REMD regression anomaly detection: REMD combines Empirical Mode Decomposition with ARIMA modeling: IMFs capture nonstationary structure and ARIMA models residual dynamics. Large residual magnitudes signal anomalies and are thresholded via harutils().

REMD combines EMD-based decomposition with ARIMA modeling on the high-frequency component to detect anomalies.

In this tutorial we: - Load and visualize a simple anomaly dataset - Configure and run the REMD detector (hanr\_remd) - Inspect detections, evaluate, and plot residual magnitudes

# Install Harbinger (if needed)  
#install.packages("harbinger")

# Load required packages  
library(daltoolbox)  
library(harbinger)

# Load example anomaly datasets  
data(examples\_anomalies)

# Select a simple anomaly dataset  
dataset <- examples\_anomalies$simple  
head(dataset)

## serie event  
## 1 1.0000000 FALSE  
## 2 0.9689124 FALSE  
## 3 0.8775826 FALSE  
## 4 0.7316889 FALSE  
## 5 0.5403023 FALSE  
## 6 0.3153224 FALSE

# Plot the raw time series  
har\_plot(harbinger(), dataset$serie)



# Configure the REMD detector  
model <- hanr\_remd()

# Fit the detector  
model <- fit(model, dataset$serie)

# Run detection  
detection <- detect(model, dataset$serie)

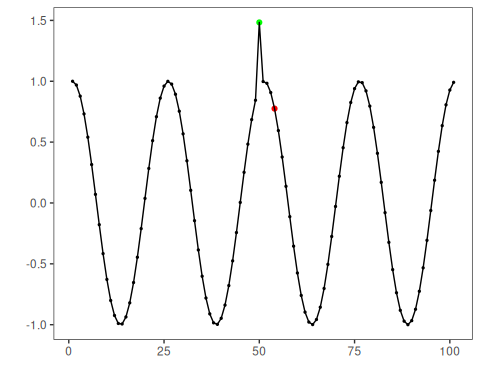
# Show detected anomaly indices  
print(detection |> dplyr::filter(event == TRUE))

## idx event type  
## 1 50 TRUE anomaly  
## 2 54 TRUE anomaly

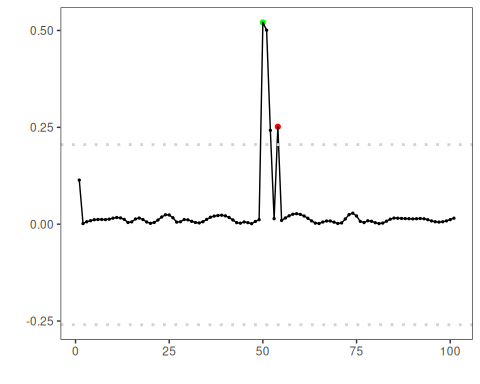
# Evaluate detections against labels  
evaluation <- evaluate(model, detection$event, dataset$event)  
print(evaluation$confMatrix)

## event   
## detection TRUE FALSE  
## TRUE 1 1   
## FALSE 0 99

# Plot detections vs. ground truth  
har\_plot(model, dataset$serie, detection, dataset$event)



# Plot residual magnitude and decision thresholds  
har\_plot(model, attr(detection, "res"), detection, dataset$event, yline = attr(detection, "threshold"))



References - Souza, J., et al. REMD: A Novel Hybrid Anomaly Detection Method Based on EMD and ARIMA. IJCNN, 2024. <doi:10.1109/IJCNN60899.2024.10651192>