POLITECNICO DI MILANO

PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 40th cycle

THEMATIC Research Field: A NEW CUTTER-WORKPIECE ENGAGEMENT ALGORITHM FOR MULTI-AXIS MILLING

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	Chip removal processes involve some of the most complex phenomena in manufacturing. Modelling them is of valuable scientific and academic interest. Of all ways of modelling chip removal processes, Cutter-Workpiece Engagement (CWE) is the most promising and advanced. Algorithms of CWE can simulate the Swept Volume (SV) of the tool removing material from the workpiece. This is done by leveraging geometric kernels such as ACIS, Parasolid and OpenCascade. This allows users to be able to predict the cutting parameters associated with the cutting operation, which in turn allows for the calculation of important hallmarks of the chip removal process such as cutting forces. All simulators incorporate CWE algorithms which are most often based on Z-Level buffer, the oldest method of all (1972), reliable but also imprecise and slow. The objectives in this field therefore are multiple: 1. Establish which kind of method allows for the best trade-off between accuracy and robustness during simulation 2. Determine which is the best geometric kernel for the task considering all constraints 3. Design of a universal interpolator which is robust, fast and capable, as faithfully as possible, to calculate cutting time and represent toolpath 4. Development of a CWE method which is robust precise and fast, building on top of the best solutions

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Methods and techniques that will be developed and used to carry out the research	The research will leverage the most advanced instrumentations in this field. A Yasda YMC650+RT20, one of the most precise milling machines in the world, will be used to carry out tests. State of the art CAM software to produce part programs allowing thorough tests of the CWE engagement algorithm. VERICUT a state-of-the-art simulator of chip removal processes and more to benchmark the developed algorithm. The best programming software available such as Python, in order to interact with geometric kernels as seen necessary.
Educational objectives	The PhD candidate is expected to develop high level technical skills in the field of research previously mentioned. The candidate will need to operate independently both manufacturing and materials characterization equipment. Design of experiments techniques will be developed to conduct empirical investigations and assess their results. Moreover, the candidate will develop scientific communication skills by participating at international conferences and writing papers for peer reviewed journals. The researcher may also be involved in teaching activities further developing a strong scientific profile apt for a career both in the research and development field as well as in the university.
Job opportunities	The acquired expertise allows the candidate to apply for positions both in manufacturing companies and in software companies developing advanced manufacturing products. The candidate will gain knowledge to actively operate in the manufacturing digitalisation sector. Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared Master of Science holders in the same field. Employment statistics of PhDs can be found at: https://cm.careerservice.polimi.it/en/employment-statistics/.

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Composition of the research group	0 Full Professors 1 Associated Professors 0 Assistant Professors 4 PhD Students
Name of the research directors	prof. Massimiliano Annoni

Contacts
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Additional support - Financial aid per PhD student per year (gross amount)	
Housing - Foreign Students	--
Housing - Out-of-town residents (more than 80Km out of Milano)	--

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