvInd(Flow = NULL, Tij = t(Flow), Import = NULL,
       Export = NULL, full = FALSE)
```

Arguments

Flow	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.
Tij	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
Import	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).
Export	vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).
full	if TRUE, also returns matrices.

Details

The mathematical formulation of these indices can be found in the package vignette - *vignette("NetIndices")*.

The PDF can be found in the subdirectory ‘doc’ of the NetIndices package.

Value

A list with the following items:

NAG	Network aggradation = average path length.
HP	Homogenization index.
BC	Synergism.
ID	Dominance of Indirect effects.
MN	Mean of non-dimensional flow-matrix (N).
MG	Mean of direct flow-matrix (G).
CVN	Coefficient of variation of non-dimensional flow-matrix (N).
CVG	Coefficient of variation of direct flow-matrix (G).
U	Only if Full == TRUE: The Utility non-dimensional matrix.
N1	Only if Full == TRUE: The Integral non-dimensional Flow Matrix.
G	Only if Full == TRUE: The Normalized direct flow (or transitive closure) matrix.

Author(s)

Karline Soetaert <karline.soetaert@nioz.nl>, Julius Kipyegon Kones<jkones@uonbi.ac.ke>

References

Patten BC, Barber MC, Richardson TH. 1982. Path analysis of a reservoir ecosystem model.

Fath BD, Patten BC. 1999. Review of the foundations of network environ analysis. Ecosystems 2: 167-179.

Fath BD, Patten BC. 1999. Quantifying resource homogenization using network flow analysis. Ecological Modelling 123: 193-205.

Patten BC, Higashi M. 1984. Modified cycling index for ecological applications. Ecological Modelling 25: 69-83.

Higashi M, Patten BC. 1989. Dominance of indirect causality in ecosystems. The American Naturalist 133: 288-302.

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
# The takapoto atoll network
EnvInd(Takapoto, Import = "CO2",
         Export = c("CO2", "Sedimentation", "Grazing"))

as.data.frame(
  EnvInd(Tij = Conesprings, Import = "Inflows",
         Export = c("Export", "Dissipation"))
)

EnvInd(Tij = Conesprings, Import = "Inflows",
    Export = c("Export", "Dissipation"), full = TRUE)
```

`GenInd` *General network indices.*

Description

Calculates general network indices such as system throughputs, link density, connectance,... of a network.

Usage

```
GenInd(Flow = NULL, Tij = t(Flow),
       Import = NULL, Export = NULL, tol = 0)
```

Arguments

`Flow`	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.
`Tij`	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
`Import`	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).
`Export`	vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).
`tol`	flows that are smaller or equal to tol are assumed to be absent.

Details

The mathematical formulation of these indices can be found in the package vignette - *vignette("NetIndices")*.

The PDF can be found in the subdirectory 'doc' of the NetIndices package.

Value

A list that contains:

`N`	number of compartments, excluding the externals.
`T..`	total System Throughput.
`TST`	total System Throughflow.
`Lint`	number of Internal links.
`Ltot`	total number of links.
`LD`	link Density.

`C`	connectance (internal).
`Tijbar`	average Link Weight.
`TSTbar`	average Compartment Throughflow .
`Cbar`	compartmentalization, [0,1], the degree of connectedness of subsystems within a network.

Author(s)

Karline Soetaert <karline.soetaert@nioz.nl>, Julius Kipyegon Kones<jkones@uonbi.ac.ke>

References

Latham LG. 2006. Network flow analysis algorithms. Ecological Modelling 192: 586-600.

Hirata H, Ulanowicz RE. 1984. Informational theoretical analysis of ecological networks. International journal of systems science 15 (3): 261-270

Pimm SL, Lawton JH. 1980. Are food webs divided into compartments? Journal of Animal Ecology 49: 879-898.

