# **Signal Processing Window Size Analysis**

## Current Window Configuration

window\_size = 1024\*1 # 1024 samples

step\_size = window\_size//8 # 128 samples

With INITIAL\_RATE = 800.0 Hz:

* Window duration = 1.28 seconds (1024/800)
* Step size duration = 0.16 seconds (128/800)
* 87.5% overlap between consecutive windows (1 - 128/1024)

**Methods Currently Being Plotted**

**1. Initial Signal Plot**

**Function:** plot\_signal()

* Raw signal visualization
* No windowing applied

**2. MNF/ARV Ratio Analysis**

**Function:** plot\_mnf\_arv\_ratio()

* Uses main window configuration (1024 samples)
* Calculates Mean Frequency (MNF) and Average Rectified Value (ARV) ratio
* Includes correlation coefficient calculation between MNF and ARV
* Correlation window size = window\_size \* (num\_results/signal\_length)
* Correlation step size = 2\*step\_size \* (num\_results/signal\_length)

**3. IMA (Instantaneous Mean Amplitude) Difference**

**Function:** plot\_IMA\_diff()

* Uses main window configuration
* Calculates difference between:
  + Mean FFT magnitude in 25-80 Hz band
  + Mean FFT magnitude in 80-350 Hz band

**4. EMD (Empirical Mode Decomposition)**

**Function:** plot\_EMD()

* Uses main window configuration
* Calculates median frequencies for first two IMFs
* Plots median frequency evolution over time

**5. Signal Fluctuation Metrics**

**Function:** plot\_signal\_fluctuation\_metrics()

* Uses main window configuration
* Calculates and plots:
  + Signal variance
  + Signal range
  + Mean absolute differences
  + Signal entropy

**6. MFDMA (Multifractal Detrended Moving Average)**

Two implementations:

1. **Whole Signal Analysis** (do\_whole\_mfdma\_and\_plot())
   * Window size = signal\_length/10
   * Scales: logarithmically spaced from 10 to signal\_length/4
2. **Segmented Analysis** (do\_segmented\_mfdma\_and\_plot\_metrics())
   * Uses main window configuration
   * Small window size = window\_samples/10
   * Plots:
     + DOM (Degree of Multifractality)
     + DFS (Difference in Fractal Spectrum)
     + SOM (Span of Multifractality)
     + PSE (Phase Space Expansion)

**Window Size Considerations**

**Current Implementation Tradeoffs**

1. **Fixed Window Size (1024 samples)**
   * Advantages:
     + Good frequency resolution (Δf = 0.78 Hz)
     + Captures low-frequency components effectively
     + Suitable for FFT-based calculations
   * Limitations:
     + May miss rapid temporal changes
     + Higher computational overhead
     + Fixed time-frequency resolution tradeoff
2. **Step Size (128 samples)**
   * Advantages:
     + High overlap (87.5%) provides smooth transitions
     + Good temporal resolution for trend analysis
   * Limitations:
     + Computational redundancy
     + Potential oversampling of slow-changing features

**Recommendations for Window Size Analysis**

1. **Suggested Window Sizes to Test:**
   * 256 samples (0.32s): Better temporal resolution
   * 512 samples (0.64s): Balanced option
   * 1024 samples (1.28s): Current setting
   * 2048 samples (2.56s): Better frequency resolution
2. **Step Size Variations:**
   * 25% overlap (window\_size\*0.75)
   * 50% overlap (window\_size\*0.50)
   * 75% overlap (window\_size\*0.25)
   * 87.5% overlap (current)
3. **Analysis Metrics:**
   * Frequency resolution vs temporal precision
   * Computational efficiency
   * Feature detection accuracy
   * Signal-to-noise ratio
   * Edge effect impact