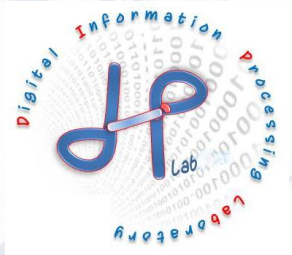
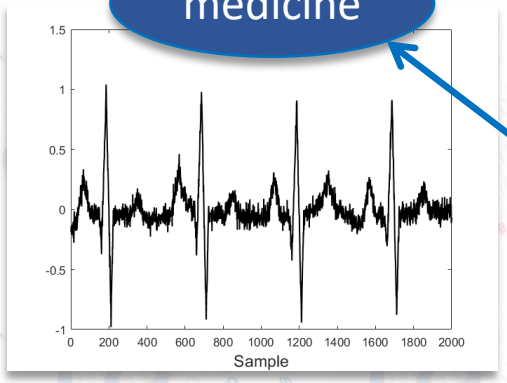
Signal modes counting@DIPLab



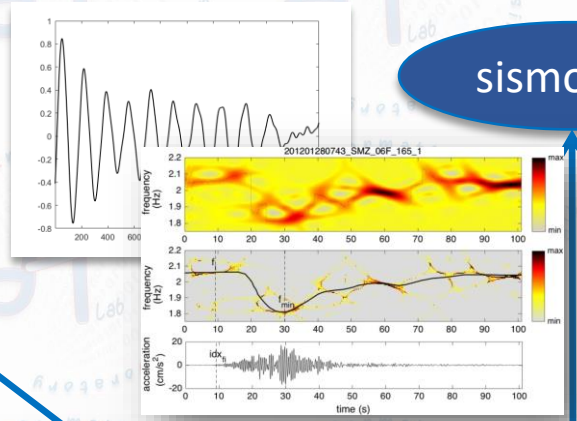
Amplitude and Frequency Modulated signals everywhere