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
# The takapoto atoll network
(GI<- GenInd(Takapoto, Import = "CO2",
             Export = c("CO2", "Sedimentation", "Grazing")))
as.data.frame(GI)

# a simple system
as.data.frame(GenInd(diag(5)))

# Conesprings is the example set 1a from Latham 2006.
as.data.frame(
  GenInd(Tij = Conesprings, Import = "Inflows",
         Export = c("Export", "Dissipation"))
)
```

`PathInd` *Pathway analysis*

Description

Calculates the direct and indirect pathways in a network, i.e. the total system cycled throughflow, Finn's cycling index and average pathlength,...

Based on Finn(1980) (and not Finn (1976))

Usage

```
PathInd(Flow = NULL, Tij = t(Flow), Import = NULL, Export = NULL)
```

Arguments

`Flow`	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.
`Tij`	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
`Import`	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).
`Export`	vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).

Details

The mathematical formulation of these indices can be found in the package vignette - *vignette("NetIndices")*.

The PDF can be found in the subdirectory 'doc' of the NetIndices package.

Value

A list with the following items:

`TSTC`	total system cycled throughflow.
`TSTS`	non-cycled throughflow.
`FCI`	Finn's cycling index (1980).
`FCIb`	revised Finn's cycling index, sensu Allesina and Ulanowicz, 2004.
`APL`	average pathlength, also known as Network Aggradation (Sum of APLc and APLs in Latham 2006).

Author(s)

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References

Finn JT. 1980. Flow analysis of models of the Hubbard Brook ecosystem. Ecology 61: 562-571.

Patten BC, Higashi M. 1984. Modified cycling index for ecological applications. Ecological Modelling 25: 69-83.

Patten BC, Bosserman RW, Finn JT, Cale WG. 1976. Propagation of cause in ecosystems. Patten BC, editor. Systems Analysis and Simulation in Ecology, vol. 4. Academic Press, New York. p457-579.

Allesina and Ulanowicz, 2004. Cycling in ecological netowrks: Finn's index revisited. Computational Biology and Chemistry 28, 227-233.

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
# The takapoto atoll network
PathInd(Takapoto, Import = "CO2",
        Export = c("CO2", "Sedimentation", "Grazing"))

# Conesprings is the example set 1a from Latham 2006.
as.data.frame(
  PathInd(Tij = Conesprings, Import = "Inflows",
          Export = c("Export", "Dissipation"))
)
```

Takapoto — *Takapoto atoll planktonic food web*

Description

Carbon flux matrix of the Takapoto atoll planktonic food web

as reconstructed by inverse modelling by Niquil et al. (1998).

The Takapoto Atoll lagoon is located in the French Polynesia of the South Pacific

The food web comprises 7 functional compartments:

- Phytoplankton
- Bacteria
- Protozoa
- Microzooplankton
- Mesozooplankton
- Detritus
- Dissolved organic carbon (DOC)

one external source:

- CO2

and three external sinks:

- CO2
- Sedimentation
- Grazing

These compartments are connected with 32 flows.

Units of the flows are mg C/m2/day

Usage

```
Takapoto
```

Format

matrix with flow values, where element ij denotes flow from compartment i to j

rownames and columnames are the components.

Author(s)

Karline Soetaert <karline.soetaert@nioz.nl>

References

Niquil, N., Jackson, G.A., Legendre, L., Delesalle, B., 1998. Inverse model analysis of the planktonic food web of Takapoto Atoll (French Polynesia). Marine Ecology Progress Series 165, 17..29.

Examples

```
UncInd(Takapoto, Import = "CO2",
       Export = c("CO2", "Sedimentation", "Grazing"))
```

TrophInd *The trophic level and omnivory index*

Description

Calculates the trophic level and omnivory index of each component of a food web.

Usage

```
TrophInd(Flow = NULL, Tij = t(Flow),
         Import = NULL, Export = NULL, Dead = NULL)
```

Arguments

`Flow`	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.
`Tij`	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
`Import`	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).

`Export` vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).

`Dead` vector with either the *indices* or the *names* of dead matter; the indices point to **row** positions in `Tij`; the trophic level of these components is assumed to be 1.

Details

Primary producers, defined as those compartments that do not receive matter from another internal compartment, will be assigned a trophic level of 1.

In many trophic level calculations, it is also assumed that TL of detritus, dissolved organic matter and other inert material (i.e. that does not feed) is also = 1.

If this is desired, these compartments have to be designated as "Dead" (i.e. `Dead` should contain an index to row positions in `Tij` of these compartments.

