

# PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 41st cycle

### THEMATIC Research Field: SURFACE TREATMENTS FOR SUPERIOR FATIGUE PROPERTIES

Monthly net income of PhDscholarship (max 36 months)

1500.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity		
Motivation and objectives of the research in this field	Despite the several research and studies done in the field of metal fatigue, this damage mechanism remains one of the main challenges, if not the main, in many field of engineering, such us mechanical engineering, automotive and aerospace. The need of increasing fatigue performance of machine and structural elements without increasing their size is of particularly important in the field of race cars. The application of some mechanical treatment, able to induce surface work hardening, compressive residual stresses and microstructural modification is an attractive way to obtain a substantial improvement of the fatigue behavior. However, the correct application of one of these treatments must be preceded by the correct design of the treatment itself. In this PhD project, shot peening and its correct application to high performance race car components are considered.Unexplored applications of shot peening to light alloy and steel parts will be investigated. Possible shotless alternative treatments will be investigated. Finally, the development of a practical code able to address the choice of the treatment parameters with respect of the specific application is expected.	
Methods and techniques that will be developed and used to carry out the research	The research includes both experimental tests and numerical analysis and is developed in cooperation with Ferrari SpA and Peenservice srl. A focus of the research will be the application of shot peening on Al components prior anodization to fill the fatigue debt due to the residual	

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	prior anodization to fill the fatigue debt due to the residual stress and brittle nature of the conversion layer will be investigated. The experimental tests are devoted to the characterization of the materials and components, before and after the surface treatments and includes: XRD residual stress measurement, microstructural analysis, fatigue tests. As regards the numerical analysis, FEM simulations of the process will allow to complete the knowledge of the effects of shot peening and to relate them to the improved fatigue behavior. Possible other numerical methods will be considered, if needed. Finally, a code to assess the shot peening parameters to the fatigue strength of the treated parts based on the experimental and numerical results, will be developed.
Educational objectives	The selected candidate will be able to define, design and carry out original research programmes by working in a team or leading a research group.
Job opportunities	Job opportunities include Companies/Organizations/Research Centers aimed at innovation and/or research and technical development, high-tech SMEs, government departments in the field of automotive, aeronautics, surface engineering. List of Universities, Companies, Agencies and/or National or International Institutions that are cooperating in the research: Ferrari SpA (Maranello (MO, Italy), Peenservice srl (Bologna, Italy), Hilase (Cechia), Tohoku University (Japan)
Composition of the research group	1 Full Professors 1 Associated Professors 2 Assistant Professors 13 PhD Students
Name of the research directors	Prof. Mario Guagliano

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Additional support - Financial aid per PhD student per year (gross amount)		
Housing - Foreign Students		
Housing - Out-of-town residents		

Scholarship Increase for a period abroad		
Amount monthly	750.0 €	
By number of months	6	

Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information

Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 6.114,50.

Our candidates are strongly encouraged to spend a research period abroad, joining high-level research groups in the specific PhD research topic, selected in agreement with the Supervisor.

An increase in the scholarship will be applied for periods up to 6 months (approx. 750 euro/month- net amount). Additionally, PhD candidates who spend at least 3 months abroad are

eligible for an extra reimbursement of €3,000 to cover travel expenses.

Teaching assistantship: availability of funding in recognition of supporting teaching activitiesby the PhD candidate. There are various forms of financial aid for activities of support to theteaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.