Crystal Plasticity Modelling of Micro-Machining Processes

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Overview

The production of small-scaled components with complex features is gaining increasing importance due to the trend of miniaturization of products. As a result, there is a growing need for fast, reliable, mass micromachining of functional components. In contrast to conventional macro-scale machining, the process zone in micro-scaled machining is usually limited to one or several grains of the metallic work-piece material. This introduces additional complexity that is non-trivial. Consequently, a cutting response in the micro-scale differs significantly from that of its macro-scale counterpart. For example, it is experimentally observed that the cutting force and chip morphology are dependent on the underlying texture of the work-piece material in micromachining of single-crystal metals. To better understand local deformation processes at a tool–work–piece interface in a micromachining process, a thorough analysis of deformation mechanisms at grain level is required. While the effect of crystallographic orientation on cutting-force variation is extensively reported in the literature, the development of the single-crystal machining models is somewhat limited.

Additionally, in recent years, significant advanced in machining processes has been made to diminish some of the well-known detrimental effects of conventional machining processes. As an example, hybrid or assisted machining processes – in which a main process directly removes material, while the other 'assists' in this by improving the conditions of machining – has been used to demonstrate significant improvements in the quality of the machined component. A well-known hybrid machining process is vibration assisted machining, in which typically high-frequency vibrations are imposed on a conventional cutting tool during machining. This converts the machining to a micro-chipping process, demonstrating significant reductions in cutting forces with improved surface finish. Since machining force is an indication of damage incurred during the process, a significant reduction in cutting forces will lead to damage free component manufacture. With reduced forces, work holding size and constraint can be reduced, therefore allowing more of a component to be machined in one operation.

This course will focus on modelling aspects in the small length-scale. It will cover some of the essential background material required to build a realistic numerically-robust computational model of small scale plasticity considering the underlying material micro-structure. A part of the course will explore the role of modelling in predicting the outcome of hybrid machining in the small-scale. It will demonstrate the power of numerical modelling in determining appropriate processing parameters without having to design expensive and time-consuming experimental studies. With such knowledge students and practitioners in India can enhance their skill set and make essential contributions in knowledge generation for academic and industrial use in precision machining and manufacture. This will directly address the goal of *Make in India*, aiding in wealth generation and bringing India to the forefront of next generation high end manufacturing.

Course Duration	**December 11 to December 15, 2017** **Number of participants for the course will be limited to fifty.**
You Should Attend If…	▪ you are a mechanical/production/industrial/manufacturing engineer or research scientist interested in optimization of micro-machining processes, design of related tools and fixtures or process planning. ▪ you are a student or faculty from academic institution interested in learning how use crystal plasticity in understanding the behavior of micro-machining.
Fees	The participation fees for taking the course is as follows: **Participants from abroad: US $500** **Industry/ Research Organizations: ₹ 15000** **Academic Institutions: ₹ 5000 (faculty),: ₹ 1000 (students, refundable)** The above fee includes all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24-hour free internet facility. The participants will be provided with accommodation on payment basis. The fee has to be paid by DD. It will be returned to students once they join the course.

The Faculty

Dr. Anish Roy is a Reader in Mechanics of Materials and Processes, Wolfson School of Mechanical, Electrical and Manufacturing Engineering, Loughborough University, The UK. His research interest is crystal plasticity and its application to the modelling of machining processes.

Dr. Uday Shanker Dixit is a Professor in the Department of Mechanical Engineering at Indian Institute of Technology Guwahati. His research interest is modelling of manufacturing processes.

Course Co-ordinator

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