AM-FM signals

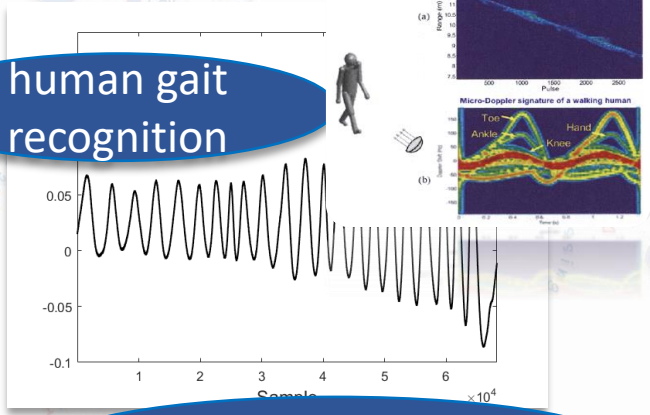
medicine



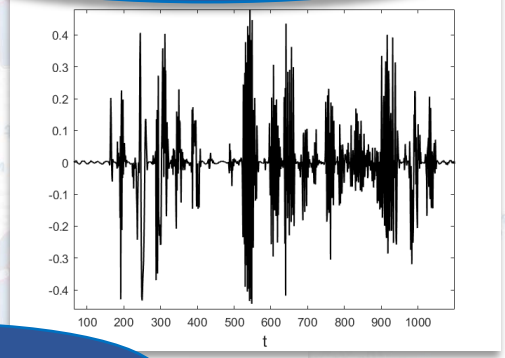
sismology



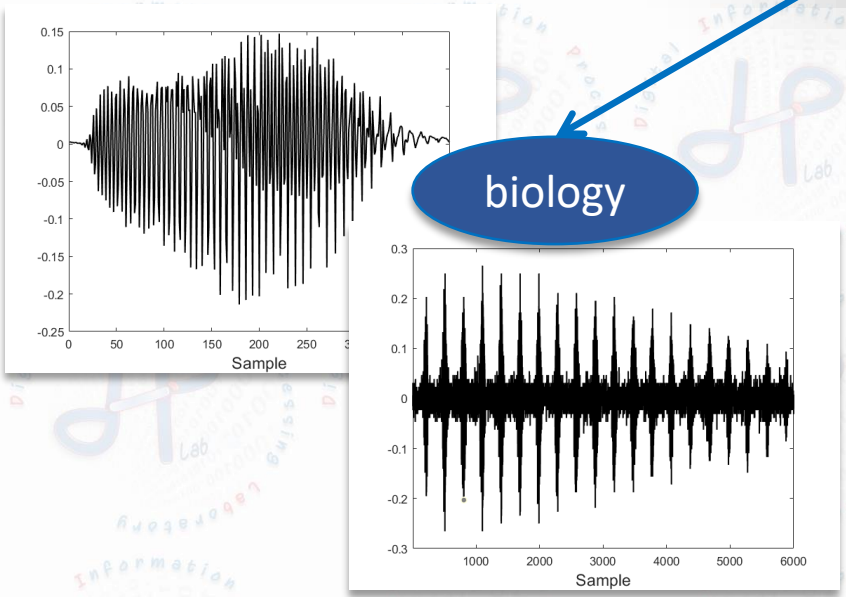
human gait recognition



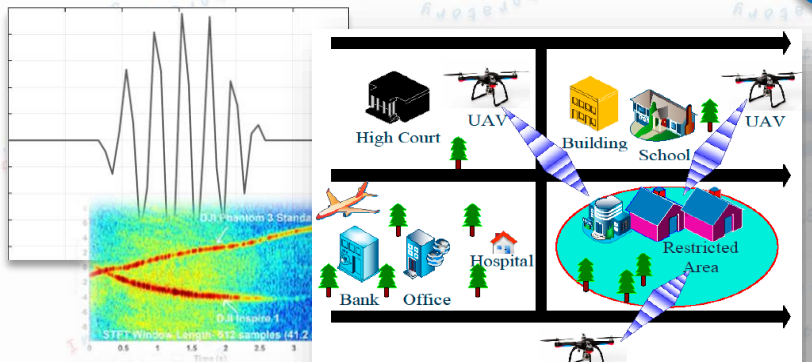
speech processing



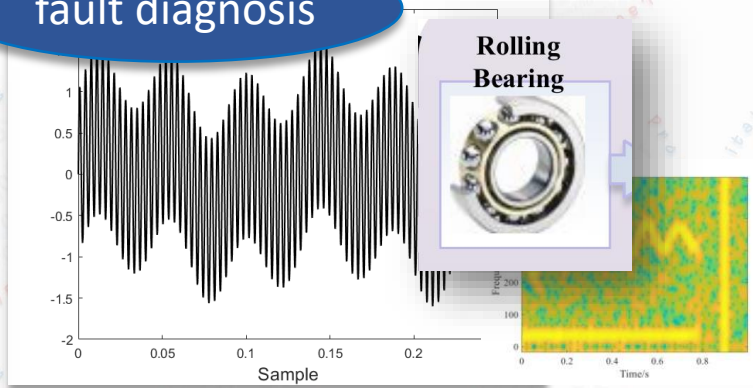
biology



airline traffic control

