

# Novel nonlinear non-stationary signal processing for mechatronics, condition monitoring and structural health monitoring

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The current status and novel future directions in signal processing for mechatronics, condition monitoring of machinery and structural health monitoring will be presented.

The classical second order and higher order spectral techniques that currently widely employed for mechatronic systems, condition monitoring and of machinery and structural health monitoring in *stationary* conditions will be discussed. The presentation will review classical examples of the second-order and higher order time-frequency techniques that currently are widely used for the mechatronic applications.

However, for some important practical mechatronic applications, it is necessary to perform signal processing in non-stationary conditions. The classical techniques and simple non-adaptive non-stationary techniques are not suitable for those conditions.

Important future directions of signal processing for mechatronics, condition monitoring and of machinery and structural health monitoring will be presented based on

- new class of non-stationary *adaptive* second order and higher order spectral transforms,
- new class of non-adaptive and adaptive higher order spectral frequency response functions,
- new techniques for complete amplitude-phase extraction from second order and higher order stationary and non-stationary transforms.

Validation of these novel techniques by simulation and experiments in laboratory and field conditions will also be presented.

It is shown that the proposed techniques offer an essential improvement (up to 70%-150%) in effectiveness of condition monitoring and of machinery and structural health monitoring in comparison to the traditional techniques.