MECHANICAL ENGINEERING

DIMEAS - Damage Assessment and Repair Criteria for Extending the Service Life of Mechanical Transmission Components

Funded By	Dipartimento DIMEAS
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Context of the research activity	The topic addresses the evaluation of damage mechanisms affecting mechanical transmission components and the definition of repair criteria aimed at extending their service life. It focuses on identifying degradation modes, assessing residual life, and establishing technically and economically sound repair strategies to ensure reliability, safety, and continued operation beyond original design limits.
Objectives	The activity will focus on a comprehensive investigation of damage assessment and repair methodologies aimed at extending the service life of mechanical transmission components, with particular emphasis on gears. Experimental testing will be carried out on representative components to reproduce typical damage mechanisms encountered in service, such as wear, pitting, surface fatigue, and crack initiation. Controlled damage will be intentionally introduced in order to study its evolution under realistic operating conditions. Following damage characterization, different repair techniques will be applied and evaluated with the objective of restoring structural integrity and functional performance. The effectiveness of the repairs will be assessed through post-repair experimental testing, allowing comparison between damaged, repaired, and reference components. In parallel, analytical and numerical models will be developed to estimate residual life before and after repair. These models will incorporate damage indicators, material degradation, and stress redistribution effects. Finite Element Method (FEM) simulations will be used to accurately evaluate stress fields, contact conditions, and fatigue behavior, supporting both damage assessment and life prediction. The combined experimental–numerical approach will enable the definition of reliable criteria for repair acceptance and service life extension of geared transmission components.
Skills and competencies for the	Studies in the field of mechanical engineering and experience in mechanical design, experimental mechanics, and analysis of mechanical components,

for the development of the activity	including non-destructive testing. Aptitude for academic research activities with a strong focus on industrial applications.