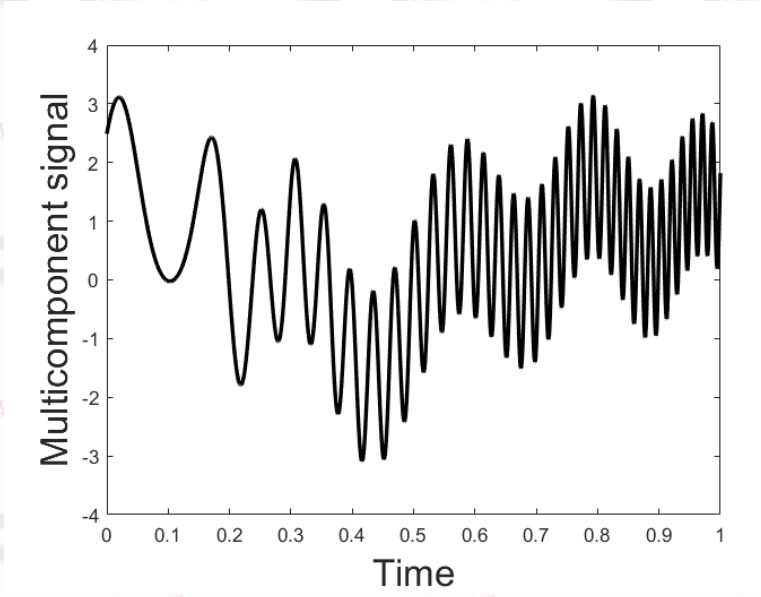


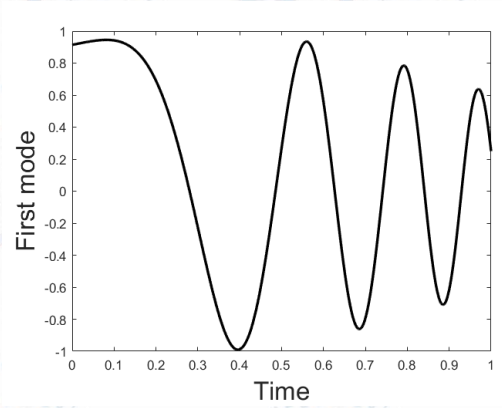
fault diagnosis

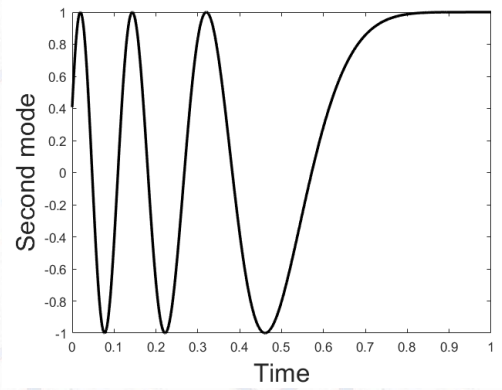


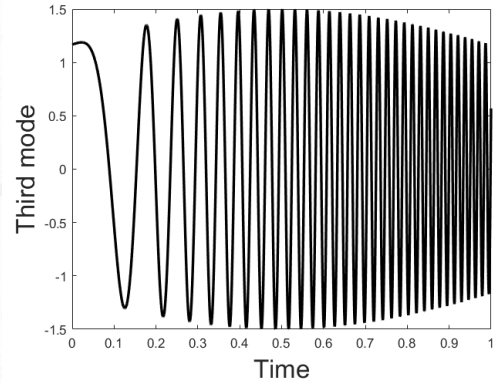
Instantaneous Frequency (IF)

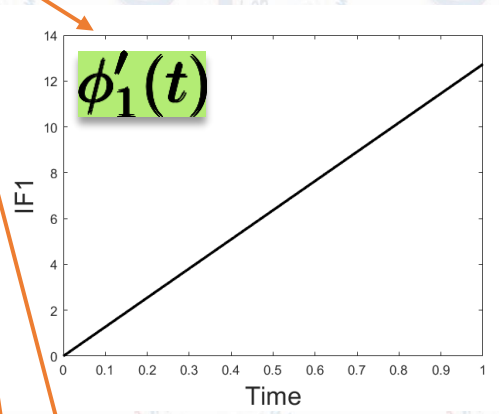
$$f(t) = \sum_{k=1}^{N} f_k(t) = \sum_{k=1}^{N} a_k(t) e^{i\phi_k(t)}$$

