Package 'SVMD'

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Type Package

Title Spearman Variational Mode Decomposition

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Description In practice, it is difficult to determine the number of decomposition modes, K, for Variational Mode Decomposition (VMD). To overcome this issue, this study offers Spearman Variational Mode Decomposition (SVMD), a method that uses the Spearman correlation coefficient to calculate the ideal mode number. Unlike the Pearson correlation coefficient, which only returns a perfect value when X and Y are linearly connected, the Spearman correlation can be calculated without knowing the probability distributions of X and Y. The Spearman correlation coefficient, also called Spearman's rank correlation coefficient, is a subset of a wider correlation coefficient. As VMD decomposes a signal, the Spearman correlation coefficient between the reconstructed and original sequences rises as the mode number K increases. Once the signal has been fully decomposed, subsequent increases in K cause the correlation to gradually level off. When the correlation reaches a specific level, VMD is said to have adequately decomposed the signal. Numerous experiments revealed that a threshold of 0.997 produces the best denoising effect, so the threshold is set at 0.997. This package has been developed using concept of Yang et al. (2021)<doi:10.1016/j.aej.2021.01.055>.

License GPL-3

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Contents

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sVMD *Spearman Variational Mode Decomposition*

Description

Optimal number of modes of Variational Mode Decomposition (VMD) using Spearman's rank correlation coefficient

Usage

```
sVMD(
  series,
  alpha = 2000,
  tau = 0,
  DC = FALSE,
  init = 1,
  tol = 1e-07,
  threshold = 0.997,
  max_modes = 10,
  verbose = FALSE
)
```

Arguments

series	The input time series signal to be decomposed.
alpha	The balancing parameter of the data-fidelity constraint. Default is 2000.
tau	Time-step of the dual ascent (pick 0 for noise-slack). Default is 0.
DC	If TRUE, the first mode is put and kept at DC (0 frequency). Default is FALSE.
init	Mode initialization (1 = all omegas start at 0). Default is 1.
tol	Convergence tolerance criterion. Default is 1e-7.
threshold	The correlation coefficient threshold to determine the optimal number of modes. Default is 0.997.
max_modes	The maximum number of modes to consider. Default is 10.
verbose	Logical, if TRUE, prints detailed messages about the decomposition process.

Value

Returns a list containing the optimal number of modes, reconstructed signal, and additional outputs from the VMD process:

- `optimal_K`: The optimal number of modes.
- `reconstructed_signal`: The reconstructed signal from the selected modes.
- `imfs`: Intrinsic Mode Functions (IMFs) obtained from SVMD.
- `u_hat`: Estimated envelopes of the modes.
- `omega`: Frequencies of the modes.

References

Yang, H., Cheng, Y., and Li, G. (2021). A denoising method for ship radiated noise based on Spearman variational mode decomposition, spatial-dependence recurrence sample entropy, improved wavelet threshold denoising, and Savitzky-Golay filter. Alexandria Engineering Journal, 60(3), 3379-3400

Examples

```
{
# Example data generation:
# Set the number of observations
N <- 300
# Set a random seed for reproducibility
set.seed(123)
# Generate random uniform values
rand_unif <- runif(n = N, min = 0, max = 1.0)
# Create the components of the time series
sig1 <- 6 * rand_unif
sig2 <- sin(8 * pi * rand_unif)  # Using sine function
sig3 <- 0.5 * sin(40 * pi * rand_unif)  # Using sine function
# Combine the components to form the final signal
signal <- sig1 + sig2 + sig3
# Apply the sVMD function to the signal
result <- sVMD(signal)
}
```

Index