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”FLEET#2 - Effective Identification of Cyclic Excitation and Resonance in Non-stationary Gearbox Vibration Monitoring”

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Since as rotating machinery, the gearbox is an important source of vibration and the identification of signals and parameters of some critical components of the gearbox is necessary for the monitoring of the system. Inside this mechanism, the rotation of elements with periodic discrete geometries (bearings, gears, turbines, …) is the origin for potential excitations which are commonly cyclic. These excitations are therefore characterized by frequencies that evolve with rotation speed Reconstructing them is equivalent to an inverse problem or an identification problem that can be treated utilizing the Least-Squares Complex Frequency (LSCF) estimator and its Poly-reference implementation to detect the temporal events. The main problem is to find the right external excitation conditions to reveal behaviors that are either resonances (a well-known linear problem and treated by identification) or internal excitations (less known and less well-treated). The difficulty here lies effectively in non-stationary operating conditions for good exploitation of time and angular Fourier Transform framework. In this work, a 1-stage gearbox is numerically developed to simulate various working conditions and generate signals which are necessary for the identification. The cyclic excitations generated by rotating elements with periodic discrete geometries pose a challenge in reconstructing their frequencies, as they vary with rotation speed but are definitely valuable excitations for FRF identification of structural parts. The presence of resonances and internal excitations further complicates the identification process, particularly under non-stationary operating conditions. To address this in this simulation, a careful balance is struck between the length of the temporal signal and the rate at which the rotational speed increases. This ensures effective separation of time-related and angle-related phenomena within the signals, facilitating accurate estimation of the Frequency Response Function (FRF) and resonance identification. Then by utilizing a meticulously induced swept frequency and appropriate working conditions, it becomes possible to mitigate temporal phenomena and achieve precise identification of cyclic phenomena.

Presenter(s) : AHANI MOJTABA

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