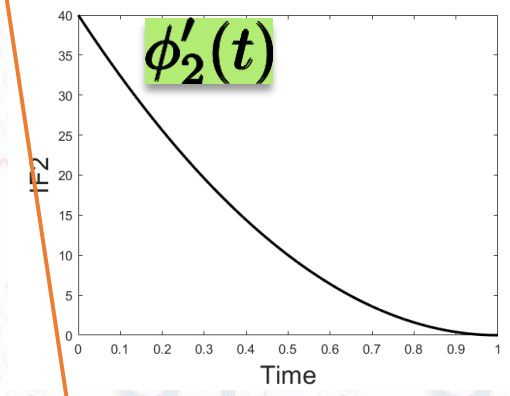


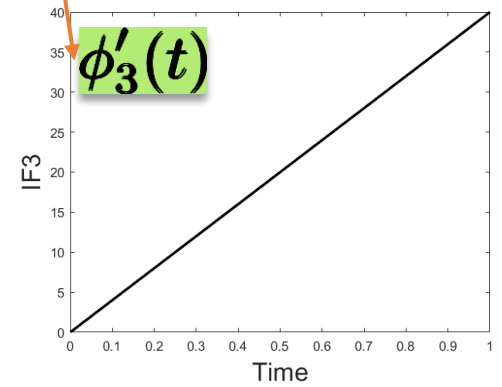






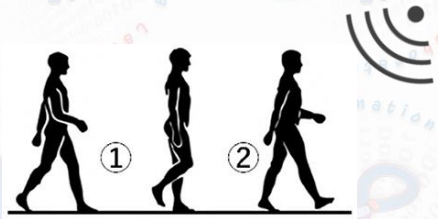


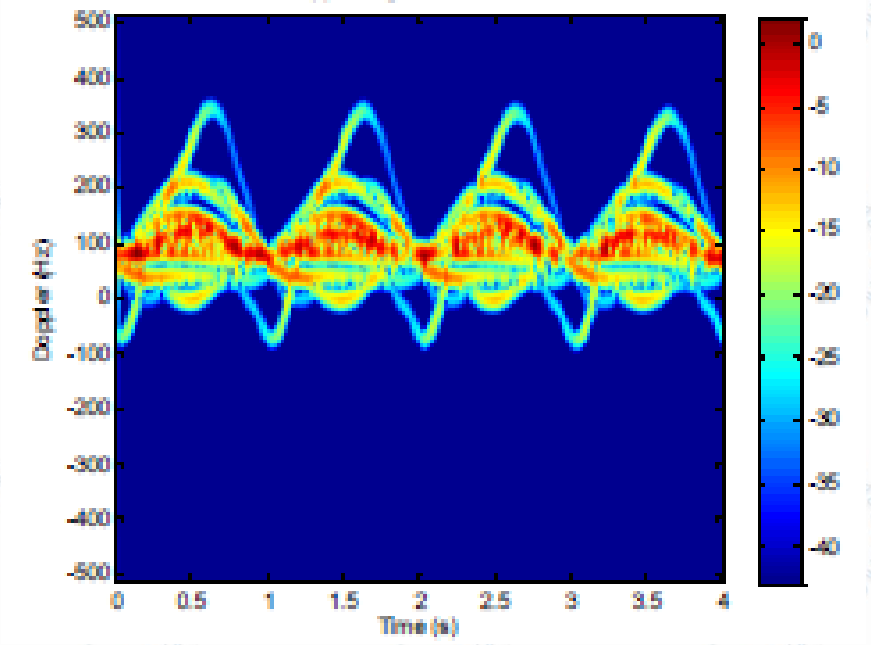




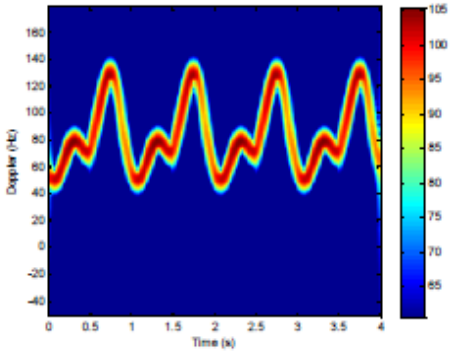
Instantaneous Frequency (IF): human gait recognition

Microdoppler signature of human body: walk

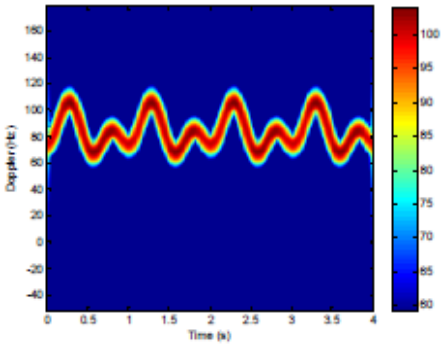




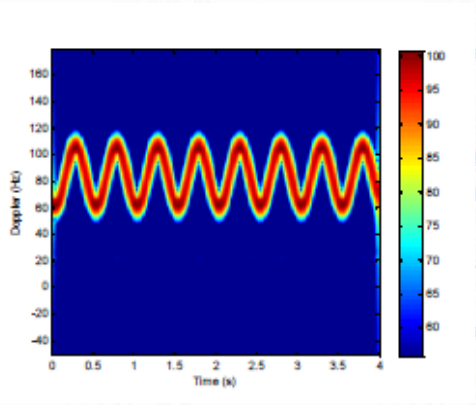
IF = speed of human body components



$\phi_1'(t)$ Leg



$\phi_2'(t)$ Arm



$\phi_3'(t)$ Head

Main contribution

Definition of local and pointwise methods for TF analysis of frequency modulated multicomponent signals having non separable modes

spectrogram evolution law and weakened separability

method

- iterative reassignement
- skeleton-based reassignment
- pde-based IF curves reconstruction
- Radon transform based IF estimation

advantages

- ✓ non parametric approaches
- ✓ independency of IF functional class
- ✓ better modes reconstruction in TF interference (non separable) region
- ✓ robustness to moderate noise