If not specified as "Dead", these compartments will have a TL > 1 and consequently the TL of other compartments will be higher too.

The mathematical formulation of these indices can be found in the package vignette - *vignette("NetIndices")*.

The PDF can be found in the subdirectory ‘`doc`’ of the NetIndices package.

Value

a 2-columned data.frame with, for each compartment of the network the following:

`TL` the trophic level of a compartment, defined as 1 + the weighted average of the trophic levels of its food items.

`OI` the omnivory index, the variety in the trophic levels of a consumer’s food.

Note

Up to version 1.4.1, the estimation of TL produced strange results in case compartments feed on themselves. Then it was possible to produce negative Trophic levels. From version 1.4.2, it is implemented that self-feeding does not affect the TL of the compartment. Because of that, results may be different from the initial versions in such cases.

Author(s)

Karline Soetaert <karline.soetaert@nioz.nl>, Julius Kipyegon Kones<jkones@uonbi.ac.ke>

References

Christensen V, Pauly D. 1992. ECOPATH II - a software for balancing steady-state ecosystem models and calculating network characteristics. Ecological Modelling 61: 169-185.

Lindeman RL. 1942. The trophic dynamic aspect of ecology. Ecology 23: 399-418.

Kones, J.K., Soetaert, K., van Oevelen, D. and J.Owino (2009). Are network indices robust indicators of food web functioning? a Monte Carlo approach. Ecological Modelling, 220, 370-382.

Examples

```
# The takapoto atoll network
# First trophic level without assuming that TL of detritus and DOC is 1
TrophInd(Takapoto, Import = "CO2",
        Export = c("CO2", "Sedimentation", "Grazing"))

# Now imposing TL=1 for detritus and DOC
TrophInd(Takapoto, Import = "CO2",
        Export = c("CO2", "Sedimentation", "Grazing"),
        Dead = c("Detritus", "DOC"))
```

UncInd *Network uncertainty indices and constraint effiencies*

Description

Calculates the statistical, conditional and realised uncertainty, the average mutual information index, and the network uncertainty, network constraint and constraint efficiency,...

Usage

```
UncInd(Flow = NULL, Tij = t(Flow),
       Import = NULL, Export = NULL)
```

Arguments

`Flow`	network matrix with Flow[i,j] the flow from i (row) to j (column); component positions in rows and columns must be the same; if present, rownames or columnnames denote the compartment names.
`Tij`	network matrix where connectance is from column j to row i; component positions in rows and columns must be the same ; if present, rownames or columnnames denote the compartment names.
`Import`	vector with either the *indices* or the *names* of *external* compartmens from where flow enters the network; the indices point to the **column** positions in `Tij` (and the row positions in Flow).
`Export`	vector with either the *indices* or the *names* of *external* compartmens to where flow leaves the network; the indices point to the **row** positions in `Tij` (and the column positions in Flow).

Details

The mathematical formulation of these indices can be found in the package vignette - *vignette("NetIndices")*.

The PDF can be found in the subdirectory ‘`doc`’ of the NetIndices package.

Value

a list with the following items:

AMI	the average mutual information; as a system matures to form a web-like pattern, the AMI drops.
HR	the statistical uncertainty, upper bound on AMI, a measure of diversity.
DR	the conditional uncertainty index, the difference between AMI and HR, a measure of stability.
RU	the realised uncertainty index, ratio of AMI and HR.
Hmax	maximum uncertainty.
Hc	constraint information.
Hsys	network uncertainy.
CE	constraint efficiency.

Author(s)

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References

Latham LG. 2006. Network flow analysis algorithms. Ecological Modelling 192: 586-600.

Ulanowicz RE, Norden JS. 1990. Symmetrical overhead in flow networks. International Journal of System Science 21: 429-437.

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Examples

```
# The takapoto atoll network
UncInd(Takapoto, Import = "CO2",
       Export = c("CO2", "Sedimentation", "Grazing"))

# Conesprings is the example set 1a from Latham 2006.
as.data.frame(
   UncInd(Tij = Conesprings, Import = "Inflows",
          Export = c("Export", "Dissipation"))
)
```

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