

DIPARTIMENTO DI INGEGNERIA – UNIVERSITY OF PERUGIA
PHD COURSE IN INDUSTRIAL AND INFORMATION ENGINEERING –
41st CYCLE

Title of the research activity:	Mechanical Life Optimisation and SHM of Industrial Rotating Machinery
State of the Art:	Modern machines are now equipped with sophisticated System Control and Data Acquisition (SCADA) systems capable of recording information about actual operation. The resulting database contains a complete knowledge of the machine's operation and performance, but is often under-utilised in normal industrial practice. Given that operation and maintenance (O&M) costs represent a large proportion of the total costs associated with industrial assets, it is crucial to focus on optimising O&M strategies [1], which are essential for reducing both downtime and maintenance costs. Maintenance encompasses several types of technical and administrative activities that are performed with the objective of maintaining or restoring an industrial asset to a condition where it can operate at an optimum level while reducing the associated costs. Maintenance programmes must be developed on the basis of a reliable assessment and prediction of the condition of the machine, so that diagnosis and prognosis [2] of faults in the most critical components should be key activities.
Short description and objectives of the research activity:	The main objective of the project is to develop new data mining methods and signal processing approaches for performance monitoring, fault detection and Structural Health Monitoring (SHM) [3] of industrial machines with a special focus on rotating machines. The topic is at the crossroads of mechanical, industrial and information engineering and can be developed initially by analysing open databases [4]. The research will be developed on both the numerical and the experimental side; by using aeroelastic numerical simulations, new approaches based on data mining and machine learning will be developed for condition and structural health monitoring of rotating machines and components. However, the methods will be validated: • Data coming from open-databases • Laboratory-scale experiments • Real operation data

	Data from real operating full-scale industrial machines will be provided by the research unit's industrial partners, especially in the field of wind energy. The new approaches developed in this project will be able to shed new light on optimising the lifespan of industrial machinery.
Bibliography:	[1] Soleimani-Babakamali, R., Soleimani-Babakamali, M. H., Heravi, M. A., Askari, M., Avci, O., & Taciroglu, E. (2024). Transferring damage detection knowledge across rotating machines and framed structures: Harnessing domain adaptation and contrastive learning. <i>Mechanical Systems and Signal Processing</i>, 221, 111743. [2] Huang, C., Bu, S., Lee, H. H., Chan, C. H., Kong, S. W., & Yung, W. K. (2024). Prognostics and health management for predictive maintenance: A review. <i>Journal of Manufacturing Systems</i>, 75, 78-101. [3] Li, B., Li, Y., & Noman, K. (2025). Structural Health Monitoring: Advanced Sensing, Diagnostics and Prognostics. <i>Sensors</i>, 25(5), 1313. [4] Barber, S., Marykovskiy, Y., & Abdallah, I. (2024, June). Improving data sharing in wind energy-structural health monitoring case study. In <i>Journal of Physics: Conference Series</i> (Vol. 2767, No. 3, p. 032007). IOP Publishing.
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