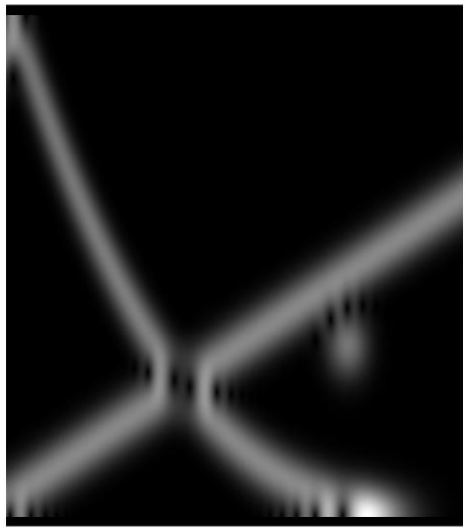
requirements

modes counting and *interference region detection*

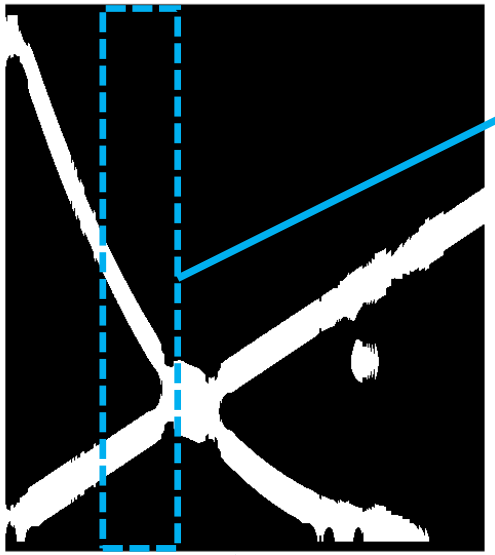
Modes counting

$$\frac{\partial P(u,\xi)}{\partial u} + \phi''(u)\frac{\partial P(u,\xi)}{\partial \xi} - \frac{2a'(u)}{a(u)}P(u,\xi) = 0$$

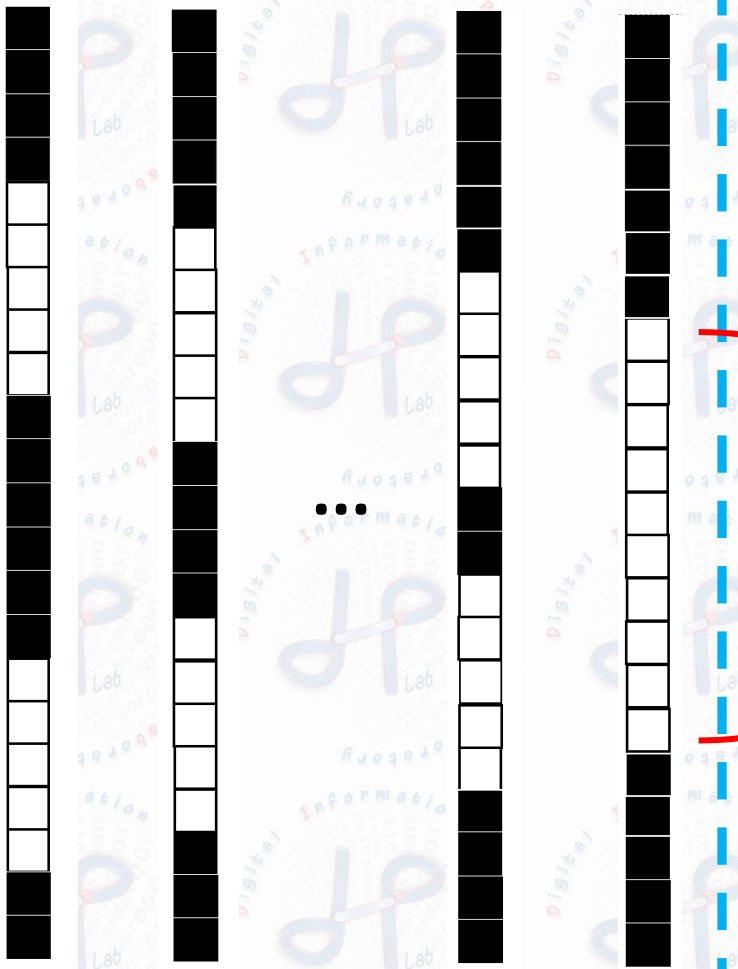
Spectrogram



Binarization and *Run Length Encoding (RLE)*



$N_{modes} = 2$ $N_{modes} = 2$



Modes OVERLAPPING is detected so that the CORRECT NUMBER of modes is estimated, for each time instant

