SUSTAINABLE MATERIALS, PROCESSES AND SYSTEMS FOR ENERGY TRANSITION

DM 630 DANIELI&C OFFICINE MECCANICHE - Design of machines for the treatment, crushing, and recycling of ferrous and non-ferrous scrap

Funded By	DANIELI & C. OFFICINE MECCANICHE S.P.A. [P.iva/CF:00167460302] Ministero dell'Università e della Ricerca - MUR [P.iva/CF:96446770586] Politecnico di TORINO [P.iva/CF:00518460019]
Supervisor	GASTALDI CHIARA - chiara.gastaldi@polito.it
Contact	BRUSA EUGENIO - eugenio.brusa@polito.it
Context of the research activity	This project aims to define a robust design methodology to be applied to shredder machines. Shredders are used to recycle metal scrap, and undergo some very high impulsive loads and severe wear. They might even operate in a harsh environment. The goal is to characterize the loads acting on these machines and develop a model-based design procedure. These models, once augmented with experimental data, will become digital twins useful for monitoring as well as for a design parameter exploration. Progetto finanziato dal PNRR a valere sul DM 630/2024 - CUP: E14D24002340004
Objectives	The project focuses on the advanced design of machines for crushing, shredding, and recycling of metal scrap from decommissioned products and vehicles. The construction of machines for metallurgy is evolving towards lighter machines and a significant reduction in the power required for their operation. The adoption of “circular design,” as an implementation of the circular economy, has specific impact on the design of scrap crushing machines. These machines undergo very high impulsive actions, severe wear of parts, and the risk of fractures and damage to supports is very high. The system presents critical safety aspects for people operating in the working area. Adapting these machines to renewed market needs requires a systematization of design procedures. The first part of this research project will focus on the study and deployment of a monitoring system for operational actions aimed at identifying actual working conditions, any

	anomalies, damages, and forecasting maintenance interventions. The second part of the project will develop a numerical model of the shredder, which, augmented with the experimental data acquired during the first phase, will become a "digital twin" validated on machines in service at the Company. Various techniques, including machine learning, will be evaluated to interpret operational data. The final part of the project will use the validated model as a design tool for the next generation of shredders. The value of the project is twofold: the shredder, in addition to being the object of performance improvement, is itself a tool for recycling materials and regenerating products.

Skills and competencies for the development of the activity	The candidate should be familiar with Machine Design, Structural Dynamics and Numerical Modeling applied to structural analysis of mechanical and mechatronic systems. Knowledge of Vibration Characterization and testing is also welcomed. These skills are typically acquired through courses in Mechanical, Aerospace, and Automotive Engineering.