National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Ultrasonic Vibration Assisted Turning of Inconel 825: Tool Design, Experimental Investigations and Numerical Modelling
Speaker	: Ananda Kumar Sahoo (Rollno : 516me6005)
Supervisor	: Prof. Susanta Kumar Sahoo
Venue	: ME-001 : Seminar Hall
Date and Time	: 25 Jun 2024 (4.30 PM)

Abstract : The growing emphasis on sustainable and environmentally friendly manufacturing practices has led to the development and adoption of various advanced machining techniques. Ultrasonic Vibration Assisted Turning (UVAT) stands out as a promising technology in this context due to its ability to enhance machining performance while reducing the environmental impact. Inconel 825 is a nickel-based superalloy with excellent corrosion resistance, especially in highly acidic environments. It is often used in chemical processing, pollution control, oil and gas exploration, and marine environments. However, its unique material properties, including high strength, low thermal conductivity, and high work-hardening rates, make it tough to machine conventionally. So, an experimental study has been carried out considering UVAT as a clean manufacturing process, emphasizing its benefits, underlying mechanisms, and potential for widespread industrial application by performing dry turning on Inconel 825 through UVAT. Here 20 kHz ultrasonic vibrational frequency and small amplitude is applied to tool to remove material by intermittent cutting.

The present work is classified into three sections (i) Design and fabrication of flexible UVAT-tool using Ansys v18® FEM analysis (modal and harmonic) using SS304 (ii) Experimental investigation of both CT and UVAT considering uncoated and multilayer coated tool inserts (iii) Numerical modelling through Deform 3D® v10.2 and validate with experimental results. UVAT showed significant reductions in cutting forces and tool-tip temperature with improved surface finish of the workpiece. The influence of multilayer coating in PVD coated TiAlN+TiAlCrN WC insert over monolayer TiAlN-WC and uncoated WC insert have been obtained. Finally, machinability indices like chip morphology, surface integrity, and tool wear were observed. The results confirm the suitability and advantages of the environment friendly dry UVAT process compared to the CT process to machine hard to cut metal Inconel 825.