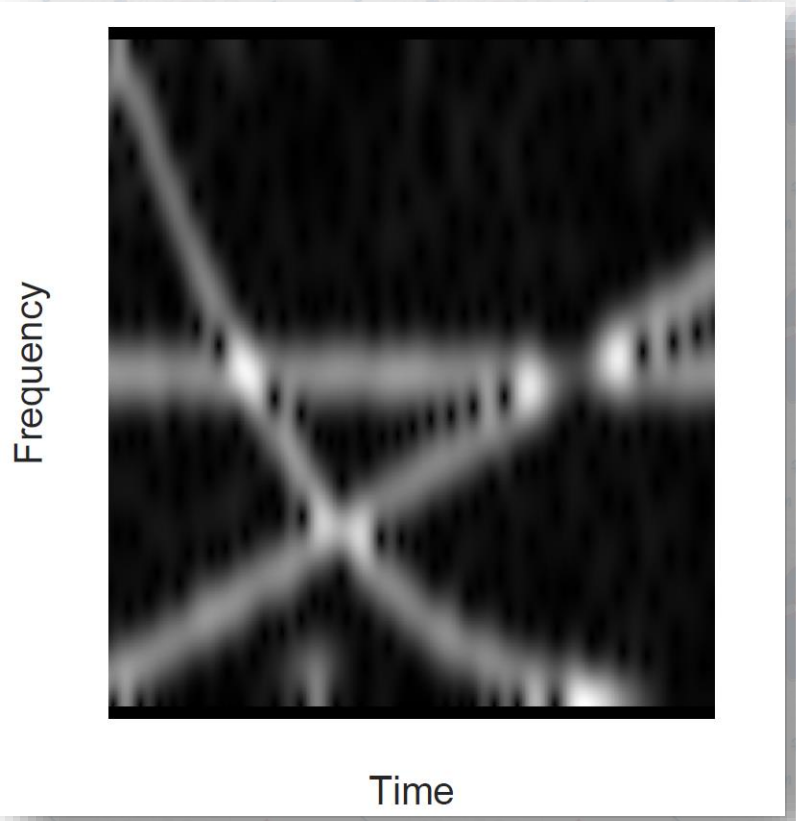
$N_{modes} = 2$

best threshold

by Minimum Description Length

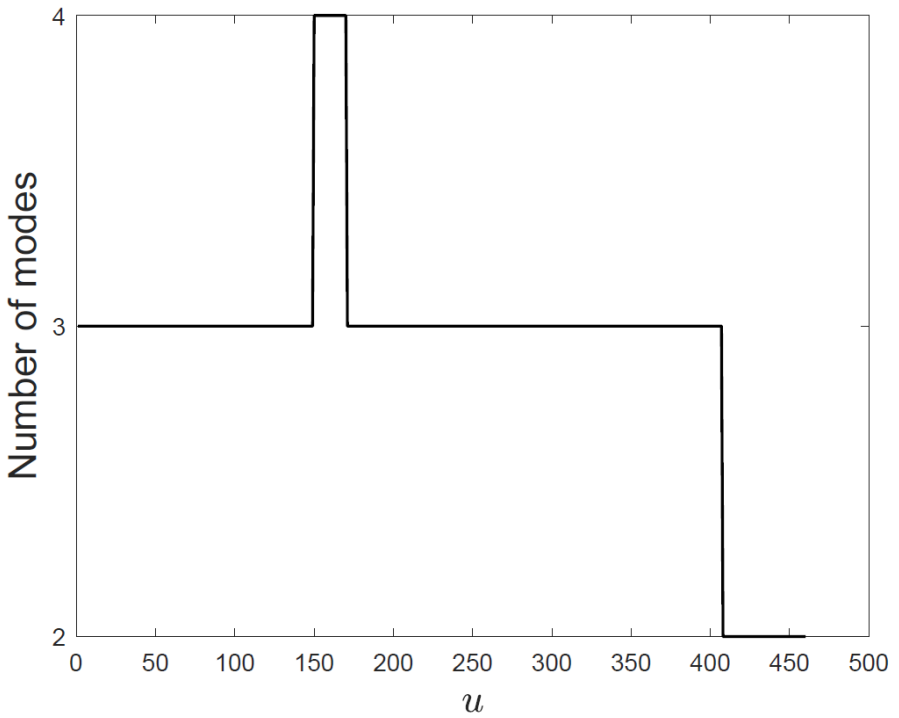
Modes counting: results

NOISY SPECTROGRAM



BINARY MAP ENCODED BY RLE

RESULT



benefits: robustness to interference and noise